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В сборнике представлены материалы Всероссийской конференции с приглашением зарубежных участников, на которой были рассмотрены актуальные проблемы в области государственно-частного партнёрства, управления качеством, образования, управления ИТ-услугами и сервисами, транспортной и информационной безопасности. Сборник предназначен для руководителей организаций и предприятий различного направления, менеджеров организаций, а также научных и инженерно-технических работников, занимающихся разработкой и внедрением интегрированных систем обеспечения качества продукции на предприятиях. Материалы также могут быть полезны студентам и аспирантам, обучающимся по соответствующим направлениям и специальностям, в их научной и учебной деятельности.

Contents

System of Mathematical Models to Manage Water and Land Resources at the Regional Level in Case of Anthropogenous Climate Changes Taking Into Account Economic Indicators and Ecological Consequences

Ruslan Sh. Zhemukhov, Marina M. Zhemukhova
Kabardino-Balkarian State University
Nalchik, Russia
ruslan210@yandex.ru

Abstract— **The fast changings of climate going in the world put absolutely new problems before world economy and economies of the certain countries. Among economic sectors the agricultural industry can undergo to the most essential changes. Thereby conditions and production volumes of the food – a basis of existence and development of humanity can be transformed. Along with significant influence of climate change on agricultural industry, the last also makes the contribution to climatic processes as a result of handling of farmlands, formation of livestock waste, meliorative actions, landing of forest belts, etc.**

Keywords— model; modeling; anthropogenous climate change; food security; decision making

It is known that the increasing anthropogenous impact on land and water resources in areas of intensive development of an irrigation leads to degradation of soils and pollution of water currents and reservoirs. Therefore to consider not scales of this impact when planning water use in an irrigation becomes impossible. It leads to the fact that decision making on development of an irrigation or management of water use for already existing irrigating system shall be based on the analysis of three groups of indicators (criteria) – economical, water management and ecological; which structure can vary depending on an environment or from the purposes of functioning of the Irrigating Systems (IS). Need of accounting of set of anthropogenous impacts on land and water resources does not allow to use effectively traditional approaches because of the structure of indicators used in decision making, need of detailed accounting of dynamic and stochastic features of the proceeding processes and impossibility of receiving of economic evaluations of damages in case of degradation of environment. Often there is a situation when cost-efficient strategy can be inefficient because of significant anthropogenous impact on environment, and, on the contrary, accounting of nature protection requirements can reduce cost efficiency of water management.
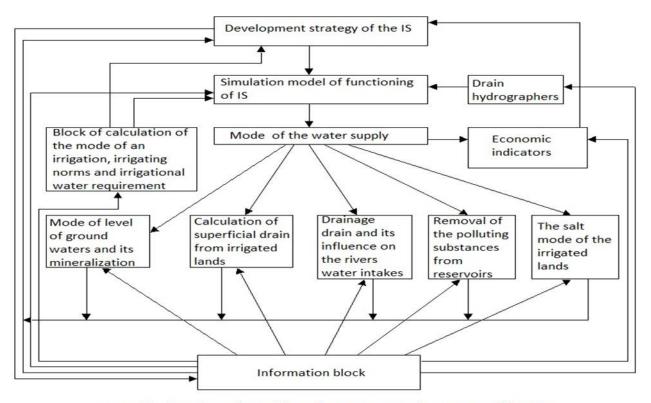
Similar reasons result in need of joint use of optimization and simulation models. Optimization models are intended for the choice of structure of agricultural production, an assessment of amounts of the used resources, research of economic aspects of development of the irrigated agriculture, and also the choice of parameters and operating modes of water storage basins, channels. However, these models allow to receive only approximate solution. Its definition with the subsequent possible adjustment of water and land use strategy is based on simulation models according to the technology provided in [1-4].

We will consider the proposed approach more detailed. We will assume that for IS are known: (1) water management scheme, parameters and modes of water management constructions; (2) scenarios of social and economic development of the region, and, from here; (3) a set of the irrigated massifs, for each of which necessary set of initial hydrological, meteorological, agrophysical, agricultural, water management and technical-economic indicators are known; (4) various strategies of water and land use. As a result of the solution of a task it is required to determine set of economic, water management and anthropogenous indicators for each strategy of water and land use and then to choose from them the most effective one.

The technology of carrying out calculations includes the following stages: (1) expert formation of an admissible set (generation) of strategy water and land use; (2) calculation of irrigating regulations, amounts and the modes of irrigational water requirement depending on the weather conditions and the vegetative period of development of a crop; (3) calculation of the modes of water supply and water management indicators with use of a simulation model of management; (4) calculation of economic and (5) anthropogenous indicators of functioning of IS depending on

the actual water consumption; (6) choice of rational strategies of water use.

The flowchart of the solution of a task is shown in Pic.1. We will give the main ratios characterizing functioning of IS

and model of the anthropogenous impacts proceeding at the same time

Pic.1. The flowchart of a problem of management of water use of IS taking into account anthropogenous impacts on land and on water resources

It is supposed that out of model, the task of optimization of agricultural production is solved, and some strategy of development of IS is accepted.

The block of strategy development of management of IS represents the formalized record of the accepted strategy for development and management of IS. At the same time, part of standard reference information, used in these ratios (admissible content of salts and agrochemicals in soil) enter the information block. Here is also all the initial information on air temperature, rainfall, etc. Further, with use of all necessary information, the modes of an irrigation and irrigating regulations of crops are calculated. For that the method of A.I. Budagovsky [5] was used.

These results are represented to a simulation model of functioning of IS. But they are biologically required for the crops. At the same time IS has limited opportunities to satisfy requirements in water and therefore, at this stage, only the requirement is created.

We will describe dynamics of functioning of the basic structural elements of IS – "alignment" and "water storage basin"

Ratios which realize distribution of water between users of system according to certain rules are put in a basis of the algorithm which is modeling work of the "alignment" element. At the same time two main cases differ:

1) Distribution of water in case of excess of water resources;

2) Distribution of water in case of deficit of water resources.

In case of excess of water resources, excess of water is dumped in drains. The case when deficit takes place is of special interest.

In case of deficit of water resources various rules for distribution of water are possible: prioritized, when according to the request water is received only by part of users; and pro rata distribution when water resources share between all users in proportion to their requests, effect of water use.

For the description of dynamics of work of the "water storage basin" element the following balance sheet ratio is used:

$$W^p(t) = W^p(t_0) + [\Pi_i(t) - P_i(W^p, t) - Q_i^p(t)](t - t_0)$$

$$W_{min} \leq V_i^p \leq W^p(t) \leq V_i^{p+1}(t) \leq W_{max}$$

,

Where W_{max} - the maximum amount of water in a water storage basin; V_i^p - equation of the dispatching line; W_{min} - the minimum amount of water in a water storage basin; $W(t)$ - an amount of water in a water storage basin in t time point;

$$W_{min} \leq W(t) \leq W_{max} \qquad ;$$

$Q_i^p(t)$ - a water consumption from a water storage basin on i -ohm a modeling interval in p -y to a dispatching zone; $P_i(W, t)$ - function of losses from a water storage basin; $\Pi_i(t)$ - inflow of water to a water storage basin.

At this stage two objectives are achieved. The first - a measure definition of functioning of IS. The indicators received at this stage are compared to standard sizes, their compliance to the guaranteed returns of water storage basins is determined.

The second - forming of the mode of water supply on the irrigated massifs depending on requirement and its availability in system.

Further, the anthropogenous processes undergoing on the territory of IS are calculated from the water supply mode created on the previous step on the irrigated massifs. Including:
1) Mode of level of ground waters and its mineralization;
2) Drainage drain and its impact on a mineralization of the rivers and water intakes;
3) Removal of the polluting substances from agricultural reservoirs;
4) The salt mode of the irrigated lands.

We will consider more in details mathematical models of the specified anthropogenous processes. So, the water balance of the irrigated massifs is determined proceeding from the equation of water balance which has an appearance:

$$\Delta W = X + B - E_{сум} - C_e,$$

Where X – the amount of an atmospheric precipitation for a settlement period of time, mm; B – water supply gross, weighted average on the territory, mm; $E_{сум.}$ - weighted average total evaporation, mm; C_e - natural superficial drain, mm. drain layer.

At the same time intensity of rise or decrease in level of ground waters it was determined

$$\Delta h = \frac{\Delta W}{\mu}$$

Where μ – a lack of saturation when raising ground waters or the corresponding coefficient of water return in case of its decrease.

At the same time, change of a mineralization of ground waters in the result of its rise was estimated on the calculation method proposed by S.F.Averyanov [6]:

$$C_2 = \alpha C_1 + 10 \frac{a C_3 d}{m},$$

where C_1, C_2 - respectively the initial and predicted mineralizations of ground waters, g/l; C_3 - content of salts in soil,%; a – amount of the salts passing from soil into ground water in unit shares (it is accepted equal 0,5); α – share of ground waters in rise of its level (is accepted equal to unit); d – dimensional weight of the soil, g/cm3; m - porosity, in unit shares.

Direct consequence of rise in level of ground waters and changes of its mineralization is violation of natural salt balance of the irrigated lands.
For calculations of the salt mode the model proposed by V.R.Volobuyev [8] has been used:

$$C_3 = C_0 EXP\left(\frac{E_{СУМ}}{\gamma \eta} - \frac{D}{\beta \eta}\right)$$

Where γ and η - constants; γ=2,718; η=0,434; β – a salt return indicator; C_0, C_3 - content of salts in a meter layer respectively at the beginning and at the end of the water management year, %; D – drainage drain, m3/hectare.
At the same time the salts getting into the river and water intakes together with drainage waters influence on their mineralization. For its assessment the basin (pool) method is used requiring available standard initial information. By this method the water mineralization at the closing alignment is determined by a formula [9,10]:

$$M_{ЗАМ} = M_{НАЧ} + a F_{ЭФ}$$

Where $M_{зам}$, $M_{нач}$ – a mineralization, respectively at the initial and closing alignments, g/l; a - coefficient, integrated landscape and geochemical indicator; $F_{эф}$ – regularly irrigated area, hectare.

Use of mineral and organic fertilizers and pesticides promotes increase of fertility of the irrigated lands. But at the same time, they increase anthropogenous load on the environment. Therefore forecasting and an assessment of carrying out of biogenous substances and pesticides with superficial, infiltration and firm drains from agricultural holdings is important and necessary. For the solution of this task the technique developed in VNIIVO [7] was used:

Carrying out of soluble agrochemicals superficial, firm and infiltration drains was determined by formulas:

$$P^B = D \frac{1 - EXP\left(X - \frac{H}{10\,\Pi}\right)}{\left(\frac{H}{10\,\Pi} - X\right)} \frac{h\,m\,\Psi}{\Pi\,h} \quad,$$

$$P^T = \frac{M\,m}{10^4\,\gamma\,h_\Pi}\,(1 - \Pi)\quad,$$

$$Q = m\,\Psi\left[1 - EXP\left(\frac{-\varpi(H + O_P)}{10^3\,\Pi\,h_\Pi}\right)\right],$$

where P^B, P^T, Q - carrying out of the polluting substances superficial, firm and infiltration drains, in kg/hectare; Π – porosity of an arable layer of earth, in unit shares; D, X – calculated parameters; h – layer of a superficial drain, mm; h_Π – depth of an arable layer, m; m – amount of the soluble and exchange absorbed agrochemicals, kg/hectare; ψ – a share capable to pass into porous mix of agrochemicals, unit shares; M – the module of a firm drain, t/hectare; γ – dimensional weight of the soil, g/cm3; ω – the coefficient considering a share of rainfall and irrigating waters, unit shares; Π – irrigation regulations; H – rainfall, mm.

The water management indicators of functioning of IS considered in a task are as follows: (1) reliability by years, periods; (2) annual amount of deficit of water resources; (3) depth and duration of deficit.

The structure of economic (and natural) indicators reflects the developed structure of management of agricultural production in IS. To these indicators: (1) a net income (i.e. the income in case of fixed prices minus costs); (2) profitability; (3) the size of decrease in a net income in case of the most adverse conditions of functioning of IS. Calculation of these indicators is based on regression dependence of productivity of the main cultures on water resources and doses of the introduced fertilizers

$$I = a_0 + a_1 x_1 + a_2 x_2$$

Where I – productivity of a crop, c/hectare; a_0 – a culture harvest without irrigation and fertilizers, c/hectare; a_1 – a harvest surplus in c. on 1 hectare on 1 kg of the amount of the operating substances of fertilizers; a_2 - a harvest surplus in c. on 1 hectare on 1 m³ of irrigating regulation; x_1 – the amount of NP active ingredients of kg on 1 hectare; x_2 – irrigating regulation, m³ on 1 hectare.

Example of calculations. Calculations were carried out for conditions of Levo-Egorlyksky irrigating system (LEIS, Stavropolski Krai) for the period of 1956 to 1985 and territories of the Kabardian Balkarian republic for the period of 1944 to 2004. In article the results received for LEIS conditions are discussed.

Complete development of IS provides bringing the area of an irrigation to 60 thousand hectares. The territory of system is located in a zone of insufficient moistening. For carrying out calculations four cameras are allocated for which the certain structure of agricultural production received on the basis of the solution of a task of optimization of structure of agricultural production which is accepted as basic is set (out of it is model).

Calculations for models were carried out for 5 groups of options:
1) basic (1); 2) change of irrigating regulations (2-15); 3) change of doses of application of fertilizers and pesticides (16-30); 4) change of irrigating regulations and doses of fertilizers (31-42); 5) change of structure of production and doses of fertilizers and irrigating regulations (43-50).

Results of calculations are given in the table of solutions where on crossing of a line and column there is a mean annual measure value in case of the chosen strategy of management of IS.

The solution of a task at the choice of optimum strategy of management of water use is carried out in two steps. At the first stage, we determine the Pareto-optimal set. For this purpose, it is necessary to normalize the considered indicators that is to lead them to a comparable dimensionless form by means of the same transformations. Further, we establish the set which is not improved across Pareto, excepting obviously not acceptable.

At the second stage, the table was analyzed with attraction of the following integrated criteria:

$$Y = \max_j \sum_i \alpha_i\,Z_{ij}\quad,$$

$$Y = \max_j \sqrt{\sum_i \alpha_i\,Z_{ij}^2}\quad,\qquad Y = \max_{i,j} \alpha_i\,Z_{ij}\quad,$$

$$Y = \min_j\left[1 - \prod_i\left(1 - Z_{ij}\right)^{\alpha_i}\right],\quad Y = \min_{i,j}\left(\frac{Z_{ij}}{\alpha_i}\right)$$

Where Z_{ij} - a rated assessment of ith an indicator of functioning of system in j[th] strategy; α_i - a priority of this indicator (the amount of priorities of indicators shall not exceed units). And, this or that strategy will be optimum if to it the preference on all or at least by the majority of integrated criteria will be given. It is obvious that the most acceptable option is between extreme strategies to which environmental protection can refer the maximum production of plant growing and animal husbandry with the maximum anthropogenous impact on water and land resources or decrease in indicators

of cost efficiency when providing a priority to an environment safety.

Analysis results of the table show that if to accept all three groups of indicators equivalent, then strategy number 15 is optimum, that is the best strategy of water use is decrease in irrigating regulations by 50% with preserving basic structure. The same strategy remains to the best and in a case when water management indicators more preferable to the rest.

In case of preference of anthropogenous indicators, strategy number 35 is optimum – increase in irrigating

regulation by 25%, with simultaneous decrease in doses of fertilizers at the same size with preserving basic structure.

And at last, if the preference is behind economic indicators, then strategy 43 appears the best strategy of water use. This strategy provides increase in a share of hygrophilous cultures. At the same time irrigating regulations decrease by 30% and the dose of fertilizers increases by 30%.

CONCLUSIONS

Results of calculations testify to a possibility of use of system of models during the planning and management of water use of irrigating system.

TABLE OF SOLUTIONS

Number of strategy	Indicator of salt conservation, $\times 10^{-3}$	Carrying out of agrochemicals thousands, t.	Reliability of the system, %	Volume of deficiency of water resources, mil. m^3	Water consumption, mil. m^3	Gross profit, mil rubles.	Collection of grain, thousand, t.	Profitability, %
1	2	3	4	5	6	7	8	9
1	- 0,428	11,5	77,4	5,3	210,5	275,1	5343,6	84,3
2	- 0,572	11,6	74,2	7,0	217,8	278,1	5401,6	85,2
3	-0,719	11,7	71,0	9,9	225,4	281,4	5451,9	86,3
4	- 0,721	11,7	58,1	13,8	231,7	283,8	5492,8	87,0
5	- 0,750	11,8	58,1	16,9	237,4	285,9	5530,2	87,6
6	- 0,747	11,9	54,8	21,9	250,1	291,6	5594,8	89,4
7	- 0,778	11,9	48,4	30,9	260,6	294,8	5671,5	90,4
8	- 0,789	11,9	48,4	38,9	271,2	298,1	5785,3	91,4
9	- 0,436	11,4	87,1	2,2	202,8	271,8	5289,7	83,3
10	0,256	11,3	90,3	0,7	193,9	268,3	5216,1	82,3
11	0,033	11,2	96,8	0,1	183,7	264,5	5125,9	81,1
12	0,121	11,1	100,0	0,0	172,9	260,4	5033,0	79,8
13	0,037	10,8	100,0	0,0	151,3	251,9	4846,8	77,3
14	0,187	10,5	100,0	0,0	129,7	243,6	4660,5	74,7
15	0,034	10,1	100,0	0,0	108,1	235,1	4474,4	72,1
16	- 0,428	11,5	77,4	5,3	210,5	275,1	5343,6	84,3
17	- 0,428	11,5	77,4	5,3	210,5	275,1	5343,6	84,3
18	- 0,428	11,5	77,4	5,3	210,5	275,1	5343,6	84,3
19	- 0,428	11,5	77,4	5,3	210,5	275,1	5343,6	84,3
20	- 0,428	11,5	77,4	5,3	210,5	275,1	5343,6	84,3
21	- 0,428	11,7	77,4	5,3	210,5	278,4	5389,2	85,3
22	- 0,428	11,9	77,4	5,3	210,5	281,6	5434,9	86,3
1	2	3	4	5	6	7	8	9

23	- 0,428	12,1	77,4	5,3	210,5	284,9	5480,5	87,3
24	- 0,428	12,2	77,4	5,3	210,5	288,2	5526,1	88,3
25	- 0,428	12,4	77,4	5,3	210,5	291,4	5571,8	89,3
26	- 0,428	11,3	77,4	5,3	210,5	271,8	5297,9	83,3
27	- 0,428	11,2	77,4	5,3	210,5	268,6	5252,3	82,3
28	- 0,428	11,0	77,4	5,3	210,5	265,3	5206,6	81,3
29	- 0,428	10,8	77,4	5,3	210,5	262,0	5161,0	80,3
30	- 0,428	10,6	77,4	5,3	210,5	258,8	5115,3	79,3
31	- 0,572	11,4	74,2	7,0	217,8	274,8	5355,9	84,2
32	- 0,719	11,3	71,0	9,9	225,4	274,9	5360,7	84,3
33	- 0,721	11,2	58,1	13,8	231,7	274,1	5355,9	84,0
34	- 0,750	11,0	58,1	16,9	237,4	272,8	5347,6	83,6
35	- 0,755	10,9	58,1	18,5	243,7	272,4	5327,1	83,5
36	- 0,747	10,7	54,8	21,9	250,1	272,0	5320,9	83,4
37	- 0,436	11,6	87,1	2,2	202,8	275,1	5335,4	84,3
38	0,256	11,7	90,3	0,7	193,9	274,8	5307,4	84,3
39	0,033	11,7	96,8	0,1	183,7	274,3	5262,9	84,1
40	0,121	11,8	100,0	0,0	172,9	273,5	5215,6	83,8
41	0,005	11,8	100,0	0,0	162,1	272,5	5168,1	83,5
42	0,037	11,8	100,0	0,0	151,3	271,6	5120,7	83,3
43	0,022	11,7	100,0	0,0	157,7	402,1	4191,5	129,5
44	0,050	11,4	100,0	0,0	141,7	70,4	6558,0	20,1
45	- 0,615	11,3	77,4	4,6	206,8	85,9	7075,4	24,5
46	- 0,589	11,4	74,2	7,3	213,9	88,3	7150,6	25,2
47	-0,589	11,6	74,2	7,3	213,9	89,3	7209,1	25,5
48	-0,650	11,8	64,5	8,4	220,2	91,6	7349,2	26,1
49	-0,659	11,8	58,1	10,8	226,2	93,9	7398,3	26,8
50	-0,659	12,0	58,1	10,8	226,2	94,9	7456,8	27,1

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Building a Digital Elevation Model of Territory of Kabardino-Balkarian Republic on Radar Interferometric Shooting

Hamisha M. Senov[#1], Renat N. Abutalipov, [#]Yuriy V. Bolgov[#2]

[#] Department of Mechatronics and Robotics
Kabardino-Balkarian State University "KBSU"
Nalchik, Russia
[1]XMSenov@mail.ru, [2]yuriy6601@mail.ru

Abstract— **Presents the results of creating a digital elevation model of territory of Kabardino-Balkarian Republic on radar interferometric photography. Describes the format of the input data and the algorithm for constructing an elevation model. The material described can be used to build three-dimensional thematic maps for various purposes, and when creating navigation systems, mobile robotics, including automated drones.**

Keywords—digital elevation model, interferometric radar survey

I. INTRODUCTION

Modern geographic information system (GIS) on the basis of three-dimensional spatial models in recent time has become widespread. The basic coordinates of such GIS models in addition to latitude and longitude are also height information. Thus, such systems provide clarity of information and operating with tens and hundreds of thousands of elevations, not with the units and tens that was possible, and by using the methods "paper" cartography. In connection with the availability of fast computer processing large amounts of elevation data becomes feasible the task of creating a realistic digital elevation models (DEM). Based on the DEM, in turn, created information systems for various purposes, for example thematic maps of slope and aspect of slopes, erosion hazards, geochemical migration of elements of landscapes stability, etc. Such data are very important in the development and design of systems of monitoring of dangerous and extremely dangerous natural phenomena [1, 2].

Of particular interest is the use of DEM in the tasks of the navigation support systems, mobile robotics, including automated drones. If to simply build the DEM used ready-made software packages [3], to more specialized tasks (including navigation in mobile robotics requires the development of specialized software.

The aim of this work was to develop algorithm and software to build a digital map of the territory of the KBR, allowing for radar interferometric measurements to build a geographical map in different areas and at different scales. The complex allows to determine the path of movement of the mobile robot from point *A* to point *B* as the ground and air way. To do this, it is possible to determine the coordinates and elevation for each point of the trajectory and to transmit the data on board a mobile robot.

II. THE SOURCE DATA FOR BUILDING DEM

Source data to build the terrain served information radar interferometric footage shot from a space Shuttle (Shuttle) and called in the technical literature SRTM (Shuttle radar topographic mission) [4,5]. The measurements were performed in the period from 11 to 22 February 2000, the SRTM project with the task of obtaining a digital model of the planet's surface with a resolution of about 30 m (1").

Selected flight parameters (altitude of 233 km, inclination of 57°, orbital period to 89.2 min) ensured the implementation of radar imagery 85% of the Earth's surface that lies between 60° North latitude. 54° s.sh. [4]. For shooting we used two installed on-Board radar sensor SIR-C and X-SAR, performing the location of the planet's surface at C-band $(3,75 \div 7,5$ cm) and X $(2,5 \div 3,75$ cm), respectively, with a resolution time of 1 second. In just 11 days and 5.5 hours the Shuttle made a loop 182, which received about 12 terabytes of radar data [5].

Distinguish between the preliminary version of SRTM data (2003) and final (February 2005), with data from 2005 underwent additional treatment, consisting in the allocation of coastlines, water bodies, filtering of erroneous values, etc. They are provided to users free of charge, in one of the following [4]:
- option 1 (for the U.S.) in the form of a regular grid with a resolution of one arcsecond (approximately 30 m) and $1° \times 1°$ (3601×3601 elements);
- option 2 (for the territories of other countries, including Russia) in the form of a regular grid with a resolution of three arc seconds (about 90 m) and $1° \times 1°$ (1201×1201 elements);
- option 3 as files ARC GRID, ARC ASCII and Geotiff format, containing the regular grid with a resolution of three arc seconds (~90 m) and the size $5° \times 5°$ (6001×6001).

Data of variant 3 was obtained by treating the original elevation data, which provides a smooth topographic surface and the interpolated values for areas with no original data.

In all embodiments, the lower supplementary series (1201, 3601, 6001) and right additional column (1201, 3601, 6001) again on the next matrix [4, 5]. The height of the nodes of a regular grid are measured relative to the surface of the geoid model EGM-96, are rounded up to one meter and are represented by integers with a length of two bytes (16 bits).

The data is divided into separate files, which names contain information about the coordinates of the presented surface area of the earth. For example, for the second reporting option, each file covers a block of the earth's surface of 1 degree in latitude and 1 degree longitude. The characters in the file name, show the South-West corner unit with N, S, E and W refer to North, South, East and West. Thus, the "N34W119.hgt" file covers from 34 to 35 degrees North latitude and 118 at 119 degrees West longitude. The file extension ". hgt" means "height". These files contain 16-bit integers, the height is measured in meters above sea level, in a geographical (latitude and longitude) projection, the lack of measurement data is indicated by the number -32768. International 3-second files have 1201 columns and 1201 data line, the total file size 2884802 bytes (1201×1201×2).

The declared value of the measurement error is 20 meters in plan and 16 metres in height [6]. The actual accuracy was slightly higher than estimated (especially for X-band with a shorter wavelength), and numerical values of the errors for different regions of the world differ in two or more times [6]. However, studies have shown that in some cases (particularly in lowland areas) data have higher precision, and in mountainous areas, the lower the accuracy, and contain systematic errors caused by averaging heights in the field of radar spots, and the height of the peaks is always underestimated, and the bottom of the narrow gorges — inflated [7].

III. THE ALGORITHM FOR CONSTRUCTING THE DEM

To create a digital elevation model software is developed in C# with DirectX. DirectX consists of several components that underlie the programming of modern computer graphics:

- Direct3D low-level graphics API (application programming interface) that displays three-dimensional objects using hardware accelerators of three-dimensional graphics. Direct3D can be thought of as the intermediary between the application and the graphics device (the hardware video card).

- DirectDraw - allows you to control the hardware of a computer, providing direct and fast access to video memory.

The basis for constructing a three-dimensional image is scene - collection of objects or models. The object is represented using a grid with triangular cells. Individual triangles of the mesh are the elements by which are modeled objects. Is added to the scene camera and light source objects.

The camera determines which part of the object seen by the viewer and therefore to which part you want to create the image. The camera is positioned and oriented in space and determines the visible region and can be considered as the objects as a whole and its separate fragments. The region of the visible space puts a truncated pyramid and is determined by the angles of sight, the front and rear planes. Objects that are not within a defined space invisible and excluded from subsequent processing.

To build the elevation model, SRTM data is written to the vertex buffer is a special memory area containing the coordinates of the mesh vertices, normals to surfaces and texture coordinates. The vertex buffers are used to store data from the respective arrays for the reason that they can be located in video memory. Data visualization, in-memory video card is much faster than rendering data located in system memory of the computer.

Fig. 1 shows the mesh of the terrain model, built according to the SRTM. The surface normal determines the direction of the reflected light, so the brightness of the triangles that form the surface depends on its position relative to the light source and camera.
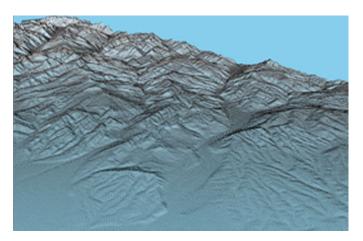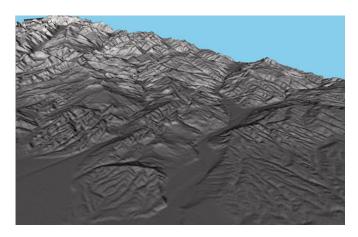
Fig. 1. Grid of the terrain model

Normal directed perpendicular to the plane of the triangle have unit length and are determined from the product of and vectors of adjacent faces of each triangle, the resulting vector is normalized .

Fig. 2 shows the elevation model, constructed with the normals.

Fig. 2. Terrain model built from chet calculated normals

For complete realism on the resulting terrain model is overlaid texture. Textures are usually stored in graphic files jpg, png, etc. In this case, the used space images in the specified areas. To overlay textures to the mesh triangles it is necessary that their vertices contain texture coordinates. Texture coordinates are a pair of numbers, usually varying in the range from 0 to 1 clearly indicates the texture elements, called Texel. For each vertex of the triangle are defined by texture coordinates, thus, is bound to certain triangular area on the texture.

Fig. 3 shows a terrain model with superimposed texture (satellite image). In this case the figure represents the plot area of the KBR (view on the Chegem and Baksan valley).
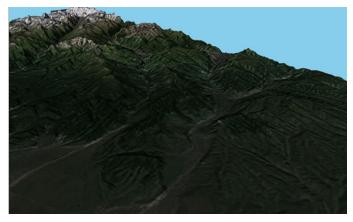
Fig. 3. Elevation model with superimposed texture

Fig. 4 and fig. 5 for example shows a terrain model of the area of the KBR in 1 degree latitude and 1 degree longitude. The upper (southwest) corner of the rectangular area has coordinates of 43 degrees North latitude, 43 degrees East longitude. Data sources for building a terrain are presented in fig. 4 and 5 contains the file - N43E043.hgt. As texture in fig. 5 we used a satellite image of this area of the earth's surface.
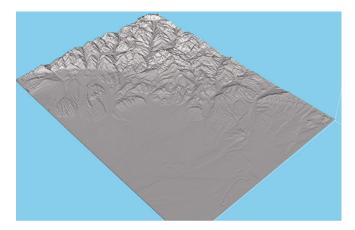
Fig. 4. Elevation Model of the land area of the KBR is built with consideration of the calculated normals
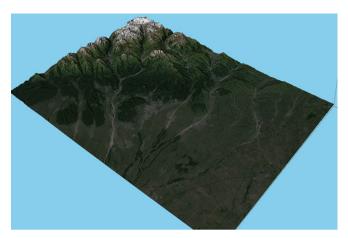
Fig. 5. Model of the topography of the land area of the KBR with superimposed texture (satellite image)

IV. CONCLUSIONS

The algorithm provides an operational construction of the DEM various sections of the earth's surface and can be used to build three-dimensional thematic maps for various purposes, and when creating navigation systems, mobile robotics, including automated drones.

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Methods for the Modelling of Transport Security

Vladimir N. Azarov
National Research University Higher School of Economics, 20 Myasnitskaya Ulitsa, Moscow 101000, Russia
Moscow, Russia
vazarov@hse.ru

Artem S. Kabanov[1], Oleg A. Kopylov, M.Yu. Morgunov
Moscow state University of railway engineering (MIIT)
Moscow, Russia
[1] kabanov_as@mail.ru

Abstract— **The paper deals with the problem of ensuring the security of vehicles and transport infrastructure. The urgency of these problems is justified and the potential threats and vulnerabilities are investigated for different types of transport. Approaches to ensure transport security are proposed. The main conclusions and recommendations are formulated.**

Keywords— vehicles; transport infrastructure; transport security; terrorism

I. INTRODUCTION

Transport infrastructure - is used for the transport network or communication routes (roads, railways, air routes, canals, pipelines, bridges, tunnels, etc.), as well as transportation hubs or terminals, where cargo or passengers are transferred from one mode of transport to another (e.g., airports, railway stations, bus stops and ports).

Vehicle – is the means by which people and/or goods are moved. (Cars, buses, trains, airplanes, etc.).

Management - the means by which the system is controlled, such as traffic lights, railway signalling, flight control, etc., as well as the rules used (including financial rules: toll systems, fuel taxes, etc.).

In brief, the various modes of transport are described as follows:

1. Air transport. The main advantage - speed of delivery. The main drawback - the high cost of transportation, but this is sometimes justified by the speed of delivery, allowing for other elements of the cost structure to be eliminated. Airports need to be located in very large open spaces, so air transportation, as a rule, is not integrated into a single system with other modes of transport except for roads.
2. Water transport (sea and river). Water transport is divided into deep ocean or sea navigation and internal river navigation. The main advantage of water transport - the ability to carry very large loads. The main drawbacks of waterway transport are limited functionality and low speed.
3. Rail transport. The value of the railways is still determined by their ability to effectively and relatively cheaply transport large volumes of cargo over long distances. Rail transport is characterized by high fixed costs due to the high cost of track, rolling stock and depot.
4. Road transport. Advantages: delivery flexibility and high-speed intercity traffic. Compared to rail transport, there is a relatively small investment in terminals, equipment and the use of public roads.
5. Pipeline. Designed to pump crude oil and liquid petroleum products, natural gas, liquid chemicals and, when transformed into an aqueous slurry, dry bulk products (cement). Pipeline transport is not considered here because it is not used for passenger traffic.
6. Public transport (including underground railways). Intended for the transportation of a large number of passengers, it requires a complex concentrated infrastructure intersecting with the infrastructure of other modes of transport.

II. THE CONCEPT 'TRANSPORT SECURITY'

Transport safety and security are important components of the national security interests of the country, so they have recently been paid a lot of attention [2].

According to Article 1 of the Federal Law of the Russian Federation "On transport security" [3], transport security in the Russian Federation refers to the protection of transport infrastructure and vehicles from acts of unlawful interference. The Russian transport security concept includes: the definition of national interests in the transport sector; the identification of factors that threaten these interests; the formation of a system to counteract negative factors and threats in this area; the definition of a set of measures capable of qualitatively raising the level of transport security in the Russian Federation to bring it into compliance with international standards.

In the most general terms the concept of "transport security" can be defined as:

- a warning system to combat and eradicate crime, including terrorism, in the transport sector;
- a warning system for transport emergencies of a natural or technogenic character;
- a system to prevent or minimize material and moral damage to the transport caused by crime and accidents;
- a system aimed at improving the environmental safety of transport and environmental sustainability of the transport system;

- the implementation of a system of national security objectives in the transport sector as a whole.

Main threats to transport:
- Terrorism and sabotage (theft or seizure of aircraft, ships or boats, railway rolling stock, vehicles or explosions at railway stations and transport centres or sabotage of hydrotechnical structures).
- Other cases of illegal interference in the functioning of transport (the imposition of foreign objects on railways, the dismantling of railway control devices, phone "terrorism", the illegal blocking of airports and major highways) that threaten the lives and health of passengers or cause direct damage to the transport sector and negative socio-political, economic and psychological consequences.
- Criminal acts against passengers.
- Criminal action against goods.
- Incidents (accidents) caused by the state of the transport engineering systems (they are worn out, accident prone or of poor quality), by the violation of the operational rules of technical systems, including regulations on environmental safety during transportation, as well as natural factors, which can lead to an emergency situation involving material losses and casualties.

Among the threats the negative effects of the inadequate development of the regulatory and legal framework governing relations in the sphere of transport, as well as the flaws in law enforcement can be included.

Characterising the sources of threats:
- Threats of a sociogenic nature (illegal interference in transport operations, terrorism, theft, hooliganism, blocking the ways and means of transport, the violation of operating rules for technical equipment, the poor quality of such rules and of legislation relating to the transport complex).
- Threats of a man-made nature (caused by the low-quality of materials used and the technology used in the transport sector, insufficient qualified personnel).
- Threats of natural origin (floods, landslides, earthquakes, snow and sand drifts on roads, tsunamis, typhoons, etc.).

In addition, the sources of threats to the security of transportation in the Russian Federation are identified as "external" and "internal".

The external sources of threats include:
- Activities by foreign political, economic, military, intelligence and transport structures aimed against the interests of the Russian Federation in the sphere of transport.
- Increased international competition for new transport markets, new transport technologies and natural resources.

- The desire of some countries to dominate the global transport and oust Russia from traditional transport markets.
- The growing technology gap between the world's leading powers and Russia and their increased capacity to counter the creation of competitive Russian transport technologies;
- The activities of international terrorist organizations.

The internal sources of threat include:
- The critical material and technical condition of some branches of the transport sector.
- A difficult criminal situation, accompanied by a tendency for the merging of state and criminal structures in the transport sector.
- The lack of coordination of the activities of federal and regional state authorities within the Russian Federation in forming and developing a unified state policy for the transport sector to ensure its security.

Serious mistakes made during the initial stage of economic reforms, the weakening of state regulation and control system, the penetration by criminal structures into business management structures, large-scale production and trade organizations and distribution networks have contributed to the formation of a large range of transport security threats in the economic sphere. These include:
- The poor efficiency of the system of state regulation in the sphere of transport, structural imbalances and other barriers to the establishment of market relations.
- The problems related to the resource, financial and technological dependence of the national transport system on other countries, Russia lags behind the leading countries in terms of the informatisation of the transport sector.
- Inadequate funding for ensuring the safety of transport in the Russian Federation.
- The reduction in the level of training of highly qualified scientific and technical personnel, a shortage of qualified specialists in the field of transport security and others.

Thus, it is obvious that the problem of transport security is multifaceted. Due to the fact that now the task of ensuring the health and life safety of people (from terrorism, etc.) is paramount - we consider road security from this angle.

III. TERRORISM IN TRANSPORT

Currently, the concept of transport safety is firmly linked to the prevention of terrorist acts committed in the transport sector or using transport [4].

Terrorism in all its forms is a transnational threat to the lives of individuals and peoples and undermines the territorial integrity, unity, sovereignty and security of states. Terrorism constitutes a direct violation of human rights, particularly the right to life, liberty, security and development. Modern terrorism is a systemic phenomenon of society caused by the

implementation of extremist ideology of extremism, using specially organized acts of violence and significant actions, especially in the number of victims, and when viewed politically can be characterised as a new form of war.

Terrorism is the state of violent confrontation, which in addition to the damage it does to national interests, infringes on many aspects of the global process and is based on the conflict of political, economic, ethno-territorial and religious interests of the various states, peoples, nations, social groups and movements, when used by at least one of the participants in terrorist acts of terrorism as a means of influencing opponents to achieve political goals [5].

Of the various manifestations of terrorism, one of the most significant threats to modern society is terrorism in transport. The most frequent terrorist attacks are targeted at crowded places, including at objects in the transport infrastructure. According to statistics, 70% of terrorist attacks are committed on transport, through or with the help of transport [6]. Many terrorist groups use the various forms of transport for their unexpected, relatively inexpensive and highly effective terrorist impact on modern society.

Transport is a means of interstate communication and it is widely used by terrorist organizations to move terrorists and delivery equipment and weapons necessary for their operations. All the trends today point to the intensification of the use by terrorists of transport, as it provides a reliable connection between the different regions of the planet and is one of the important components of the process of globalization [7].

Terrorism in transport is a kind of technological terrorism directed against dangerous industrial targets and objects necessary for social life-support of society, the destruction or elimination of which could entail grave consequences associated with massive loss of life. Terrorism appeals to the psychological fear factor in order to create panic in society, to disorient the work of its various sub-structures and uses violence to achieve political goals [8].

Characteristic features of the process of terrorism include the magnitude both in terms of number of victims, and the volume of material damage; the combination with emergency situations of technogenic character, which can cause a whole chain of other disasters. The main parameter that establishes transport terrorism as a form of technology is that objects in the transport infrastructure are already sources of high risk and enhanced danger.

Not all forms of transport are equally exposed to sabotage and terrorist attacks. The most attractive for terrorists are air and rail communications. River and sea transport in this respect are in a better position.

The main trends of modern terrorism in transport are the changes in the forms and types used by terrorists to carry out their intentions. The dynamics of the development of terrorism in transport has some specific features. To start with, transport served as the space in which terrorist attacks against political leaders were conducted. Then terrorism became more subversive, the main goal of terrorist acts was to damage and destroy government infrastructure. Acts of terrorism are often to use blackmail to highlight an issue, with the taking of hostages and political demands. There has been an increase in terrorist actions aimed at extorting money from the state by using the threat of killing the hostages. Currently, terrorist activity takes on the character of a new unconventional weapons aimed at causing catastrophic consequences for modern society.

A comprehensive strategy to combat terrorism should include not only police interventions. In recent years, the international community and individual states have been paying more attention to not only the problem of the fight against terrorism as such, but have made every effort to overcome the conditions that potentially contribute to the emergence of terrorism. Countering terrorism in transport should be seen as a preventative process against emerging terrorist threats. Unfortunately, the fight against terrorist crime is conducted mainly in response to crimes already committed.

According to D. Aras, a researcher into the problem of modern terrorism, we should recognize that today the trend for terrorism in transport is towards intensification, not least because of the rapidly developing transport elements, which provide a reliable connection between the different regions of the planet as one of the important components of the process of globalization. And that's why millions of people every day when fastening their seatbelts before takeoff suffer from the psychological pressure of fear - not afraid of natural or technological causes, but because of the unlimited destructive power of human hatred [8].

Summarizing, we can identify the main factors justifying the urgency in considering transport security in terms of the threat of terrorism:
1. The growing role of transport and the whole social infrastructure in international communication, the introduction of high technology leads to the fact that transport is becoming a vital artery of modern civilization and interference with it, as well as terrorist attacks, can lead to disastrous consequences for the whole society.
2. Terrorist groups use different forms of transport to organize unexpected, relatively inexpensive and highly effective terrorist acts on modern society. Transport is a means of interstate communication and it is now widely used by terrorist organizations to move terrorists and delivery the equipment and weapons necessary for their operations.

3. With the development of science and technology and increasing access to information technology, people holding extremist views have the opportunity to acquire or manufacture any types of weapons (including those of mass destruction), as well as to use the latest advances in science, including in transport for implementing their plans.

IV. THREATS AND THE VULNERABILITIES OF TRANSPORT SECURITY

The list of potential threats of acts of unlawful interference with objects of the transport infrastructure (hereinafter - OTI) and means of transport (hereinafter - MT) is presented below [9]:

1. The threat of capture - the ability to capture the OTI and / or MT, establishment of control over them by force or threat of force, or by any other form of intimidation.
2. Risk of explosion - the possibility of the destruction of the OTI and / or the MT or by exposing them and / or their cargo, personnel, passengers and other persons to the threat of being damaged by explosion (or crossfire).
3. The threat of placing or attempting to place explosive items (explosive substances) on OTIs and of MT, - the possible placing or acting in any way to expose OTIs and MTs to explosive items (explosive substances) which could either destroy the OTI or MT and in any other way damage them of the freight.
4. Risk of hazardous substances – the possible contamination of the OTI and/or MT or any critical parts thereof using hazardous chemical, radioactive or biological agents that threaten the life or health of personnel, passengers and other persons.
5. The threat of capture of critical parts of the OTI and/ or MT - the possible capture of critical parts of the OTI and/ or MT or the establishment of control over them using force, threats or other forms on intimidation.
6. The threat of explosion of critical parts of the OTI and/or MT - the possibility of destruction of critical parts of the OTI and/or MT or causing them damage through explosion (or crossfire), which can pose a threat to the functioning of the OTI and/or MT, the life or health of personnel, passengers and other persons.
7. Threats to place or attempt to place explosive items (explosive substances) on critical parts of OTIs and of MT, - the possible placing or acting in any way to expose critical parts of OTIs and MTs to explosive items (explosive substances) which could either destroy the OTI or MT and in any other way damage them of the freight.
8. The threat of blockade - the possibility of creating obstacles making it impossible to move the MT or restrict the operation of the OTI, threatening the life or health of personnel, passengers and other persons.
9. The threat of theft - the possibility of committing the theft of items from the OTI and/or the MT, which could render them unfit for use or put them into a state that

threatens the life or health of personnel, passengers and other persons.

An example of the mapping of potential threats and vulnerabilities associated with them is presented in Table 1.

TABLE I.   TABLE POTENTIAL THREATS TO OTI AND MT

Vulnerabilities Threats	Organizational	Technical
The threat of capture	1.The search for and use of vulnerabilities in the organization of the security system. 2.The physical removal of security personnel (possibly by gaining possession of their weapons). 3.Fraudulent entry using prohibited methods (weapons, etc.).	1.The search for and use of vulnerabilities in technology of the security system. 2.The failure of security equipment making capture easier. 3.The use of communication systems to coordinate activities.
The threat of explosion	1.The search for and use of vulnerabilities in the organization of security system. 2.Carrying explosives disguised as other products. 3.The physical elimination of security personnel enabling unfettered access.	1.The search for and use of vulnerabilities in technology of the security system.. 2.The failure of the technical equipment for the detection of explosives. 3.The use of communication systems for remote detonation and coordination.
The threat of damage by hazardous substances	1.The search for and use of vulnerabilities in the organization of security system. 2.Carrying hazardous Substances under the guise of other products. 3.The physical elimination of security personnel enabling unfettered access.	1.The search for and use of vulnerabilities in technology of the security system. 2.The failure of the technical equipment for the detection of dangerous substances. 3.The use of communication systems for the activisation of hazardous substances and coordination.
The threat of blockade	1.The search for and use of vulnerabilities in the organization of security system. 2.The carrying of lethal and \ or non-lethal methods of coercion. 3.The physical elimination of security personnel to neutralize OTI management system and MT (station managers, drivers, etc.).	1.The search for and use of vulnerabilities in technology of the security system. 2.The failure of the technical equipment for the detection of lethal and \ or non-lethal methods of coercion. 3.The use of technical violations damaging the efficiency of the OTI and MT (local and remote). 4.The use of communication systems to coordinate activities.
The threat of theft	1.The search for and use of vulnerabilities in the organization of security system. 2.The failure of the technical equipment for the detection of theft. 3.The physical elimination of security personnel to enable theft.	1.The search for and use of vulnerabilities in technology of the security system. 2.Deactivation of technical means of detection of the theft of funds. 3.The use of communication systems to coordinate activities.

The process of ensuring the security of OTI and MT safety VTI and TC is carried out by the following structures: private security companies, law enforcement agencies, special services, IT-departments, etc. It should be noted that in all

these areas training in Russia is conducted separately. But it is impossible to speak about the effectiveness of the control of security in the transport process, if there are no specialists capable of managing all these directions. The "ideal" manager in this situation is someone having a higher education with at least an "average" training in each of the following areas:

- Management.
- Computer technology and communication.
- Information Security.
- Special engineering training (OTI and MT).
- Social psychology.
- Investigative-detective activity.
- Military affairs and others.

As is clear from the above list, there is the need for an understanding of various technical disciplines. It follows, therefore that managers should be trained with at least a basic technical education. From Table 1, the main basic elements of security should be selected. As part of any organizational security measures, the main tasks as related to OTIs and MTs are:

1. The maximum concealment of internal structures and algorithms of the protection system.
2. The continuous search for vulnerabilities in the organization of security systems - the process must be cyclical. Of particular relevance here are the model Shewhart-Deming (Cycle PDCA - Plan, Do, Check, Act and ISO 27000 family of standards and their national counterparts in Russia.
3. Constant preparedness, including the physical fitness and technical support required for staff for resisting physical attacks.
4. Control of prohibited items and the prevention of any possible entry by unauthorised persons. It should be noted that the key to the successful response to these risks is to increase the vigilance of security personnel carrying out the control at the entrance to the OTI and/or MT, the use of technical equipment suitable for detecting prohibited items (metal detector, control of radiation levels, etc.) and the control of visitors (by using automatic face recognition systems for example).

As part of any technical security measures, the main tasks as related to OTIs and MTs are:

1. The maximum concealment of internal structures and algorithms for technical equipment and security systems.
2. The continuous search for vulnerabilities in the technical means and security systems (using intrusion detection systems, etc.).
3. Countermeasures to prevent the failure of control systems (for example, the use of autonomous systems that are not connected to remote control channels, etc.).
4. Countermeasures to prevent local and remote attempts to prevent the operation of OTIs and\or MTs (e.g. the use of firewalls to counter external attacks).
5. Countermeasures to prevent the use of communication

facilities to coordinate the activities of terrorists and/or to remotely activate devices (e.g. listening to and the blocking of conversations, analysing internet content etc.).

It is clear from the above analysis that the spectrum of security issues is very broad and requires considerable depth of understanding that (according to the authors) is currently not provided by any existing educational programs. To fully control the security system of the transport infrastructure and means of transport needs specialist-managers with a strong interdisciplinary training (knowledge of psychology, principles of management, deep knowledge of the hardware and network systems, etc.). These professionals must lead the data management process in the OTI and MT. In this way, it will be possible to significantly reduce the risks of "bias" and "gaps" in the protection of OTIs and MTs by using quality management systems (to ensure compliance with the principles of equal strength (avoiding weak links) and fit for purpose security etc.). Unfortunately, at the present time on a global scale the frequency of incidents in OTIs and MTs is high, underlining the complexity of the problem and the vulnerability of security systems in part due to the lack of developed (qualified) security management.

Clearly, the security requirements for each type of transport will be different. According to the authors, then, it is advisable to create models for the security of the various types of transport with the aim of studying the state of security, to improve the training process and to take correct decisions. The models for each type of transport should take into account:

- Distinguishing features of the means of transport (technical, economic, statistical, etc.).
- Characteristics of the security organisation (technical, organizational, etc.).
- Characteristics of the infrastructure objects (location, etc.).

Indicators that would be useful to include in the model are those such as vehicle operating characteristics and are shown in Table 2 [10]. Such indicators are used for economic analysis and in, but can be successfully applied in preparing the security model. For example, the passenger capacity directly affects the potential number of victims of terrorist attacks, as will the specific features of the security system etc. In addition, other parameters such as the criticality of any damage to operational capacity should be taken into account (for example with air transport, that will have a higher value).

TABLE II.   COMPARISON OF DIFFERENT MODES OF TRANSPORT

Indicators	Water Sea	Water River	Rail	Road	Air
Passenger capacity	Unlimited	High	High	Low	Low
Cost of transport	Low	Low	Low	Medium	High

Indicators	Water Sea	Water River	Rail	Road	Air
Transport speed	Low	Low	High	High	Very High
Regularity of transport	Sometimes restricted	Seasonal	Stable	Controllable	Weather restricted
Transport range	Intercontinental	Internal	Intracontinental	Limited	Unrestricted
Volume of freight	Large	Large	Large	Small	Small
Need for road network	Not needed	Not needed	Required	Required	Not required
Need for special terminals	Terminal	Pier	Station terminal	Not needed	Airport

When forming such models it is appropriate to include in the review the characteristics of the various OTIs and MTs. For example, ship parameters (displacement, load capacity, deadweight, tonnage), rail transport parameters (load capacity utilization, capacity factor, technical load rate), etc.

In designing the transport security models, the principles of the process approach and methods to describe business processes [11], ie, model transport security can be used to describe the set of business processes. A business process is a set of interrelated or interacting activities that transform "inputs" into "outputs" of value to the consumer. This activity can be performed in a single unit, and can be an activity carried out by different departments or even organizations. Simulation can be used to usefully describe the business process, which the aim of creating an accurate, concise, easy to read description of the system as a set of interacting components and inter-relationships. The key points in producing the simulation is the choice of methodology for the description of the processes and the necessary technology for the simulation and for the collection of the information needed to achieve the goal.

At the present time, there are a considerable number of methods to describe business processes in the form of paradigms of object orientated design, automated systems to implement this paradigm using a formalized description language, for example, UML (universal modelling language) and others, as well as the development of universal formats for the description of documents - XML.

The transport security process, can be presented as a set of core transport business processes, providing uninterrupted, continuous, quality and functionality of the system when exposed to threats from various sources. As metrics safety performance and the security of the traffic infrastructure and means of transport are used, as well as those of cost and time.

From an engineering point of view we use decomposition principles, based on changing priorities and functions and allowing for their individual development and evolution, i.e. "Setting processes for a given function," based on the life cycle of individual elements as products. Modeling business processes also allows for the quantitative assessment of the positive and negative effects on the system and the

relationship between them and the overall result. The decomposition level also allows for the cataloging of individual control actions (control actions include all kinds of influences and threats, risks, vulnerabilities, and so on.) on the system and the necessary resource support to perform inherent functions, as well as for counteracting threats.

This approach to modeling allows us to solve a number of organizational measures and design the infrastructure of organizations, the development of the various provisions, regulations and functional duties of responsible persons to ensure the safety of the transport infrastructure and means of transport.

V. CONCLUSIONS

1. The largest number of transport security breach incidents are caused by terrorism.
2. The "basic elements" of transport security are identical for all modes of transport. The decomposition of the "basic elements" for each mode of transport should be individual.
3. The approach proposed in this article for the construction of models for transport infrastructure and means of transport enables the construction of the most relevant models for various forms of transport with the aim of assessing their state of security, for increasing the quality of the training process and for taking the correct management decisions.
4. The preparation of professional managers capable of leading the departments for the security of transport infrastructure and means of transport remains unresolved. Discussion on the launching of new directions for the training of specialists for each mode of transport has been continuing for a long time [9],[10], but is still unresolved. Until resolved it is not possible to talk of effective management in this area.

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Methods Dedicated to Fight Against Complex Information Security Theats on Automated Factories Systems

Karlova T.V., Bekmeshov A.Y., Sheptunov S.A.

Institute of Design-Technological Informatics of RAS
Moscow, Russia
karlova-t@yandex.ru; b-a-y-555@yandex.ru; ship@ikti.ru

Kuznetsova N.M.

Systems and Information Processing Department
Moscow State University of Technology STANKIN
Moscow, Russia
knm87@mail.ru

Abstract — **Modern factories often collide with the problem of new kind of ciber-threads - Advanced persistent threat, characteristic by its complexity. The example of such kind of threads is virus Stuxnet, which had attacked almost all the automated control systems of Iran nuclear industry. Advanced persistent threats are related to the most dangerous ciber-threads of highest level.**

Keywords — information security, automated control, automated systems.

I. Introduction

Principle characteristics of advanced persistent threat (APT) are:

- duration;
- purposefulness;
- intellectuality;
- complexity;
- obscurity.

Consider each characteristic in more detail.

Usually the **duration** of APT is about year to several years. APT is related to heavy threats, which demand a lot of time.

Realization of APT is very expensive, in this connection the **goal** of APT is always clearly set and defined. As a rule, the objects of the threat are certain information resources of industrial enterprises, in particular, top secret information, information of special importance, individual hardware and software systems, and large automated systems (AS). APT final goal is the lay-up of main automated control factories systems.

Almost always APT are clearly formulated and planned, therefore high level of knowledge and experience in sphere of information security, telecommunication and psychology are demanded.

Since the realization of the threat takes place in large heterogeneous information environment, the APT is **complex**. The objects of threat could be automated process control systems (APCS). APCS are complex large information systems, contained of several interconnected modules. In addition, according to competent policy of direction, high information security technologies are often used. Complexity of APT requires a knowledge of all described systems' and technologies' features.

As noted previously APT are long-term attacks, therefore APT act **insensibly**: 99,9 % of the threat time is devoted to collecting and analysis of the information, and only 0,1 % - to active steps.

In this connection malefactor acts gradually, complexly and carefully.

It is important to note that in addition malefactors often use social engineering methods, prevention and opposition of which are actual problem.

In accordance with APT characteristics are the following properties:

- difficult detectability;
- difficult removability;
- hard analyzability

II. Human element and information security concept

In term of information security there is no absolutely protected resources. Any AS includes man-machine interface, and that it directed most of the attacks.

The interface is "a bottleneck" due to the fact that its control does not focused on one subject but distributed between man and AS. Most disadvantages of both components are concentrated in the interface. In this connection APT realization is associated with human-machine interaction. Scheme of man-machine interface control is shown in Figure 1.

Any use of the interface for commutation in heterogeneous environment is potentially dangerous.
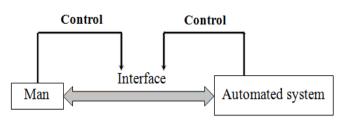
Fig. 1. Man-machine interface control scheme

Commutation between man and machine occurs in a heterogeneous environment. Today there is no such technology that allows to completely eliminating the risk of data leakage. In addition distributing of control between two subjects of relations (in this case, subjects are man and AS, object is transmitted information) complicates the solution of the problem.

Important role played by human elements. At this time all of realized cyber-threats in one degree or another are related to human factor. In principle the machine (AS in our case) itself cannot produce an error because it does not accept the basic management decisions.

All the errors which led to the realization of cyber-threats are human:

- AS design errors;
- errors AS operating;
- errors design support information systems – SIS (including information security systems - ISS);
- errors integration of SIS (including ISS);
- disregard the rules of information security policy;
- errors operation SIS (including ISS) and so on.

Those who produce the attack have "the advantage of white chess": they go first. Therefore the design of protection systems needs to use preventive methods. However, it cannot reflect full spectrum of cyber-attacks.

III. BULLET AND ARMOR PROBLEM

Information defense is one of the most ancient problems. Attack and defense technologies had been improving for centuries. The stronger armor the faster and more powerful bullet is. And vice versa, the more perfect the bullet the better must be the armor. And if some years ago in the focus of the defenders and the attackers had been a specific mechanism, but now the object of study (and with that, and on the other hand) are complex systems and sophisticated technologies [1, 2, 3].

Tools of design and analysis of such systems follow subjects must be used simultaneously:

- complicated mathematical analysis;
- decision theory;
- probability theory and mathematical statistics;

- algorithms theory;
- the theory of finite automata;
- cryptography;
- systems theory;
- networks and telecommunications;
- information systems;
- control systems;
- physics;
- geography;
- biology;
- virology;
- psychology.

Any ISS is compound of interactive modules set, each of which is dedicated to specific type of protection. These modules themselves are studied and analyzed thoroughly, but unfortunately developers of ISS, test each of the modules, often neglects serious test the system as a whole and questions of synergy. The situation is increased by the seemingly innocuous feature of the system – flexibility. While application of SIS and ISS the company's management and information security department (ISD) management select set of modules. For each factory depending on the specific production there is the fixed set. Therefore developers of SIS and ISS have no time and recourses for serious integration testing. Moreover, the set of modules undergoes constant modification.

For attackers this situation is much easier: the object threat is well-defined information system to study the characteristics of which there is plenty of time and resources.

IV. RECOMMENDATION TO PREVENT COMPLEX THREATS ON INFORMATION SYSTEMS

To ensure a high information security level of main automated systems of factory need to:

- ISS testing (including secret) both at the beginning of the operation and for any changes;
- definition of clear allocation of access rights in every factory SIS;
- conduct special checks of ISD employees (including tests by trusted external auditor, including spot checks);
- regular training and refresher all employees, who have special access rights, in the field of information security;
- regular refreshment of ISD staff followed by trainings and testing;
- ensure isolation LAN from the Internet. In other words strategic computing complexes should be isolated. The

boundary of main factory information system should be clearly marked;

- providing the physical location of server farms, computing clusters and information storage on the territory controlled by the enterprise;

- ban on the use of cloud technologies;

- use access control policy taking into account the fact that the total access level to the entire volume of information should not be provided to any of the factory staff, including senior management;

- adding to security policy of clear data communication rules (for sharing, distribution, copying and so on) from external to internal information systems, namely the use of special inspection and registration mechanism.

As control element of the mechanism may be considered:

- ISD employees group, who «manually» control the traffic (this approach is appropriate according to special importance data transmission monitoring);

- automated system of analysis and data filtration;

- hybrid scheme of involvement both ISD staff and special automated systems.

V. MODEL «ATTACKER OUTSIDE THE PERIMETER OF MAIN FACTORY INFORMATION SYSTEM»

As shown in Figure 2, the interaction of the external environment and the internal factory information system is realized by means of special tools and techniques. Thereby the external data traffic is forming.

The main purpose of protection system is data traffic control on the information network border. As solving of the described task Data Leak Prevention (DLP) technologies could be applied.

Model «Attacker is outside the perimeter of main factory information system» is shown on Figure 2. However this model is the exception rather than rule.

In this situation object of control is clearly defined – it is information traffic, formed on the border between external environment and internal factory information system. Subject of control is protection systems, in particular prevention from data leakage module, cipher module and information detection module [4, 5, 6]. This modules are the main shield of factory ISS.
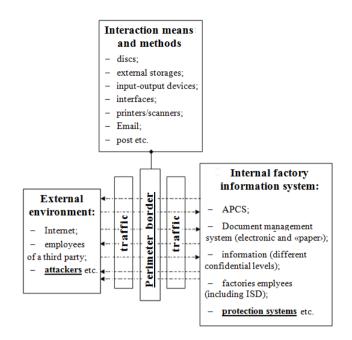
Fig. 2. Scheme of external information traffic on factory

VI. MODEL «ATTACKER INSIDE THE PERIMETER OF MAIN FACTORY INFORMATION SYSTEM»

APT often uses methods of social engineering:

- factory employees bribery;

- hireling former factory employees;

- intimidation of factory employees etc.

In all enumerated cases the attacker is inside the perimeter of main factory information system, therefore the problem of opposition ciber-threats becomes more difficult. Moreover, in this model attacker:

- has part of confidential information;

- knows the factories infrastructure;

- knows the features of information protection systems.

In this connection information security policy should include following means and tools of protection from **inner threats**:

- inner factory information traffic monitoring (corporate email, faxes, printers etc.);

- planning of all kind of works on the factory territory, in other words prohibition of any data processing outside the perimeter of main information system or using of cloud-technologies;

- application special personnel monitoring technologies (on factory territory only and only in case of previous employee acknowledgment and permission). For example, closed-circuit television (CCTV) systems;

- organization of special analyst psychologist department. Providing the media-content (including

real-time media-content, typing only on the factory territory) to the department employees.

VII. MODEL «ATTACKER INSIDE THE INFORMATION SECURITY SYSTEM». IRREVERSIBLE THREAT CASE

This scenario assumes finding the attacker in the ISD.

ISD has the highest level of responsibility. ISD employees control the main protection system. They serve the monitoring and audit functions.

In this model attacker:

- knows the factories infrastructure in details;

- has access rights to main automated system monitoring journal and information traffic journal;

- owns all the information about protection system.

The last point of list is fatal in most of cases. Rarely manage to save main automated systems in situation of protection system collapse.

To prevent attacker's total control on protection system information security policy should be added by following methods:

- oddly sounds, but ISD employees should have the lowest level rights to confidential factory information about developments and process on main automated system;

- presence of «manual breakers» mechanism. This mechanism is to emergency shutdown of all the automated factory systems in the shortest time in safe mode for staff when the threat realization is discovered.

The main criteria of success serve the speed of reaction. In the situation when the protection system is controlled by the attacker, minimization the system itself functioning duration is very important (since it was system which contaminated).

VIII. SOCIAL ASPECTS

The stricter protection rules are the more vulnerable to psychological pressure factory employees are. Important to note that the information security policy should be wisdom and not overstep the bounds of reasonable, in particular, keep human rights and personal boundaries. In according to this, company staff should be aware about CCTV systems and personnel monitoring technologies applied on the factory territory.

A measure of responsibility for the disclosure of company secrets should be set in writing form in the relevant document signed by the employees.

IX. HARDWARE AND SOFTWARE OF MAIN FACTORY AUTOMATED AND PROTECTION SYSTEMS CONTROL

Information security policy should include hardware and software control aspects.

APT are high intellectual and long-term acts. Attackers could get access to confidential information long before it's processing, using the markers in main factory automated systems hardware and software. To prevent this situation must be:

- using import substitution products;

- purchase of equipment only in the long-term and reliable supplier [7];

- using hardware licensed by Federal Service for Technology and Export Control (FSTEC);

- using of original own development;

- holding a scrutiny of all hardware (including dismantling of all the details to the elementary constituents, maintenance check Transient Electromagnetic Pulse Emanation Standard – TEMPSET, radiography etc);

- holding a scrutiny of all software (including special checks for markers, source code verification, testing under boundary conditions etc);

- global system testing of all the modules and complexes.

In this case, in constant to work with staff, tightening of regulation should become the rule.

X. REQUIREMENTS FOR INFORMATION SECURITY DEPARTMENT EMPLOYEES

As noted before, ISD staff knows configuration, architecture, infrastructure and process logic of main object for protect – APCS. However in purpose to prevent the situation of irreversible threat information security policy should include the point, which determines the lowest access level to the confidential data, connecting with company developments and processes in APCS.

Thereby the analogy with modern cryptography technology (both symmetric and asymmetric) could be discovered: the encryption algorithm should be open, but the privacy must be ensured by the secret key [8, 9]. In case of ISD staff the analog of the encryption algorithm is means and methods of processing data in APCS, the APCS information itself must be hidden (like the cipher key in cryptography technology).

According to noted, ISD employee should:

- be graduated in field of information security;

- have experience in field of information security;

- know actual information about newest methods, means and technologies of confidential data processing;

- participate in the conferences and seminars devoted to information protection problems;

- increase the level of skills and qualification followed by training and testing.

XI. PROTECTION SYSTEM INFRASTRUCTURE

As shown on Figure 3, protection system contains the automated and organization protection system, which interaction between themselves. In turn, automated systems include software and hardware, and organization systems – guidance documents. All infrastructure elements are connected [10]. This complex approach improves the level of defense from APT.

Important to say that all information security methods in automated and organization protection systems should interaction between each other. In the other words the methods should not be autonomous and should work in complex [3].

No matter how high the degree of protection in automated system, in case of use wrong organization methods main information system and the confidential information in it would be attacked by APT sooner or later.

Similarly in the case when perfectly designed organization protection system is used with improperly functioning automated protection system, in a result the overall security level of main information system would determined by the «weakest link».
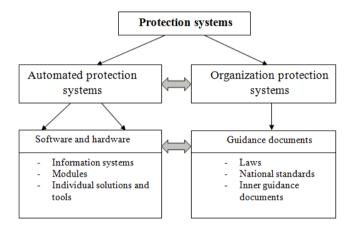
Fig. 3. Protection system infrastructure

XII. ADVANTAGES OF METHODS TO FIGHT AGAINST COMPLEX INFORMATION SECURITY THREATS ON AUTOMATED FACTORY SYSTEMS

The advantages of using the methods described in the article in comparison with other existing conception are:

- simplicity and clarity of methods;

- apply transparency to protected object (APCS);

- functioning without intrusion in APCS algorithms themselves, which in turn means lack of influence on the main protected object's efficiency, in particular, on the APCS process speed.

The proposed methods do not purpose integrating of supplemental hardware and software integration in APCS itself. As shown on Figure 2, all the modules of ISS should be out the APCS LAN and work only for access control and information traffic monitoring. These modules do not affect on the main protected system parameters of operability, processing, fault tolerance and reliability.

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Wireless Access Monitoring and Control System Based on Intrabody Communication

Igor A. Khromov [1], Andrey A. Dvornikov [2]

Department of Computer Engineering
National Research University Higher School of Economics (HSE)
Moscow, Russia
[1] ignx@yandex.ru,   [2] advornikov@hse.ru

Abstract— **The paper investigates the wireless body area networks (WBANs) and proposes a novel wireless monitoring and access control system based on BodyCom technology. Authentication methods were analysed. Besides, WBANs and standard IEEE 802.15.6 were considered. This paper presents a prototype of the proposed system and shows a scheme for the implementation. Digital door access control is an electronic locking system operated by a digital key. An electromechanical lock control unit has been designed for this purpose. In addition, a special microcontroller module was designed. The system has a flexible functionality. It can be used both as a home security system and company security systems. The product will be useful for monitoring and access control systems implementation.**

Keywords— access control; authentication; MACS; WBAN; IBC; BodyCom technology; IEEE 802.15.6

I. INTRODUCTION

The monitoring and access control systems (MACS) is much more than entrance monitoring and access control. They are an integral part of any security system and offer a convenient platform for a selective object access restriction. These systems provide property and information protection. It`s a problem to solve these tasks for an ordinary citizen, and even for a large corporation.

Among the various security methods, authentication is a fundamental step in the way of the initial establishment of the trust. An effective authentication method creates a lot of problems for a hacker on his way to gain unauthorized access to the facility.

Authentication methods are divided into two classes: the cryptographic and non-cryptographic. Cryptographic authentication methods use symmetric and asymmetric encryption. In symmetric encryption, the difficulty of algorithm implementation is less than in asymmetric encryption. However, a safe keys transfer between two nodes is a difficult task. Asymmetric encryption requires high computational cost [1].

The non-cryptographic methods provide an alternative method of authentication without pre-distributed keys. Moreover, most non-cryptographic schemes have simpler protocols with fewer complex calculations. Currently, non-cryptographic authentication mechanisms, mainly divided into the following categories according to the type of cryptography:

- Biometric-based authentication.
- Channel-based authentication.
- Proximity-based authentication.
- Other authentication schemes.

The most common are two methods: biometric authentication [2, 3] and proximity authentication [4-7]. Disadvantages of biometric authentication are [8]:

- First, when the body is in different positions, the sensor is difficult to accurately measure the physiological signal.
- Second, a spoof attack may occur using a fake biometric characteristic.

The main disadvantage of the proximity method is that the devices must be in close proximity to be authenticated. Another disadvantage is that the message is transmitted unencrypted text [1].

A lot of the problems can be solved in case a human body is a transmission medium. However, few of the researchers have been studying the possibility of using the human body as a transmission medium for security issues. However a lot of works investigate a problem of data transmission using a human body for healthcare systems. [9-11].

The main purpose of the article is to consider WBAN use in the security field and presents monitoring and access control system based on BodyCom technology.

II. WIRELESS BODY AREA NETWORKS

Intrabody communication (IBC) was first proposed by Zimmerman [12-14] as a new communication technology for data exchange between wireless body area network (WBAN) electronic devices. Its application is not limited to data transmission and power transmission cover [15]. Electronic devices receive the energy needed to operate simultaneously with the data. IBC can also be used for communication between wearable devices and environment devices. It is a new method for connecting mobile devices inside and outside the human body. This method uses the human body as a signal transmission medium and has many advantages over

traditional RF approaches. Most of the signal from the transmitter doesn`t leave a user body because of its operation is based on short-range communication. The signal is not influenced by interference from external RF devices.

As part of the IEEE 802.15, the working group developed a communication standard TG6 focused on the link between energy-saving devices that operate near or inside the human body [16]. The IEEE 802.15.6 standard defines only two lower levels in a wireless communication system. It is the physical layer and the transmission medium access control layer. The standard supports three different physical layers - narrowband NB-PHY, ultra-wide-band UWB-PHY and communication within the human body HBC-PHY.

III. BODYCOM TECHNOLOGY

BodyCom is new wireless communication technology that uses the human body as the data transmission medium. Communication between BodyCom system devices occurs when they are within a few centimetres of the human body: a simple proximity or touch can establish a BodyCom nodes connection [17]. The base unit and the mobile unit, as the Fig. 1 shows, use a capacitive coupling to transmit the signal.

The BodyCom system was implemented with the following priorities [17]:
- Very low consumption, especially for the mobile unit.
- Fast system response.
- Stable and robust communication with fault detection.
- Limited field of action (as little as a few centimetres) to allow identification when the touch action takes place from whoever wears the mobile unit.
- Low cost and complexity.
-

The mobile unit is a battery-powered portable device with the energy saving priority, while the base unit usually connected to an external energy source. When a touch is detected, the base unit begins data transmission to the mobile unit using the human body as a transmission medium. Then the mobile unit receives a request, decodes it, it generates a response, encrypted and it back to the base unit. After receiving the response, the base unit decodes it, and a microcontroller compares the mobile ID with identifiers stored in his memory. If the identifier matches, the microcontroller executes the programmed action [18].

The main advantages of this technology: transmission is performed only when the user is touching the coupling pad and with a number of modifications this technology allows to get unique characteristics of the user body.
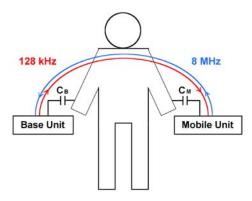
Fig. 1 BodyCom system working principle

The frequencies in BodyCom selected according to a power consumption factor. Another factor is the power of the mobile unit in the reception mode. This is a result of the limited low-power receiver circuits available on the market; they limit the receiving frequency to the 60-400 kHz range. The transmission mode demanded by the same unit, it's recommended to use a frequency between 6 and 13 MHz for the outgoing channel. The relation between the power consumption and the performance is optimal within that frequency range. Thus, a frequency of 128 kHz has been chosen for the signal transmitted from the base unit and received by the mobile unit. A frequency of 8 MHz has been chosen for the signal transmitted from the mobile unit and received by the base unit [17].

IV. EXPERIMENTATION AND RESULTS

The aim of the experiment is to demonstrate the possibility of using WBANs in the security field to protect facilities from unauthorized access.

A. BodyCom Development Kit

BodyCom Development Kit based on BodyCom technology developed by Microchip includes:
- Base unit.
- Two mobile units.
- Two coupling pads.
- USB cable.
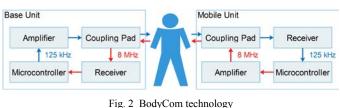
Fig. 2 shows the principle of BodyCom technology [19]. The base unit includes a receiver system, the transmission scheme and a communication interface, all controlled by a microcontroller. The receiver module provides a reliable and efficient circuit implementation for demodulation/decoding signals compatible with the signal transceiver. The microcontroller controls the process of transmission/reception, which performs encoding/decoding and error detection. In addition, it supports the implementation of the security algorithm for protected communication. Transmitter module controls the coupling pad, designed to detect the touch/proximity. A simple serial interface can be directly connected to other systems or microcontrollers, to provide easy integration and design flexibility. In a BodyCom system, the mobile unit should be able to receive and process the
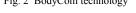
incoming data, and send back an answer, all performed with low-power consumption [17].

The firmware has been modified to transmit the control signal from the base unit.

B. Control Unit

The control unit was designed to control the lock, as the Fig. 3 shows. The current load of the control unit is limited to 3 A.

Fig. 2 BodyCom technology
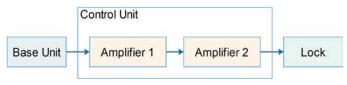
Fig. 3 Control unit

C. Locking device

The locking device is an electromechanical lock for a door, with 3 A working current at 12 V. The base unit microcontroller uses the control unit to drive the lock, as the Fig. 3 shows.

D. Algorithm

The algorithm of the system is shown in Fig. 4. The system is activated by the user touch of the base system coupling pad, as the Fig. 2 shows. After that a basic unit transmits a signal using the human body as a transmission medium. Then transmitted signal is received by the mobile unit, which decodes the data, generates a response, encodes and sends answer. If the answer is correct, then the base unit transmits a control signal to the control unit (Fig. 3). Finally, the control unit unlocks the electromechanical lock using the control unit and the user gets access to the facility. After a few seconds the lock is closed and the system changes to the initial waiting state.

Fig. 5 shows a picture of a developed MACS prototype. The prototype includes: a mobile unit, electromechanical lock, base module and designed control unit.

Research on the use of IBC in the monitoring and access control system was completed in the Department of Computer Engineering of the National Research University Higher School of Economics (HSE).
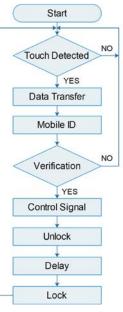
Fig. 4 System algorithm

Fig. 5 Developed system prototype

The experiments are performed in the different premises and using the various people. These experiments indicated that IBC can be used in MACS to protect facilities from unauthorized access. Besides, it was found that the signal can be transmitted through several people with joint hands.

V. CONCLUSIONS

This paper introduced a monitoring and access control system based on BodyCom technology. The developed system prevents unauthorized access to the facilities. It uses a human body as a transmission medium it is its unique feature. This feature enhances the reliability of signal transmission in contrast to other technologies used in MACS. The signal is transmitted encoded as opposed to the 125 kHz RFID technology. It doesn't require expensive equipment, which is used in biometric systems for accurate user authentication. Hardware is flexible and can be reconfigured on the fly allows you to use it on various objects.

The unique properties of this system are optimized power consumption, low cost of the hardware and a variety of

possible applications.

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The Evaluation of the Electronic Services with Accordance of IT-security Requirements Based on ISO/IEC 27001

Ilya I. Livshitz#[1], Kseniya A. Nikiforova#[2]
JSC Gazinformservice
Saint Petersburg, Russia
[1] livshitz.il@yandex.ru, [2] nikiforova.k.a@yandex.ru

Pavel A. Lontsikh #[1], Viktoria A. Karaseva # [2]
National Research Irkutsk State Technical University,
Irkutsk, Russia
[1] palon@list.ru, [2] golbery@yandex.ru

Abstract—**This publication discusses the problem of compliance evaluation for electronic services (ES). The relevance of this publication caused certain problems in the ES organization, formation of international confidence in the ES provided, as well as a wide range of approaches to ensure IT-security. It is noted that along with well-known standards set by the various national regulators, well-known term for the purpose of forming an objective and independent evidence of the ES credibility can provide international standards ISO 27001 series. Methodical basis of the ISO 27001 series operates with an objective and independent assessment of the many IT-security metrics for the quantitative estimation of the IT-security level for ES. The obtained results can find application in the provision of international confidence for ES services through objective and independent IT-security evaluation.**

Keywords—Information security; Information Security Management System; audit; risk management; threats; vulnerabilities; Standards.

I. INTRODUCTION

One of the urgent problems at the present stage of development of electronic communications is for providing information security (IT-Security) for electronic services (ES). The solution to this problem is as obtaining a formal assessment of compliance of the measures (means) (in the terminology [1] – "controls") requirements for IT-Security, which will correspond to the evaluation criteria, recognized by all participants in international information cooperation.

The independent evaluation may be imposed on authorized representatives of the various States. For example, with the aim of consolidating the national requirements of the Russian Federation, Belarus and Kazakhstan, the assessment of compliance of ISMS is carried out in accordance with the requirements of international standards ISO 27001 [1 – 4], taken at the national level in each of the States:

A. GOST R ISO/IEC 27001-2006 in the Russian Federation,

B. STB ISO/IEC 27001-2011 in the Republic of Belarus,

C. ST RK ISO/IEC 27001-2008 in the Republic of Kazakhstan.

It is relevant to the question of the necessity of developing a standard methodology and procedure for evaluation of compliance with these requirements ensuring an open and not contrary to the requirements of national regulatory documents of the various States listed above. The aim of this publication is the consideration of the object of evaluation of the information infrastructure of ES as a management system information security (ISMS) and, accordingly, certification of the object in accordance with the requirements of national standards of ISO 27001 in different States. While the challenge of ensuring international confidence in the level of IT-Security on the basis of objective evidence and independent audits. Evaluation of the ISMS conducted according to international recognized standard certification audits by 3rd party, national certification bodies, under the control of the IAF (International accreditation forum).

II. TASK DEFINITION

Consider General requirements for ES that need to be taken into consideration in implementation and successful certification of ISMS. We believe that the modern ES includes technologies designed to ensure the verification of electronic signatures (electronic signature) for electronic documents (ED), maintaining a public key infrastructure (PKI) in a fixed time in respect of the respondents (sender or recipient). The implementation of ES providers are trusted by all parties of information exchange under the agreement (the accession agreement). On the provider side, ES can be performed to implement the following services:

a) Services PKI – key management and certificates, which provides a single space for the documents treatment;

b) Service trusted time that provides the network time Protocol (NTP markers reference time from the global reference;

c) Service and maintenance of object identifiers, which allows us to understand the structures that participate in information exchange;

d) Service of documenting events and information that enables you to support the functions of the audit.

It is recommended that the implementation of complex solutions used in providing security for ES, so that to ensure the properties of availability, integrity, confidentiality, authenticity, validity and suitability for use regardless of any changes (migration) within the software and specific technical solutions. Specification of the technical solutions used in providing security for ES determined by the specific composition and the technical solutions used in the concrete national implementation of [5 – 7].

III. THE ADVANTAGES AND DISADVANTAGES OF CERTIFICATION SCHEMES ES ACCORDING TO THE REQUIREMENTS OF ISO 27001

Description of the advantages and disadvantages of proposed options for assessing the information infrastructure of ES as ISMS in accordance with the requirements of ISO 27001 are shown in table 1. Description of the advantages and disadvantages of the assessment of ES as ISMS

TABLE I. DESCRIPTION OF THE ADVANTAGES AND DISADVANTAGES OF THE ASSESSMENT OF ES AS ISMS

Advantages	Disadvantages
The international standardized procedure of audits of management systems (19011) [12].	The possible complexity of organization of the audit process through the development of a national audit team.
International standard (27001) ISMS requirements, including the list of recommended of measures (tools) information security [2].	The requirement to hold two stages of the audit, including the compulsory audit of the facility ("on-site audit").
Additional certification of ES as it services according to ISO 20000 [13].	Possible problems in implementing national requirements for information security in view of the choice and applications of various means (measures) information security, such as cryptographic means.
Additional certification ES in the area of continuity of business processes in accordance with ISO 22301 [14].	
High standardization of the work at any national level – single plan audits, common audit criteria.	
Accessibility audits for information exchange of various States.	
The certificate of conformity as evidence of objective evaluation of accredited national and international authority (IAF).	
Accessibility periodic monitoring over the quality and timing of independent and objective audit of the ISMS.	
The possibility of independent control not only of the expert assessment of documentation on the audit object, but also the implementation of ISMS control audit at the facility.	

IV. THE IMPLEMENTATION OF CONFORMITY ASSESSMENT INFRASTRUCTURE ES THE REQUIREMENTS OF ISO 27001

The adoption of the object (information infrastructure ES) with defined boundaries ("boundaries"), the certification scope ("scope"), together with the measures (means) - security ("controls"), system documentation ("documented information") as the ISMS implementation and certification under a single and recognized requirements of national regulators – standard ISO 27001 will:

a) To develop and approve a single document that defines requirements for information security, for compliance certification of the ISMS (the scope of certification, area of certification, allowable exceptions, etc.);

b) To develop a plan of audits, including certification of the ISMS for the criteria of the ISO 27001 standard. Developed an audit plan ISMS should detail the procedure for conducting audit of the ISMS (on-site audit"), in particular, control measures (means) of information security;

c) To appoint a group of auditors composed of competent and certified representatives of the various States having the right to perform independent audits according to the criteria of ISO 27001

d) To conduct an audit of 3-rd party (certification) ISMS on conformity to the approved criteria of the ISO 27001 standard according to an agreed audit plan;

e) To submit a report of the group auditors on the review of national bodies with internationally recognized accreditation for the certification of ISMS in accordance with the national standard ISO 27001 and trusted;

f) The certification body issues a certificate of conformity of the ISMS with the requirements of the national standard ISO 27001, which is recognized in various States and in the world (in the framework of the recognition of accreditation of certification bodies in the system IAF).

V. MATHEMATICAL JUSTIFICATION OF THE CHOICE OF THE CERTIFICATION SCHEME ISO 27001 FOR ES

It is necessary to prepare a mathematical justification for the optimal choice the objective of the scheme infrastructure assessment ES for the purpose of providing internationally recognized certification on the basis of ISO 27001. For the planning of this process usually take into account a certain set of IT-Security criteria. It is known that the fundamental difficulty of the choice at many criteria is the inability to a priori determine the best and the only best solution; moreover, a number of studies have been sufficiently addressed the problem of minor (small) changes [15, 16] or small perturbations, which can over time lead to change of meaning with the best solutions, or, in the limit, to disastrous consequences.

It is known that the multi-criteria imply the solution of complex management problems in which feasible solutions are evaluated according to several indicators (or criteria) at the same time [15, 16]. It is known that there is a fundamental difficulty of solving the above problems is the inability to a priori determine the best (optimal) solution from the set of feasible solutions. Note that the best selected solution must meet the expectations of all stakeholders (in the notation of ISO [1] – "stakeholders"), the list of which is countable [17 – 19].

We define the set of numeric functions $f_1, f_2, ..., f_m, m \geqslant 2$, defined on the set of possible solutions X as optimality criteria (objective function).

The vector $f = (f_1, f_2, ..., f_m)$ is called the vector criterion, which takes values in m-dimensional space Rm, called a criterion space or a space assessments.

Vector evaluation of possible solutions $x \in X$ to the vector criterion f is called

$$f(x) = (f_1(x) f_2(x),... f_m(x)) \in Rm \quad (1)$$

All possible vector evaluations form the set of possible evaluations:

$$Y = f(x) = \{y \in Rm \mid y = f(x) \text{ at } x \in X\} \quad (2)$$

All possible select the evaluation form set of selected vectors (estimates):

$$S(Y) = f(S(X)) = \{y \in Y \mid y = f(x) \text{ when } x \in S(X)\} \quad (3)$$

A multi-criteria task (the task of multi-criteria optimization, MCO) is called the selection task that includes many possible values X and vector f-test. Or say that the task of the MCO is to find many solutions to choose C(X) such that $S(X) \subset X$ given the preference relations $\succ$ x on the basis of a given vector criterion f installed in accordance with the objectives (preferences) of decision makers (DM).

It is known that the solution $x^* \in X$ is called Pareto optimal (or Pareto optimal) if there does not exist such a possible solution $x \in X$ for which the following inequality holds $f(x) \geqslant f(x^*)$.

Pareto-optimal solutions form a Pareto set P j (X):

$P_j(X) = \{x^* \in X \mid \text{does not exist such an } x^* \in X \text{ for which } f(x) \geqslant f(x^*)\}$.

It is important that Pareto-optimal solution is a valid solution that cannot be improved on any of the available criteria without degrading other existing criteria. Many Pareto-optimal solutions, lots of compromises, in which the decision maker consciously decides on the selection of a particular "winning" and making the minimum loss on one criterion. The task can be somewhat simplified, if the DM offers some criteria of optimality and then a so-called "areas of interest" decision-maker. But in this case also have to fix the limitations of the dominance of solutions X ($x_1 \succ x \ x_2; \ x_2 \succ x \ X_3;...$) which can lead to the empty set (in the limit).

The General principle Edgeworth-Pareto says – if the DM behaves "reasonably", then choose the solution must be Pareto-optimal [15]. Here "reasonable" behavior of the decision maker involves the execution of two minimal conditions:

a) The implementation axioms of exclusion of the dominant vectors: for any pair of admissible vectors $y_1, y_2 \in Y$ for which y_1 will be executed $\succ y_2$, y_2 is made $\notin C(Y)$

b) The implementation of the Pareto axiom: for all pairs of feasible solutions $x_1, x_2 \in X$, for which executed the inequality $f(x_1) \geq f(x_2)$, then $x_1 \succ X \ x_2$

In the practical aspect it is important to take into consideration an important property of the Pareto set of the non-empty set of Pareto-optimal vectors. This means, for example, that under certain criteria f (e.g., budget, goals, deadlines, and personnel), there is a fundamental choice, for example, the optimal set of measures (means) of information security in the project implementation infrastructure ES for certification as ISMS.

IV. EXAMPLE OF EVALUATION ES AT CERTIFICATION SCHEMES ISO 27001

For example, for the creation of assessment IT-Security criteria to solve the task, namely the creation of internationally recognized assessments of information security infrastructure, ES, may be offered the following criteria:

- f_1 – project cost certification
- f_2 – cost consulting for certification
- f_3 – project duration certification
- f_4 – documentation required for certification
- f_5 – the value of new contracts (international) after certification
- f_6 – the price of the recognition of certificate of conformity
- f_7 – availability of national experts to certify

In [15, 16] noted that the presence of Pareto-optimal vectors by brute force with unlimited dimensions possible vectors is impossible. Accordingly, it requires no special knowledge of the decision maker (which in practice occurs quite often) or the system are necessary and sufficient conditions of Pareto optimality.

In this example, the Pareto optimization are:

- 3 options Y = { y(1), y(2), y(3) };
- 7 criteria (m = 7);
- Quantitative (scoring) scale – 5 points;

In addition, the need to minimize the number of criteria:

- $f_1 \rightarrow f_1 = 5 - f_1$
- $f_2 \rightarrow f_2 = 5 - f_2$
- $f_3 \rightarrow f_3 = 5 - f_3$

Consider specification options:

- y (1) = Certification infrastructure ES as OI (requirements – documents Gostekhkomissii RF);
- y (2) = Certification of ES infrastructure as it systems (requirements – ISO 15408);
- y (3) = Certification infrastructure ES as ISMS (ISO 27001 series).

A detailed analysis of options for all criteria is presented below (see Table. 2):

TABLE II.   THE DETAILED ANALYSIS OF OPTIONS FOR ALL CRITERIA

The vector of estimates	f_1	f_2	f_3	f_4	f_5	f_6	f_7
y_1	2	2	1	1	3	3	3
y_2	2	3	2	1	3	4	3
y_3	2	4	2	2	4	5	5

It is obvious that $y_2 \succ_y y_1$ (due to lower labor, national recognition of the evaluation results of ES as an object of evaluation according to ISO 15408), and that, in turn, $y_3 \succ_y y_2$ (because of more streamlined requirements documentation, the universality of the model for the estimation of ES, availability of technical experts for designing and auditors to assess, as well as a wide national and international recognition of ISO 27001). Thus, the vector y_3 dominates all other vectors (y_2, y_1), which excludes them from the set of Pareto-optimal: $y_1 \notin C(Y)$, $y_2 \notin C(Y)$.

V.   CONCLUSIONS

Performance assessment of the infrastructure of ES as ISMS and the formation of the conclusion with the issuance of a certificate of compliance with ISO 27001 ensures the recognition of the trust in such a certificate for all participants of information exchange and infrastructure user ES in the World.

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Implementation of Information Security and Data Processing Center Protection Standards

Pavel A. Lontsikh [1], Viktoria A. Karaseva [2],
Egor P. Kunakov[3],
National Research Irkutsk State Technical University
Irkutsk,
Russia   [1]palon@list.ru, [2]
golbery@yandex.ru, [3]egor-kunakov@mail.ru

Ilia I. Livshitz[1], Ksenia A. Nikiforova[2]
LLC «Gazinformservice»
Saint Petersburg, Russia
[1] livshitz.il@yandex.ru,
[2] nikiforova.k.a@yandex.ru

Abstract - **The article deals with the issue of information security. The purpose of the research is to analyze information security procedures, development information security systems and implementation of international information security standards. Information security involves both storing and accessing sensitive information and data warehousing. It can be carried out with Data Processing Centers.**

A number of standards were developed to improve efficiency of information security departments. One of them is ISO/IEC 27001. It involves requirements to information security management systems which are obligatory for certification. Along with management elements for computers and networks, ISO/IEC 27001 specifies the issues of security policy development, staff relations.

Processed information security is one of the crucial issues when creating new data processing centers. Accordingly, reliability and fault-tolerance of data centers in the Uptime Institute's Tier Classification System are paid special attention to. Operational Sustainability is an additional characteristics to asses DPC's performance. Advantage of the standard is due to the flexibility of its requirements which enable objective evaluation of DPC's performance at the design stage and comparison of the current performance. Data centers can be awarded with Tier 1 to 4 depending upon the degree of reliability. Tiers is progressive: each Tier incorporates the requirements of all the lower Tiers. The Uptime Institute also developed Tier Standard: Topology and Tier Standard: Operational Sustainability which specify the methods of DPC performance evaluation.

The article analyzes the key points of these standards, their advantages and implementation experience in Russian organizations.

Keywords - *information technologies; information security; data processing centers (DPC); data centers (DC); tier; security; information protection; standard; confidentiality; operational sustainability*

I. INTRODUCTION

At present, databank security, primarily Data Processing Centers (DPCs), is a key issue for producers and consumers of information security services. Information is one of the main business resources which provides additional value for businesses and needs to be protected. Information security vulnerabilities may result in financial losses and damage to market transactions. So information security system development and implementation is a strategic issue for any organization.

II. THEORY

Literature on the issue under study

Analiz sovremennyh trendov po sertifikacii sistem menedzhmenta informacionnoj bezopasnosti po trebovanijam ISO 27001 [Analysis of modern trends in information security management system ISO 27001 certification]. Bulletin of Irkutsk State Technical University. 2015. Vol. 3 (98)

Sistema upravlenija informacionnoj bezopasnost'ju v sootvetstvii s ISO/IEC 27001 [Information security management system in compliance with ISO/IEC 27001]. Information Security. 2007. Vol. 4.

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Data and Methods

The paper aims to find information security vulnerabilities in data centers, analyze international standards which comply with information security management requirements, as well as to study information security procedures and information security systems. It also deals with implementation of

international information security standards and use of DPC establishment and maintenance standards.

III. RESULTS

ISO/IEC 27001:2013 "Information technologies – Methods of information security – Information security management systems – Requirements"[1] was developed by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) based on the BS 7799 standard. This standard is an addition to the ISO/IES 17799:2005 standard "Information technologies – Security methods – Practical rules for information security management" [1-8].

ISO 27001 defines information security as a preservation of information confidentiality, integrity and availability; in addition, other properties, such as authenticity, accountability, non-repudiation, and reliability can also be involved [2].

Confidentiality means that information is not made available or disclosed to unauthorized individuals, entities, or processes;

Integrity means accuracy and completeness of data and data processing methods;

Availability means that information is accessible and usable upon demand by an authorized entity.

ISO/IEC 27001:2013 defines the requirements to the information security management system which are mandatory for certification. ISO/IEC 17799:2005 is an implementation guide utilized by organizations when designing control tools to reduce information security risks [3-4].

ISO 27001 assists businesses in setting up, improving, controlling and maintaining the efficient information security management system; specifies the requirements for establishing, implementing, maintaining, monitoring, analyzing, and improving an information security management system within the context of existing business risks.

An ISO 27001 information security management system helps organizations:
A. Make information clear for the staff;
B. Find security vulnerabilities;
C. Calculate risks and select solutions in compliance with business objectives;
D. Provide efficient system management in emergencies;
E. Find and eliminate information security vulnerabilities;
F. Clearly identify personal responsibilities;
G. Reduce and optimize security system support costs;
H. Facilitate integration of the security subsystem into business processes and integration with ISO 9001:2015;
I. Show adherence to information security policies;
J. Gain international recognition and strengthen company's credibility;

K. Emphasize transparency and law-obedience [3-8].

In addition to management elements for computers and computer networks, ISO 27001 deals with security policy development, staff management (recruitment, training, and dismissal), continuity of manufacturing processes, legal requirements [7].

ISO 27001 requirements are of general nature and can be used by organizations of different types, sizes and fields (finances, telecommunications, transport, utilities, government, etc.).

ISO 27001 is in keeping with ISO 9001:2015 [2] and ISO 14001:2015[3]. It is in compliance with basic management system principles. Mandatory implementation procedures are relevant both for ISO 9001 and ISO 27001. An ISO 27001-compliant documentation structure is similar to the ISO 9001-compliant one. Many documents required by ISO 27001 have been already developed and used within the framework of ISO 9001 when implementing the integrated management system. Thus, if an organization has already implemented ISO 9001 or ISO 14001 compliant management systems, it is more preferable to comply with ISO 27001 requirements within the existing systems.

ISO 27001 compliant implementation and certification based on an ISO 9001 compliant quality management system help reduce company's internal costs as well as implementation and certification costs.

The regulatory information security management system certification must comply with ISO/IEC 27001:2013. Standard compliance certification is a signal for business partners, investors and customers that the company has efficient information security management [3-4].

ISO 27001 enables:
A. Identification of objectives and principles of information security;
B. Identification of approaches to business risk assessment and management;
C. Information security management in compliance with applicable legal acts and regulatory requirements;
D. Development of the unified approach for establishing, implementing, maintaining, monitoring, supporting, and improving management system in order to achieve information security management objectives;
E. Identification of information security management system processes;
F. Specification of information security measures;
G. Internal and outside auditing to determine information security management system compliance with standard requirements;
H. Delivery of data on information security policies to business partners and other parties concerned.

[1] ISO/IES 17799:2005 Information technology - Security techniques - Code of practice for information security management, 2005. – 125 p.

[2] ISO 9001:2015 Quality management systems - Requirements, 2015. – 29 p.
[3] ISO 14001:2015 Environmental management systems -- Requirements with guidance for use, 2015. – 38 p

One of the advantages of ISO/IEC 27001 is a direct benefit for organizations aiming to simultaneously implement more than one management system. The information security system can be integrated with:

A. Business continuity management system (ISO/IEC 22301)4;
B. IT services management system (ISO/IEC 20000-1)5;
C. Quality management system (ISO 9001). [5-6-7]

The similar structure of standards saves time and other resources due to implementation of integrated policies and procedures.

Companies awarded with ISO/IEC 27001:2013 certifications

Table 1 shows the number of Russian companies awarded with ISO/IEC 27001:2013 certifications [6] as at the start of 2015.

TABLE 1 RUSSIAN COMPANIES AWARDED WITH ISO/IEC 27001:2013 CERTIFICATIONS

№	Organization	Certificate number	Certification body
1	CMA Small Systems AB	IS 97256	BSI (British standards institute)
2	CROC incorporated, CSC	IS 95689	
3	LANIT, CSC	IS 516523	
4	Lukoil-Inform, LLC	IS 502464	
5	Multiregional TransitTelecom, OJSC	IS 512669	
6	Rosno, SC	IS 515437	
7	Rutenia, JSC	IS 517942	
8	M-City	IS 534629	
9	CBI	IS 537968	
10	ICL KME, JSC (GDS Fujitsu-Siemens)	IS 539248	
11	CB, Renaissance Capital	IS 540477	
12	Metalloinvest Managing Company, LLC	IS 541109	
13	ONLANTA	IS 551873	
14	Luxsoft, Moscow	LRQ4002352	LRQA
15	Bank24.ru, Ekaterinburg	231663	Bureau Veritas Certification
16	TransTeleCom	HU08/3058	SGS

Table 1 shows that the majority of the organizations are large companies.

IV. TIER CERTIFICATIONS. CLASSIFICATION SYSTEM

Uptime Institute was founded in 1993 as an independent, vendor-neutral organization aimed to enhance the data center efficiency and performance through the fruitful collaboration of experts and end users, researches, implementation and further application of innovations. At present, Site Uptime Network involves more than 100 members, the majority of which rank among Top 100 of the largest companies by Forbes magazine. Each member owns data centers with a capacity of 6 MW and area of 4,645 m². At annual closed conferences and symposia, they share experience by presenting recent developments of the Uptime Institute's research group in DC design, maintenance, and classification. Among Uptime Institute's developments, there are a lot of top ranked industrial standards: the concepts of hot/cold aisles, dual redundancy, and Tier Classification System.[7]

Information is a valuable and liquid resource of any company. So DC reliability and fault-tolerance (these two parameters are determined by Tier Classification System) are of acute importance. "Tier Classification System certifies that a DPC has been designed in such a way that its uptime meets business requirements", Julian Kudritzky, COO of Uptime Institute says. The system is universal. This property enables effectively evaluate the performance when designing new DPCs and compare the existing ones. Due to clearly defined engineering evaluation criteria and a meaningful scale, the system can be used both by experts and end users. The certifications are awarded in four levels. The higher Tier, the greater the availability and long-term uptime. To determine redundancy level, such factors as raised floor height, watts per square meter, annual down time etc. must also be taken into account [9-12].

For the first time, the standard considers human factors in DPC operations. This parameter is very significant: about 70 % of errors in data center operations are due to human factors, and only 40 % of errors are operation service errors. Staff development and mature staff policy enable minimize such errors. [15]

Operational Sustainability (Bronze, Silver, and Gold) is an additional property which has been used to evaluate the DC uptime performance since 2010. It ensures that the system maintenance meets Tier requirements for system availability over the long-term. Tier IV Gold DC is ideal in terms of reliability and fault-tolerance, but not in terms of financing. Tier III DC construction costs are twice as much as Tier I DC construction costs. [12]

Uptime Institute Professional Services is a consulting department of the Uptime Institute consortium which is licensed to certify data center projects according to the terms of Uptime Institute Tier classification. It aims to optimize customers' costs. A company can get the most out of Tier Certification only if projecting DC costs are more than $ 100 mln. [14]

Uptime Institute created the standard Tier classification system to evaluate data center infrastructure in terms of business' requirements for system availability.

[4] ISO / IEC 22301:2012 Business continuity, 2012. – 35 p.

[5] ГОСТ Р ИСО/МЭК 20000-1-2013 Information technology. Management of services. Requirements to a management system services, 2012. – 28 p.

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[7] Tier Standard: Operational Sustainability. [Digital resource]. URL:https://ru.uptimeinstitute.com/tiers (date of the address: 02.05.2016).

The standard Tier classification system provides the DC industry with a reliable method to compare unique facilities based on the expected site infrastructure performance. In addition, Tiers allows companies to align their DC infrastructure investments with business goals specific to growth and technological strategies.

The DC Site Infrastructure Tier Standard: Topology defines the requirements and benefits of four Tier classifications. Each Tier aligns with a specific business function and sets the appropriate criteria for electric power, cooling, maintenance, and operational safety. Tiers is progressive; each Tier incorporates the requirements of all the lower Tiers. In addition, Tiers has been demonstrated as a meaningful industry-specific standard because Tiers allows a lot of solutions allowing the system flexibility, helps achieve the expected performance goals and meet local codes and regulations. Tiers encourages innovative engineering solutions and recognizes that all data centers are not alike and do not need to be. [10-11-15]

Tier I and Tier II standards are tactical solutions: first costs and time- to- market are more important than life cycle costs and performance requirements. A substantial part of revenues of organizations selecting Tier I and Tier II solutions does not depend on real-time delivery of products or services. As a rule, these organizations are protected from any damages stemming from lack of system availability. [13]

Rigorous uptime requirements and lack of system availability are the reason for selecting strategic solutions found in Tier III and Tier IV of site infrastructure. The solutions found in Tier III and Tier IV have an effective life beyond the current IT requirement, and are typically used by organizations that know the cost of a disruption —in terms of actual dollars—and the impact to market share and continued mission imperatives. [13]

Topology is the DPC infrastructure and operational sustainability is the DPC management, but both are required to achieve objectives. Operational Sustainability can be defined as the behaviors and risks beyond the topology of engineering systems that impact the ability of a DPC to meet its objectives or mission imperatives over the long term.

The Tier Standard: Operational Sustainability is an objective methodology for DPC owners to align the facility management program with the specific Tier of installed site infrastructure in order to achieve the organization's objectives or perform business tasks.

Tier Standard: Operational Sustainability defines the behaviors and risks beyond the Tier Classification System (I, II, III, and IV) that impact long-term DC performance. Tier Standard: Operational Sustainability unifies site management behaviors with the functionality of the site infrastructure. [12]

Uptime Institute Tier Standard: Topology and Tier Standard: Operational Sustainability are consistent systems of performance criteria that can be satisfied, and adjudicated, worldwide. For the DC design, implementation, and sustained operation to be successful, extra factors should also be taken into account by the owner and project team. Many of these factors depend on the site location as well as local, national, or regional peculiarities and/or regulations. For example, building codes, seismic data, extreme weather conditions (high winds, tornado), flooding; adjacent property uses, union or other organized labor force, and/or physical security.

Due to many design and management options which may be dictated by the owner, regulated by local governments, recommended by industry groups, or followed as general practice, it is impossible for Tier Standard: Topology and Tier Standard: Operational Sustainability to establish criteria for these extra factors and worldwide. The Uptime Institute does not wish to confuse the recommendations of local experts which are key for timely project delivery, regulatory compliance, and implementation of best practices.[8]

The Uptime Institute recommends that the project team create a comprehensive list of project requirements which involves Tier Standard: Topology, Tier Standard: Operational Sustainability and elaborated mitigation measures of these extra factors. This approach will ensure the project meets the compliance objectives of Uptime Institute's international standards and local constraints and owner's business case [13].

Companies awarded with Tier certifications

Table 2 shows the Russian companies awarded with Tier certifications as at the start of 2015.

TABLE 2 THE RUSSIAN COMPANIES AWARDED WITH TIER CERTIFICATIONS.

Company	Name of DPC	Location DPC	Certification on the standard Tier
CROC Incorporated	Kompressor Data Center	Moscow, Russia	Tier III Gold Certification of Operational Sustainability Tier III Certification of Constructed Facility Tier III Certification of Design Documents
DataSpace	DataSpace 1 Moscow Data Center	Moscow, Russia	Tier III Gold Certification of Operational Sustainability Tier III Certification of Constructed Facility Tier III Certification of Design Documents
Sberbank	Mega Data Center 1	Russia	Tier III Certification of Constructed Facility Tier III Certification of

[8] Tier Standard: Topology. [Digital resource]. URL: https://ru.uptimeinstitute.com/tiers (date of the address: 04.04.2016).

			Design Documents
Mordovia Republic	Technopark-Mordovia Data Center	Saransk, Mordovia, Russia	Tier IV Certification of Design Documents
VTB Bank	Perovo Data Center	Moscow, Russia	Tier III Certification of Design Documents
DataLine	Nord-4 Data Center	Moscow, Russia	Tier III Certification of Design Documents
GDC ENERGY GROUP LLC.	Green Bush DC	Moscow, Russia	Tier III Certification of Design Documents
Federal Tax Service of Russia	Reserve Data Processing Center	Gorodetz, Nizhny, Novgorod, Russia	Tier III Certification of Design Documents
AiEmTi	CloudDC Moscow1	Moscow, Russia	Tier III Certification of Design Documents
DataPro LLC	DataPro Moscow	Moscow, Russia	Tier III Certification of Design Documents
OJSC VimpelCom	1Yaroslavl Technical Center	Yaroslavl, Central Federal District, Russia	Tier III Certification of Design Documents
Goznak	Moscow Printing Works DC	Moscow, Russia	Tier III Certification of Design Documents
Federal Tax Service of Russia	Federal Data Processing Center	Dubna, Russia	Tier III Certification of Design Documents
JSC Technology & Innovation Center	Technical Center "Zhiguli Valley"	Samara, Russia	Tier III Certification of Design Documents
DataPro LLC	DataPro Tver	Tver, Russia	Tier III Certification of Design Documents
Rostelecom	M1	Moscow, Russia	Tier III Certification of Design Documents
MegaFon	Samara Data Center	Sumara, Russia	Tier III Certification of Design Documents
High Technology Technopark IT-Park	High Technology Technopark IT-Park Data Center	Kazan, Russia	Tier III Certification of Design Documents

*It is made by authors

As can be seen, the majority of the organizations are the leading Russian telecommunications companies. Some companies are awarded with Tier 1 to 4 certifications.

V. CONCLUSIONS

At present, information security is a relevant issue. Any organization deals with information acquisition and transfer. Loss of data causes serious damage to organizations.

Organizational measures based on regulatory requirements are an efficient method and tool of human activities regulation.

The paper describes only a few information security and reliability growth standards.

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Quality and Competitiveness Improvement of NPP Safety Systems

Elena V. Plakhotnikova

Polytechnical Institute, Department of Tool-Associated and Metrological Systems

Tula State University

Tula, Russia

e_plahotnikova@mail.ru

Abstract— **The article deals with the issue of quality and competitiveness of "electric drive – stop valves" systems. The main reasons for the decline of systems' competitiveness are given. The stiffness of the mechanical part of the system is suggested as a new control parameter. When designing it allows to increase competitive advantage of national systems provided that general requirements of NPP safety are satisfied.**

Keywords— quality, competitiveness, electric drive, stop valves, nuclear power plant, safety, reliability, import substitution

I. INTRODUCTION

NPP safe operation is largely determined by reliability of operate equipment where pipeline valves are considered as one of the main elements.

Tightness, reliability and safety are basic quality indicators of pipeline valves that ensure its functioning under conditions of high temperatures, pressure and hostile environment. The priority of valves for NPP, among other indicators, is its high speed defining the overlap time of the pipeline in case of an emergency situation. To ensure the required velocity the stop valve control is realized by high-speed electric drives.

The characteristic data that define the possibility of functional combination of the electric drive and stop valves in the system are power parameters, such as torque and efforts, the values of which are registered in standard specification and data sheet.

The existing system of design is based on traditional techniques of static power calculation, which are presented in Standard of Central Design Bureau of Valve Construction (CKBA) 002-2003 "Pipeline fittings. Gate valves. The technique of power calculation" and in reference works intended primarily for manual valves calculation [2, 4]. The technical combination of stop valves with high-speed electric drives under the existing system of design leads to mismatching of "electric drive – stop valves" systems according to actual and standardized (rated) power parameters (efforts and torque).

The specified mismatch causes the fundamental loading in stop valves from the electric drive that increases the risk of non-serviceable condition of the system.

This article provides an overview of the existing approaches to solving the problem of quality improvement under conditions of the raised load by speeding-up of "electric drive – stop valves" systems. Moreover, a new control parameter is offered which allows to increase competitive advantage of national systems provided that general requirements of NPP safety are satisfied.

II. QUALITY AND COMPETITIVENESS IMPROVEMENT OF "ELECTRIC DRIVE – STOP VALVES" SYSTEMS

The quality assurance problem under conditions of the raised load with increasing velocity of "electric drive – stop valves" systems is currently solved by means of upgrading of each separate item of the system. The stiffness of stop valves is increased to ensure their demand reliability. Positioning accuracy of the electric drive is provided with control system upgrading. The delay time of control system operation within the operating object is decreased by retrofit installation. In addition to ways of dissipation of excess energy stored in the system, add-on damping devices that decrease both load and power efficiency of systems are used.

All specified techniques directed primarily to quality improvement raise the total price of production. However, the products to be purchased at higher price, it is necessary that the improvement of production to lead to increase in economic benefits of demand [1].The reverse situation is observed in consequence of the lack of common strategy of integrated quality assurance of the electric drive and stop valves as uniform system components. End product value of "electric drive – stop valves" system increases, at the same time rise in price is connected with need to ensure a basic level of object's quality and safety, rather than with intention to increase product value for the consumer.

It should be noted that not only the price of systems increases, but also their dimensions, weights and power specifications. It leads to decline in competitiveness of domestic production interfering with implementation of the priority direction,that is the development of Russia's economy regarding import substitution.

The comparative analysis of systems of different types of producers allowed to reveal that in some cases foreign and home producers use electric drives of various power for control of completely identical stop valves. For example, the bellows-sealed stop valve (nominal diameter DN 100 mm, nominal pressure PN 11 MPa, temperature 300°C) is completed by western producers with the electric drive with torque limiting coupling 200-500 N·m and the motor power 1,5 kW. Home producers use for control of similar stop valves the electric drive with torque limiting coupling 400-1000 N·m

and the motor power 3 kW [6]. The cost of used electric drives, for example, differs more than 30% that is certainly an added advantage in favor of western producers.

As a result, despite continuous actions of all producers interested in quality improvement there is no raise of technological level and no competitiveness with cost increase of the product. That is activities for quality improvement of separate system components (electric drive, stop valves and control system) yield no results [5].

The described situation shows that home producers miss the opportunity when it is necessary to start new production output or to stop investing in quality improvement and limit themselves to comply with criterion of performance [3].

It becomes obvious that the problem of quality improvement of "electric drive – stop valves" systems should be comprehensive:

- a fresh approach to the basic design of the system is required;

- instead of the adapted techniques intended for manual valves the development of techniques of stop valves' power calculation operated by the electric drive is needed;

- new parameters of the system are necessary. Their control will make quantum leap towards the raise of domestic production competitiveness possible.

Findings of investigations [7, 8] allow to state that one of such control parameters, which is not currently used in design works, is the stiffness of the mechanical part of the system. The stiffness in the design makes it possible:

- to ensure effective and functional compatibility of the electric drive and stop valves in the system;

- to minimize the danger of overload that impacts on reliability and safety of the objects operating the systems;

- to solve a variety of engineering problems aimed to improve the quality and competitiveness of the considered systems.

One of the problems is power reduction of the electric drive at rated requirements to tightness of stop valves.

The results of the experiment carried out at artificial reduction of system's stiffness [7] allowed to reveal a 10 – 15% increase of the share of the energy perceived in the system by means of variation of the specified parameter and decrease of excess voltage in the system which causes the premature non-serviceable condition of the considered systems.

The power characteristics in high-speed systems subject to the stiffness parameter allowed to prove the power reduction of the electric drive from 1,5 to 0,75 kW [9]. At the same time, the following qualitative characteristics of the system were guaranteed: weight reduction by 27 kg, cost reduction of the system in the offered complete set by 22% (economic benefits made up 13000 RUB per product) with operating time reduction twice. Serviceable condition of systems with lower power characteristics is confirmed in the course of testing over the period of the specified service life (3000 cycles).

In this case, the integrity of the object was ensured by compliance with basic requirements imposed to technical systems, that is technical compatibility of components in the system. However, at the same time, new operating parameter, such as stiffness of the mechanical part of the system, was introduced in addition to conventional for producers dimensional and functional compatibility of components and the most important for consumers compliance with the requirements of reliability and safety indicators.

III. CONCLUSIONS

These findings allow to conclude that the stiffness of the mechanical part of "electric drive – stop valves" high-speed systems is the most essential of all previously used.

It opens up the possibility for breakthrough and competitive advantage provided the interaction of producers when designing is directed to solution of the single task, that is import substitution.

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Game-Theoretic Algorithmization Context of a Risk-Management

Valery G. Semin
Russian State Social University
Moscow, Russia
semin_valeriy@mail.ru

Evgeny R. Khakimullin
Academy of State Fire Service of EMERCOM of Russia
Moscow, Russia
evgeni.hakimullin@mail.ru

Abstract— **formulation problem of algorithmization process of risk management using a conceptual model of risk management, reflecting the basic concepts of the semantic domain**

Keywords— risk; risk management; system; management; structure; threat

I. INTRODUCTION

Currently, the development of risk management system (RMS) is a prerequisite for business approach, providing the creation of long term shareholder value. Such a condition is to use the opportunities and manage the risks arising from internal and external economic, environmental and social developments.

However, the development and implementation of risk management systems (RMS) for the purpose of continuous improvement of corporate risk management is conducted in accordance with the recommendations of existing international standards (GOST R ISO 9001-2008, GOST R IEC 61508-5-2007). The aim of this work is the formalization of the approach to the construction of RMS based on game-theoretic representations of context - the definition of internal and external parameters that must be taken into account in risk management.

II. METHODOLOGY

It is known that the risk - this is the effect exerted by the uncertainty on the goals of the organization, which is described by the combination of features (probability) of occurrence of uncertain events and its possible consequences.

As a general rule, to assess risks - R used -F functional linking the likelihood of the risk - P and expectation damages - U this adverse event.

$$R = F_R\{U,P\} = \sum_i \left[F_{R_i}(U_i, P_i) \right] = \int C(U)P(U)dU = \int C(P)U(P)dP$$

Where

- i - types of adverse events;
- C - weighting functions, taking into account mutual risks.

The main objectives of the RMS increase the probability of occurrence and the impact of favorable developments and to reduce the likelihood and adverse effects. By the central stages of the risk management process should include the identification of risks, calculation of the maximum possible damage, production of protective measures. At the stage of identification is necessary to clarify the fundamental possibility of the existence of resources threats organizations. Threat source can be both internal and external. At the stage of determining the consequences of risk is to build scenarios for future development and evaluation. The construction of such scenarios, often quite complex, require consideration of the mutual influence of a sufficiently large number of factors. Therefore, threat modeling framework (forecast) should be the main tool for risk management organization.

For the formulation of the problem algorithmization context of risk management using a conceptual model of risk management, reflecting the basic concepts of the semantic domain and shown in Fig. 1[7, 8].
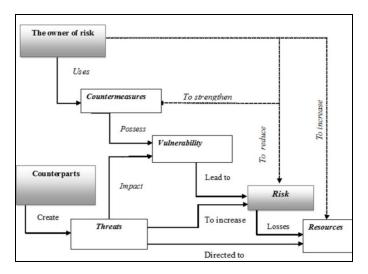
Fig. 1. Conceptual model of the risk management process

Consider the basic model elements and their definitions:
- the owner of risk - decision maker, responsible for risk management, pursuing the goal of maintaining the organization's resources;
- counterparts- uncertainties of external and internal environment of the organization, influencing the decision-making process;

- countermeasure -•measures to counter the risks;
- threat - a set of factors and conditions arising in the process of interaction with the organization of other internal and external systems and components, potentially able to have a negative impact on the result and purpose of the organization;
- vulnerability - inherent features of the organization, influencing the probability of the threat;
- risk - a potential state, which characterizes any damages corporate resources as a result of threats.

It should be noted that in terms of this model of operations research can be interpreted as a schematic description of an elementary operation to select one party (the owner of resources), spending operation, from a variety of strategies for the conservation of resources at minimum cost.

The effectiveness of an operation depends not only on the choice of the parties carrying out the operation, but also on the implementation of uncertain events, due to the influence of external and internal organization of the media. In the absence of knowledge about the probability measure on the set of uncertain factors you need to select a risk management strategy that maximizes the chosen criterion of effectiveness of the operation at the least favorable behavior undefined factors.

Let the operation identified with the choice of strategy x belonging to the set of admissible strategies X and let there be a predetermined criterion of effectiveness of the operation, which also depends on Y- uncertain factors that have a random nature.

As a rule, the formalization of the decision-making process, decision maker (DM) has the ability to select only the part of the vector of coordinates $(x, y,... , t)$ consisting of $x=(x_1, ..., x_n)$ and $y=(y_1,..., y_m)$. It is required to choose such strategy, that the criterion of efficiency of operation $K(x_1,...,x_n,y_1,...y_m)$ had the maximal value.

Areas of variation of vectors x and y essence X, Y accordingly. In this case, assume that any value uncertain factors can actually be realized and the choice of strategy take into account the least favorable value of uncertain factors. The strategy chosen so that at the least favorable value of uncertain factors of the internal environment of the objective function value is maximized. This approach leads to the selection of strategy in accordance with the criterion [4.9]

$$min_x max_y K(X,Y) \qquad (1)$$

Decision-makers and the effect of uncertain factors will be called the first and second players, respectively, the function $K(x, y)$ - payment function game. Value of payment function at a choice the first player of strategy x, and the second player of strategy y, we shall name a prize of the first player. The first player tries to maximize his winnings. The value of $-K(x, y)$ define the gain of the second player. In this case, set the game for persons with conflicting interests (antagonistic game). Let x and y vectors n- and m-dimensional Euclidean spaces; X and Y closed bounded set of n- and m-dimensional Euclidean

spaces respectively. In this case, all the points of these spaces can be ordered lexicographically and renumber them so that $K(x, y)$ enters the function $K(i,j)$, $i = 1,..., r$; $j= 1,..., r$, and then we will consider function of two arguments and end the game with a payment function $K(i,j)$.

It is known that for a finite games $max\ min\ K(i, j) \le min\ max\ K(i, j)$ with the ultimate game has a saddle point, there exist pure strategies i_0, j_0 and a constant w for which $K(i_0, j_0) = max\ min\ K(i, j) \le min\ max\ K(i, j)$, where $w = K(i_0, j_0)$. This result holds for finite zero-sum games in mixed strategies. The task of finding a solution ultimate zero-sum game can be reduced to the solution of linear programming problem.

Let the given task $\min_{w,y} w$;

$$\sum_{j=1}^{m} K(i,j)y_j \le w, i=1,...,n; y_j \ge 0; \sum_{j=1}^{m} y_j, j=1,...,m. \qquad (2)$$

Let's fix a vector $y = (y_1,...,y_m)$. satisfying to restriction (2) when

$$\min_w w = \max_{1<i<n} \sum_{j=1}^{m} K(i,j)y_j;$$

$$\sum_{j=1}^{m} K(i,j)y_j \le w, i=1,...,n,$$

or

$$\min_{w,y} w;$$

$$\sum_{j=1}^{m} K(i,j)y_j \le w; y_j \ge 0; \sum_{j=1}^{m} y_j = 1, j=1,...,m; y = (y_1,...,y_m). \qquad (3)$$

As a result of the decision task (3) get value games and optimal mixed strategy of the second player $y^* = (y_1^*,...,y_m^*)$. To determine the optimal strategy for the first player need to solve the problem

$$\max_{x,w} w;$$

$$\sum_{i=1}^{n} K(i,j)x_i \ge w; x_i \ge 0; \sum_{i=1}^{n} x_i = 1; i=1,...,n, j=1,...,m. \qquad (4)$$

Tasks (3) and (4) are the dual problems of linear programming.

Consider the possibility of numerical solving the problems (3) and (4) using the conceptual framework of the risk management process, which reflects the basic relationship between its elements, in the form of the following sets [7].

Let the following notation:

- $T = \{T_i\}, i = (1,..., I)$- set of threats;
- $R = \{\langle E_j, Q_j \rangle\}, j = (1,...,J)$ - set of risks, where E_j- event of risk Q_j - size of damage;

- $U = \{U_d\}$, $d=(1,...,D)$ - multiple vulnerabilities - conditions conducive to the implementation of the threats;
- $S = \{S_k\}$, $k=(1,...,K)$ many sources of negative influences (threats);
- $O = \{O_b\}$, $b=(1,...,B)$ set of objects influences;
- $Z = \{\langle F_n, C_n \rangle\}$, $n=(1,...,N)$ - set of measures aimed at minimizing risks, where F_n - implemented function, C_n - the cost of measures to counter the negative influences.

For the given sets we shall generate structure by the task of following attitudes:

- $O \times R \xrightarrow{f_1} A$, where A is a set of numbers from 0 to 1, determine the degree of conditionality of risks there is a set of objects;
- $S \times T \times O \xrightarrow{f_2} V$, where V-set of numbers from 0 to 1, determine the degree of criticality of the impact of negative factors;
- $T \times U \times R \xrightarrow{f_3} P$, P- where a plurality of pairs of numbers $\langle P^{(E)}, P^{(Q)} \rangle$, that determine the potential risk - the degree of marketability of risk events if there are many negative influences and a variety of corporate vulnerabilities, such that $0 \le P^{(E)} \le 1, P^{(Q)} \ge 0$.
- $Z \times U \xrightarrow{f_4} M$, where M is the set of numbers from 0 to 1, determine the degree of accessibility of application vulnerabilities in a variety of ways to counter.

To develop a formal structure of an effective algorithm for the optimal choice, the required set of methods to minimize the effects of risk events on the criterion of form [6]:

$$\min_Z \max_T P_\Sigma \qquad (5)$$

$$P_\Sigma = \{\langle P_\Sigma^{(E)}, P_\Sigma^{(Q)} \rangle\} \qquad (6)$$

where

P_Σ - consolidated risk taking into account the risks involved in all the activities of the corporation; $P_\Sigma^{(E)}$ is the degree of marketability risk event; $P_\Sigma^{(Q)}$ - consolidated damage Corporation.

Methods for solving the minimax problem (5) depend on the type of the constituent elements of the pair $\langle P_\Sigma^{(E)}, P_\Sigma^{(Q)} \rangle$, as well as the requirements to the quality and type of optimization problem.

To address the risk assessment tasks necessary to implement the step threats structure modeling based on typed threats structures-trees. One embodiment of such structures is shown in Fig. 2. In the root of the tree T_0 placed threat correlated with a set of components threats, forming tree leaves T_i.
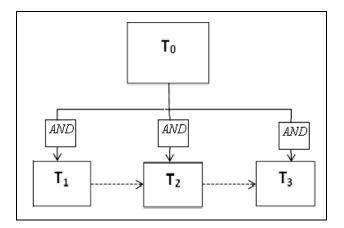
Fig.2. Example of treat- aggregation tree

The threat T_0 is realized only when implemented by a sequence of threats T_i.

Combining a number of trees leads to the formation of the structure G, having a partial order of properties that define how network threats $R = \bigcup_{i=1}^{M} T_i, i \in N$.

It should be noted that structural abstraction viewed directly involved procedural abstractions are widely used in various processes of programming technology. The task of identifying and calculating risks requires the determination of the system of indicators for the assessment of these risks and the relevant models and methods for the calculation of these indicators. So in order to specification f_1 introduces the concept of criticality risk indicator object that defines how this risk can be associated with exposure to a particular element. For the specification f_2 introduced the concept of criticality index impact of negative factors on the set O. In order specifications f_3 introduced the concept of the index of criticality vulnerability single risk potential and the potential systemic risk. In order specification f_4 introduces the concept of vulnerability in terms of application availability activities and means of influence.

The degree of marketability risk event is determined by the maximum degree of feasibility of a risk event among all possible risk events:

$$P_\Sigma^{(E)} = \max_j P_j^{(E)}, \qquad (7)$$

where $P_j^{(E)}$ - the degree of marketability j-risk events.

Consolidated damage is defined as the aggregate amount of the potential j-damages associated risks in all indices j:

$$P_\Sigma^{(Q)} = \sum_{j=1}^{J} P_j^{(Q)} \qquad (8)$$

where $P_j^{(Q)}$ - j-potential damage risk.

The degree of feasibility of the j- risk event is a functional of the form:

$$P_j^{(E)} = P^{(E)}(T, R, U, S, O, Z) \qquad (9)$$

Potential j-damage risk is a functional of the form:

$$P_j^{(Q)} = P^{(Q)}(T, R, U, S, O, Z). \qquad (10)$$

Consequently, the consolidated risk is defined as a pair - $\left\langle P_\Sigma^{(E)}, P_\Sigma^{(Q)} \right\rangle$ where the relevant elements of the pair are determined by the formulas (7) and (8).

Subject to set the values of parameters *T, R, U, S, O, Z* and mappings $f_a, a = 1,2,3,4$ in the form of the corresponding sets of discrete values, fully describe the set of functional definition of (9) and (10) the solution of the optimization problem (5) can be considered as a game of the payment matrix $P_\Sigma^{I \times N}$, where the elements of the matrix are determined according to the following rule $p_{i,n} = \left\langle P_\Sigma^{(E)}, P_\Sigma^{(Q)} \right\rangle_{i,n}$.

On account of the decomposition of the original problem, we have two problems with the performance criteria $P_\Sigma^{(E)}$ and $P_\Sigma^{(Q)}$ respectively.

In this matrix game can be reduced to a pair of dual linear programming problems, because in this case are considered antagonistic games of chance, then the solution is sufficient to consider one of the dual games.

To minimize the problem of linear programming is introduced the corresponding game Boolean vector $X = (x_1, ..., x_N), x_n \in \{0,1\}$, which describes the optimal from the point of view of criterion (5) decision. Coordinate x_n takes a value equal to 1 if to counteract the non-empty set of threats $\{X_i\}$ function is used to counter F_n with C_n price, i.e. given pair $\left\langle F_n, C_n \right\rangle \in Y$, and 0 - otherwise.

In the work, subject to the specifications $f_a, a = 1,2,3,4$ of the problem solution is obtained by reducing (4) to the problem of integer linear programming.

In accordance with the definition of the degree of availability vulnerability is calculated as follows:

$$M_d = (1 - Y_{dn}) \times X_n$$

where

M_d - the degree of feasibility *d*-vulnerability;

Y_{dn} degree of efficiency *n*-function counter existing threats by exposing the vulnerability;

$X_n = \{1,0\}$ - vector decision in which: *1* corresponds to the realization of the *n*-ways to counter; *0*- in otherwise.

It is necessary to find such $X_n, (n=1,...,N)$, to achieve:

$$\min_{1 \le n \le N} \max_{1 \le i \le I} P_\Sigma$$

with restrictions:

$$p_j^E \le P_{j_{max}}^E, \text{ where } P_{j_{max}}^E \text{ – the maximum allowable}$$
$$\text{risk of realization;}$$

$$P_\Sigma^{(Q)} \le P_{\Sigma_{max}}^Q, \text{ where } P_{\Sigma_{max}}^Q \text{ – the maximum damage in}$$
$$\text{the implementation of the risk;}$$

$$\sum_{n=1}^N X_n C_n \le C_{max},$$

where

C_{max} – the maximum permissible value of the means to counter the risks.

As part of this statement M_d as a vector in n

$$M_d = (1 - Y_{dn}) \times X_n$$

Revealing the consolidated risk, we obtain the expression:

$$\min_{1 \le n \le N} \left[(\max V_{ikb}) \times (\max_{b,j} A_{bj}) \times (\max(1 - Y_{dn}) \times X_n) \right]. \quad (11)$$

Similarly conducted substitution and disclosure of formulas for the second criterion of effectiveness:

$$\min_{1 \le n \le N} \left[\sum_{j=1}^J (V^{max} \times A_j^{max} \times Q_j) \times (\max_d (1 - Y_{dn}) \times X_n) \right]. \quad (12)$$

where

V^{max} - index of criticality threat;

A_j^{max} - index of criticality with respect to *j*-risk;

Q_j - is the magnitude of the damage with respect to *j*-risk.

III. RESULTS

Thus, the solution to the problem of game-theoretic algorithmization context of risk management have allowed to develop generic algorithm risk management system, which has the properties of invariance in relation to objects and areas of applications [1-3,8,9].

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A Process Model of Risk Management in the System of Management of Strategic Sustainability of Cargo Motor Transport Enterprises

Valery G. Semin[1], Svetlana V. Grigoreva[2],
Tatiana V. Dmitrieva[3]
Faculty of Information Technology and TechnosphereSsafety
Russian State Social University
Moscow, Russia
[1]SeminVG@rgsu.net, [2]Grigorevasv@rgsu.net,
[3]Tatiana V. Dmitrieva

Ekaterina A. Ilyina
Faculty of Management
Chuvash State Pedagogical University named after
IY Yakovlev
Cheboksary, Russia
kaviyana@mail.ru

Abstract— The article is devoted to the actual problem of regional development - the development of a process model of risk management in the system of management of strategic sustainability of cargo motor transport enterprises. The article discusses the concept of 'strategic stability of freight transport companies'. Application of the process approach reasoned in this study. To build a process model of risk management in the system of management of strategic sustainability of cargo motor transport enterprises, the authors propose a methodology IDEF. A process model of risk management in the system of management of strategic sustainability of cargo motor transport enterprises, including context diagram, context diagram of decomposition diagrams. The basic operation of risk management in assessing the strategic sustainability of cargo motor transport companies: risk classification, risk management planning, risk identification, risk analysis, risk assessment, risk treatment, monitoring and control risks. Methodical bases of allocation of risks temporal and spatial stability study management issues of strategic stability of freight transport companies. In order to identify risks provided a method of scoring. Risk assessment of the strategic sustainability of freight transport companies carried out using the theory of fuzzy sets. Based on fuzzy logic ranked risks temporal and spatial stability in the development of freight transport companies. The authors propose a method to minimize the risks of strategic stability of freight transport companies based on strategic outsourcing. Substantiated transfer into a strategic outsourcing of functions related to the analysis of long-term factors and trends of the company and the region, the development of predictive estimates to achieve the strategic objectives of the freight transport companies. Testing of a functional model of risk management in assessing the strategic sustainability of freight transport companies carried out by the example of the Chuvash Republic.

Keywords— process model; methodology IDEF; risk management; strategic sustainability; strategic outsourcing; freight motor transport enterprises

I. INTRODUCTION

Risk management is a subject of many scientific papers [2,4,10], normative documents, including ISO standards [14], determining the quality management systems of the enterprise. Standards should serve an integral part of quality management and decision-making in all areas of management. This also applies to economic and social, and environmental performance that meets the requirements of the sustainable development of the enterprise. In order to maintain an effective risk management system, it is important to create the company's corporate culture, vision, mission and goals of all members of the workforce. One can express the way that risk management is everyone's business, as workers in their places had better understanding of the causes, consequences and the likelihood of risk.

Risk management requires an integrated approach. This is because the enterprise in modern conditions are faced with a number of different risks (e.g. political, economic, technological, social, environmental), which do not confront any individual risk without attention to the others. Thus, the concept of 'esidual risk' arises, which may contain unidentified risk. Thus, risk management should be comprehensive, defined as a continuous process with a focus on the prospect of achieving the strategic goals. Only such approach will help achieve the strategic objectives, keeping the strategic stability of the enterprise.

The strategic stability of the cargo motor transportation enterprise (CMTE) means the preservation of long-term upward trend of development, expressed complex targets determined by economic, social and environmental characteristics of the company, taking into account achievable transport development of the territory. Strategic management of CMTE based on temporal expression (i.e. characterized by the upward trend of development) and spatial (i.e. transport is characterized by development of the territory to ensure access of economic entities to natural and human resources) stability. There are many different risk management tools, one of which is the process approach. In the 80 years, it complicates the process of production, exacerbated competition and increases the growth of corporations. All this has led to is the emergence in the west of the concept of the process approach to management. Process approach consisted of interacting

business processes, each of which is in the form of graphical design. All business processes consist of a sequence of operations with the chain-adjusted responsibility and have the final value for the consumer in the form of creating a product or service. To further optimize or restructure used a detailed analysis of the control system by constructing a simplified model of the company.

II. A PROCESS MODEL OF RISK MANAGEMENT IN THE SYSTEM OF MANAGEMENT OF STRATEGIC SUSTAINABILITY OF CARGO MOTOR TRANSPORT ENTERPRISES

In this paper, we consider the process approach to risk management when evaluating of strategic sustainability of the CMTE. For the modeling of business risk, management process when evaluating of strategic sustainability of CMTE, the IDEF (i.e. Integration DEFinition) methodology is applied. IDEF methodology views any of the studied system as a set of interacting and interconnected blocks, reflecting the processes, operations, actions that occur in the system under study.

The objectives of the modeling business process of risk management when evaluating of strategic of sustainable development of CMTE are: Indication of the main risk management processes; Identifying links between processes; Formation mechanisms in the process of risk management; Disclosing resources required to manage the risks.

Process model 'Risk Management when evaluating strategic of sustainable development of CMTE' includes: context diagram, containing the inputs, outputs, resources and mechanisms of the model and the decomposition diagram of context diagram that shows the relationships between the elements of the model.

Figure 1 shows a context diagram of risk management models when evaluating sustainable development strategy of CMTE, built using IDEF0 methodology in software product AllFusionProcessModeler 7 (BPwin), components of which are: Information on the retrospective assessment of CMTE, information about the market situation, the management plan for the strategic development of resistance CMTE (input); A report on the assessment of the effectiveness of risk management measures (output); Documents regulating the activities CMTE, regulations on risk management, risk management tools (tools and methods); A group of experts, the deputy director for strategic development, risk managers, specialists in control, logistical, financial and informational resources (resources).
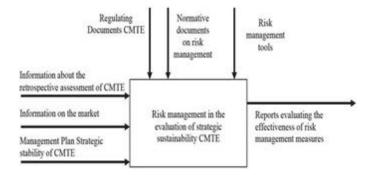
Fig. 1. The Context Diagram A-0 'Risk Management When Evaluating Strategic Of Sustainable Development Of Cmte'

Decomposition of context diagram represents the basic operations that must be performed in the modeling business risk management process when evaluating of strategic of sustainable development of CMTE: risk classification, risk management planning, risk identification, risk analysis, risk assessment, risk treatment, monitoring and control risks.

III. BASIC OPERATIONS IN THE MODELING BUSINESS RISK MANAGEMENT PROCESS WHEN EVALUATING OF STRATEGIC SUSTAINABLE DEVELOPMENT OF ENTERPRISES

3.1 Risks classification

Before assessing the market situation and understanding the possible causes of risk, it is necessary to classify the risks that could significantly affect the state of strategic stability in the long-term development of the enterprise. Strategic management of CMTE based on the temporal and spatial expression of stability, respectively, classify the risks of strategic stability must be based on these concepts, etc., highlight the risks of temporal and spatial stability [7]. Risks of temporal stability divided by short-term (mid-term) and long-term risks. The first risk may occur in 3 years, the second – in the period from 3 to 10 years.

Short-term (mid-term) risks associated with the risk of incorrect assessment of the short-term (mid-term) factors in the development of the enterprise, the downside risks to the economic potential and the risk of loss of liquidity and solvency of the company. The long-term risks associated with long-acting factors, which include tactical, technological, social, legal and environmental factors. These factors determine the development trends of the economy and the region, and the associated risks at the enterprise level. These include the risk of incorrect assessment of trends in the development of the enterprise, the forecast risk and the risk of failure to reach the strategic goals of the enterprise.

All identified risks have a direct impact on strategic sustainability of CMTE. Defining development trends helps answer the question of how well the company manages the financial and non-financial assets during the analyzed period, how to effectively use their own capital. Positive trends in the development of enterprises will testify about it, and negative

– will characterize the gaps in enterprise management.

Risks of spatial stability are dividing into two groups: business risks and regional risks. The first group of risks related to the scope of activity of business partners, which include banks and investment funds, as well as suppliers and customers of freight motor transport enterprise. As part of this investment can be identified (credit) risk, the risk of loss of competitiveness of services, reputation risk, and, finally, the risk of losing customers. These risks in the event of their manifestation certainly complicate the implementation of the strategy of the enterprise. The second group consists of regional (country) risks associated with political and economic situation in the country. These

include the risk of changes in economic conditions, technological, legal, demographic and environmental risks. These risks may adversely affect the ability to attract investments (loans), financial results, liquidity, and the implementation of environmental activities eventually, the strategic stability CMTE.

3.2 Risk Management Planning

The inputs of the planning process of risk management are information about the retrospective assessment of CMTE, information about the market situation, the management plan for the strategic development of resistance CMTE. It is also necessary to consider the factors that affect the formation of the level of demand for freight transportation [8].

The operation of risk management planning should form a risk management plan, which describes the general approach to risk management in the project, their classification, methods for identifying and responding. At the heart of the risk management plan are documents regulating the activities CMTE, regulations on risk management, specific methods to reduce the negative impact of adverse events on the management of strategic stability of CMTE. The risk management plan of the project includes a description of the risk factors; description of the risk profile; required resources; management measures for each risk; measures to inform people about the status of project risks; the critical routes of the plan.

3.3 Identification of risks

This operation involves the precise definition of tendencies of development CMTE, which in turn depend on retrospective assessment of the correct development of the enterprise. Risk Identification is the process of identifying the risks that may affect the control system of strategic stability CMTE, and a description of their characteristics.

To identify risks of temporal and spatial stability CMTE, a method of scoring is proposed, taking into account the opportunities the SWOT-analysis and PEST-analysis to determine the potential risk coverage of the company's strengths and market opportunities [7]. The level of coverage of short-term risks of CMTE is higher than the long-term, which requires special training to identify trends in the development of both the company and trends at the regional level. Noteworthy is that the risks are covered by more than the strengths of the company, rather than the market opportunities. Therefore, the company needs more thoroughly explore the opportunities provided by the market environment, the banking sector, infrastructure, businesses and other market elements. Finally, we can draw attention to the risks of low scores coating that will adjust enterprise development program towards achieving the strategic goals of the enterprise.

The result of the process of risk identification is the risk map, comprising: to thwart the identified risks; list of response measures; the prerequisites for a risk, clarification of risk.

3.4 Risk analysis

This operation includes selection of categories of resources; definition of requirements (regulatory, contractual, technical) resources; identify relevant threats and vulnerabilities for selected categories of resources; calculation of the probability of threats and vulnerabilities.

3.5 Risk assessment

Based on the developed structure of risks, reports on the identification and analysis of risks, taking into account the risk assessment techniques, [12] takes calculated risks and a comparison of the risks to a predetermined scale of the risk. The study [6] demonstrates the advantage of fuzzy logic approach to traditional approaches for risk assessment of strategic stability CMTE. Fuzzy logic, proposed in 1965 by the American mathematician L. Zadeh [15], is the first point of view, which operates with inaccurate or even not quite clear concepts.

Risk assessment of the strategic sustainability CMTE using the theory of fuzzy sets is doing in several stages. We introduce the basic concepts of the theory of fuzzy sets.

- Introduce the so-called 'linguistic variables' that are set on a quantitative scale, and take values in the form of combinations of words. One of the linguistic variables is 'strategic risk' that has five values (i.e. fuzzy subset of states): 'the ultimate strategic risk', 'high strategic risk', 'medium strategic risk', 'low risk strategy', and 'little strategic risk'.
- Settle hazards of temporal and spatial stability, which are subject to a comprehensive assessment.
- Introduce a system of five membership functions corresponding keystone species for a given linguistic variable.
- Form a group of experts.
- Estimate and rank the current level of risk types.
- Calculate the importance of each indicator for the risk of strategic stability of the motor transportation enterprise by rule Fishburne [5].
- Classify the current value of the degree of risk as a criterion for partitioning venture set into subsets.
- Draw conclusions about the risk of temporal and spatial stability of the motor transport enterprise (linguistic recognition).
  After the procedure of recognition of linguistic risk of strategic sustainable development of CMTE Chuvash Republic JSC 'Akkond-trans' using the method of fuzzy sets was complete, the following results were obtained: the risk of temporal stability of the enterprise can be estimated 30% as the lowest and 70% as a minor; the risk of spatial stability of the enterprise can be estimated 40% as the lowest and 60% as insignificant.

3.6 Processing risk

The goal of treatment is to change the identified risks in order to achieve the development goals of the enterprise. The process of risk treatment is continuous and involves the study of options for handling each risk to an acceptable level of residual risk. It also includes selecting and implementing a method for processing the risk. Among the

treatment options available to visit are risk avoidance methods, adoption, change, risk sharing. Methods such as avoidance, acceptance and change risk are static in nature and can be using to handle the risks of the current period. To minimize the risks of strategic stability of freight transport companies propose a method based on the use of strategic outsourcing.

Outsourcing is a versatile management tool, because its essence lies in the possibility of transferring some of the external executor functions of the organization as a whole or in part, as long life, and for a short period [1,3,9,11,13]. Strategic outsourcing based on the changes and continuous adaptation of the company to changing market conditions. Its main distinguishing feature is a long-term relationship in which the two sides focused on the implementation of the strategic objectives of the enterprise. As the relationship develops, in this case for a long time, this leads to a strengthening of the partnership the enterprise-customer and the outsourcer, and to increase the skills and knowledge of employees.

Conceptually, strategic outsourcing has the following positions: choice of outsourcer; outsourcing contract; risks associated with outsourcing. For effective outsourcing the relations between the parties should be developed in the context of the strategic development of the company, which is the central element in the choice of outsourcer. Selecting an outsourcer requires an entity to analyze its features and function definitions for the transmission 'aside'. An important condition for this must be specialty enterprise in the field of economic analysis and forecasting by using advanced technology in this direction. The transfer of the functions of the outsourcer will enable the company to simplify the work of the development and implementation of company strategy, and, consequently, to minimize the risks of strategic stability. In this respect, one can divide the factors that are associated with the risks of strategic stability and distribute their analysis between the enterprise-customer and the outsourcer as follows (Fig. 2).
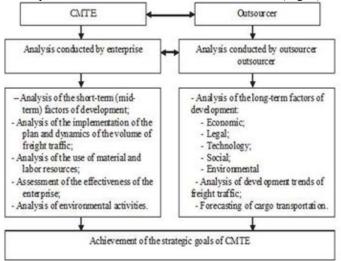
Fig. 2. Distribution of analytical procedures between the freight transportation company and the outsourcer

Strategic outsourcing is quite a powerful tool for ensuring strategic stability of CMTE. However, to ensure the efficiency of its use is necessary to conduct in-depth analytical and organizational work objectively evaluate not only the expected current results, but also long-term effects of the individual functions by external organizations - outsourcers.

Monitoring and controlling risks

Risk Monitoring and Control is the process of responding to the risks, tracking identified risks, monitoring residual risks, identifying new risks and assessing the effectiveness of risk management measures. The monitoring and risk management decisions on changing the risk management plan, risk maps, methods of minimizing risks and compiled a report on the evaluation of the effectiveness of risk management measures.

IV. CONCLUSIONS

Risk management with business processes enables to respond more quickly to changes in the management of strategic stability and development of CMTE control. Classic risk management methods are time-tested and effective, but the use of modern tools, will help strengthen the 'weak points' in the management of strategic stability of CMTE and make the strategic goals more stable and confident.

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Model Estimates of the Probability of Risk Events in the System

S. Guskov, V. Levin

Department of Fundamental Science

Bauman Moscow State Technical University

Moscow, Russia

ser0432@yandex.ru

Abstract — **There are introduced models of risk events assessment in the system in the article. Bank is represented as complex financial system. Special attention is paid to the models of credit risk assessment that can be used in any production system.**

Keywords— bank; credit risk; probability of default (PD); scoring; application scoring (AS); behavioral scoring (BS); fraud scoring; odds; score; cut-off; validity indicators

Bank is a complex structural multifunctional financial system. One of the main Bank`s functions is enterprise lending, government lending and population lending. To make a profit is the main aim for Banks. Interest rate is known to be a money costs compensation for bank that occurs during loan service. Also it is necessary to take into account credit risk costs, operational risk etc. Bank could suffer losses in case of ignoring these costs.

Banks are forced to implement modern automatic risk assessment systems to control risks because of supervisor requirements (The Central Bank), market lending expansion and lending portfolio growth, usage of storage systems and data processing. Such automatic system allows to increase speed of data analysis and to reduce the time to make decision about feasibility of the loan that is, in certain degree, quality increasing of the decision and reduction of the probability of corrupt practice among staffs. Credit risk assessment models are used to estimate quality of made decisions.

Credit risk is the risk of default under the credit agreement. In credit risk assessment models under the default usually understand a continuous non-execution of obligations on payment monthly payments more than 90 days. The result of applying the model of credit risk assessment is estimation of the default probability (PD).It is possible to evaluate the PD with a binary classifier [9]. To solve the problem of classification are used logistic regression, support vector machine, artificial neural network etc. in practice.

Each value of PD can be mapped to a certain scoring point. Score is the result of the scoring evaluation. Under credit scoring understand the method of differentiation of different groups of potential clients that would be in default or would not appear. It is necessary to determine the value of the score below which a customer will be evaluated as "bad" (potentially default) or as "good" (potentially non- default) to solve this problem. That score value is called as cut-off level [1]. Select the cut-off level is a separate optimization problem.

It is possible to calculate score by formula [5]: $score = A * \ln(odds) + B$, where A and B are solutions of the system (1):

$$\begin{cases} score = A * \ln(odds) + B \\ score + \Delta = A * \ln\big(x * (odds)\big) \end{cases} \quad (1)$$

$A = \dfrac{\Delta}{\ln(x*(odds))}$ corresponds to the x times increase in odds to be "good" or "bad" when you change the scoring points on Δ.

$$B = score - \frac{\Delta}{\ln(x * (odds))} * \ln(odds)$$

$$Odds\ to\ be\ good = \frac{1 - PD}{PD}$$

For example, score increasing at 20 (Δ) points increases odds to be good in 2 (x) times.

The described models are applicable at the first stage of work of Bank with the client – acceptance decision on the loan. The main task here is to assess the creditworthiness of the borrower over the next 12 months of service. This uses application scoring (AS) is statistical assessment of probability of failure (default) of obligations on return of the credit and fraud scoring (FS) that is statistical assessment of probability of fraudulent activity by the applicant. When building

assessments AS and FS uses historical application data and its link with the default probability or fraud probability of loan, in addition, when building AS or FS uses information from the credit Bureau about the possible connection the client previously committed fraud.

Tool for monitoring and regulating the quality of the loan portfolio is behavioral scoring (BS).Statistical assessment of BS based on historical data about the behavioral characteristics of the client when servicing accumulated data from credit bureaus and the Bank and their impact on the fulfillment of the obligations under the credit agreement. As the behavioral characteristics to assess the creditworthiness of credit card frequently used data on average number of transactions, replenishment, transactions, utilization of credit limit, average withdrawal amounts or making, etc. By non-card credit products you can use information about the number of missed monthly payments during the service time, the request rate on a loan to other credit institutions, customer activity in social networks and others. Typically these characteristics are calculated for the last 6 months of service.

Bank performs the correction of rules and decision-making processes, employees actions involved in the process of preparing, issuing and tracking credits in accordance with the results of monitoring of the current loans in the previous period.

Below based on correction information obtained from the monitoring of activities at the preceding stage under construction planning activities of the Bank for the future to ensure a given credit risk level and required yield.

At each of these stages the Bank should manage risks including using the aforementioned tools. For example, at the stage of monitoring the borrower's creditworthiness the Bank takes decisions on raising or lowering the limit on loans, the granting of restructuring the client, creating a sufficient reserve for this client, etc. Depending on the decision the Bank may incur additional losses in the service for the client. For example, in the case of raising the limit to a borrower for a certain amount he goes out in the schedule of payments, thereby causing damage to the financial stability of the Bank.

At the planning stage, when you build the processes to assess the probability of a risk event (default or fraud) on the basis of AS, FS, BS there are required quality assessment models. Currently, the necessary validity indicators are as follows [1,7,8]:

1. Cumulative Accuracy Profile curve (CAP – curve) and its summary statistic Accuracy Rate (AR). We say that model quite well differs bad population from good population when AR >60%.

$$AR = \frac{a_R}{a_P}$$
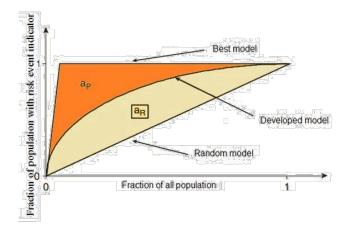
Fig. .1 CAP curve

CAP curve of the ideal model corresponds to a scoring system, which assigns less scoring points to "bad" clients than scoring points, attributed to "good" customers. That is under ideal scoring score for any "bad" client will have less value of any "good" client.

CAP curve for rating model is based on the following rule: for a given level of rating (score) C on the Y-axis is delayed, the proportion of "bad" clients that have a rating (score) is not greater than that but along the X-axis is delayed, the proportion of all customers who have a rating (score) is not greater than C.

CAP curve of the random model corresponds to a scoring system for which the fraction of "bad" customers with score is not greater than the given level C equals to the fraction of all customers that have a scoring point not greater than C.

2. Receiver Operating Characteristic (ROC curve) and its summary statistics Area Under Curve (AUC).
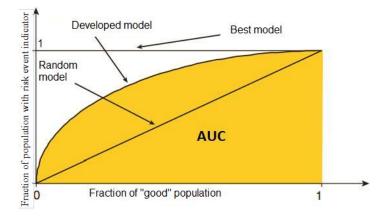
Fig..2 ROC curve

ROC curve has similar meaning with CAP curve, but on the x axis is laid fraction of good customers.

3. The Gini Coefficient:

Gini = (AUC-0.5)*2

4. The criterion of Kolmogorov – Smirnov is maximum difference between the cumulative distribution functions of good and bad populations.
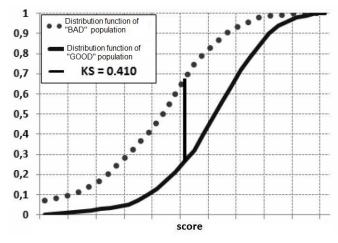
Fig. .3 Estimators of distribution of «BAD» and «GOOD» population, the criterion of Kolmogorov – Smirnov

5. Confusion Matrix for the given cut-off level:

TABLE CONFUSION MATRIX

Model	Real	
	Positive	Negative
Positive	TP	FP
Negative	FN	TN

TP (True Positives) – truly classified positive samples;
• TN (True Negatives) – truly classified negative samples;
• FN (False Negatives) – positive samples that were classified as negative (1st type error).
It`s so-called "false missing" – when the interested event falsely not detected (false negative examples);
FP (False Positives) - negative examples classified as positive (2nd type error).

Also, it is required to have a confidence interval estimate for the above written validity indicators of the model to increase the accuracy of validity indicators. Currently the most used is the evaluation of the Mann-Whitney for AUC.

A hybrid scoring systems are used to resolve the issue associated with using the method of constructing estimates of PD, i.e. use a weighted average of estimates obtained by different models (logistic regression, support vector machines (SVM), artificial neural network (ANN) etc.) [4].

Formally, the estimated probability of default (Probability of Default) using the hybrid scoring system is written in the following form:

$$PD = \alpha_1*PD_1 + \alpha_2*PD_2 + \ldots + \alpha_n*PD_n$$

where PD_i is estimator based on i-th model and α_i is weght of the i-th PD estimator.

For development of long-term quality plans in Banks you can apply the following dynamic models [3]:
1. Reputation structural model
2. Survival model
3. Markov transition model

These models allow to forecast the PD for individual client and portfolio loans based on the changing conditions of the economy.
The following is the algorithm for stress testing using a dynamic model [2]:
1. Building a dynamic model taking into account the macro parameters on the training set;
2. Modeling the plausible macro parameters on historical data;
3. Simulation of default events by the test data by substituting the simulated values of the macro parameters into the model.
4. Repeat step 2 and 3 m times to construct the loss function for the estimated PD under different macroeconomic conditions;
5. Use the loss distribution to calculate the estimated PD for the worst economic conditions.
Conclusions
The article describes models for estimating the risk events probability in the banking system. Risk event means the fulfillment of the obligations under the credit agreement, i.e. the risk that a client will transfer to default class.

The model estimates of PD and evaluation of the validity of these models assumes the presence of a representative training and test samples to use the asymptotic approximations for the estimation of probabilities of 1st and 2nd type errors. Currently, the most commonly used confidence interval is Mann – Whitney estimator for AUC for datasets with large enough volume, when it is possible to use the asymptotic approximation for this estimate [1]. Remains open the problem of the confidence bounds for the criteria of validation in the case of "small samples", when the volume of observations is not sufficient to use the asymptotic formulas of probability theory [6,9].

Today already difficult to imagine the Bank functioning without the use of expert automated systems of control and management of the loan portfolio quality. In the market of IT-technologies firms provide services for the development and implementation of the described methods. Every year offered tools for assessment of credit risks are expanding.

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SADT Technology as a Tool to Improve Efficiency in the Use of Process Approach in Management of Engineering Enterprise

Oksana V. Islamova, Alan A. Zhilyaev, Asiyat.M. Bozieva
Department Quality Management
Kabardino-Balkarian State University
Nalchik, Russia
islamova_81@mail.ru, alan.zhilyaev@gmail.com

Abstract— **On the example of machine-building enterprise expediency use of SADT technologies in perfecting of the main business processes is shown. As-Is model one of key processes is constructed, the analysis is carried out it and To-Be model, taking into account recommendations about its perfecting is offered.**

Keywords— the functional model operation; business process; process approach; IDEF0 methodology; entrance monitoring

Priority of the modern machine-building enterprise in the conditions of the continuous competitive fight, complication of technological and organizational and economic systems is perfecting of management of the organization of production for upgrading and competitiveness of the made production. The solution of this task is impossible if at the enterprise there are following shortcomings:

- processes of the organization of production are not described and not documented properly;
- there is no process approach in the work organization of various divisions;
- mechanisms of the continuous perfecting network of processes of the enterprise are not stable.

In order to avoid the above drawbacks, many enterprises use functional simulation (SADT - Structured Analysis and Design Technique), which is relevant and requires a comprehensive approach that enables enterprises personnel not only visually see the graphical model of the network of processes of production organization, but also to analyze its effectiveness, constantly improve and use in current operations as regulations.

Creating a model of the enterprise involves the creation of the organizational and personnel structure of the company and, consequently, the system of functional interaction between structure units.

With SADT technology, you can display and analyze the business model of a virtually unlimited range of complex systems in the various sections. This breadth and depth of the survey processes in the system is determined by the developer,

which allows not to overload to create models of redundant data [1].

The expediency of use SADT-technology in this paper is demonstrated by the example of a specific machine-building enterprise of "Avtozapchast", located in Kabardino-Balkaria (Russia), Baksan, specializing in mufflers issue for cars and trucks.

Context diagram describes the activity of the company is shown in fig.1.
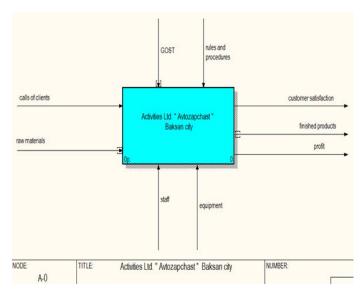
Fig. 1. Context-sensitive chart of activity of LLC «Avtozapchast»

For the decomposition level 1 diagrams the basic business processes:
- Marketing and analysis of agreements / contracts;
- Production planning;
- The purchase and storage of raw materials;
- Logistical support;
- Manufacturing of products;
- Storage and warehousing.

The relationship identified business processes, the necessary resources and mechanisms for their implementation are shown in fig. 2.
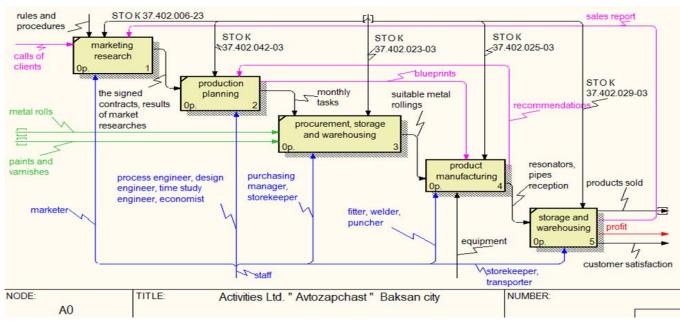
Fig. 2. IDEF0 "Basic Processes of the Enterprise" Model

In this paper the results of the decomposition of one of the key business processes of the enterprise "Production of products."

Release silencing begins with procuring process. It includes: storing material only in the room and on the shelves, to preserve its form; for cutting sheet metal blanks with a guillotine shear roller and if necessary their punching and (or) stamping the desired shape and forming a shoulder Cutting through hole as an additional stiffener.

In the future, with the help of the stocks (conductors) are assembled all the components, and then their welding. Due to this, the size of the deviation is always in the tolerance zone. Element welding inner silencer is made with a continuous weld at least 50% percent, it is much more practical and safer than resistance welding.

For the production of finished tubes for exhaust systems using automatic machine with modern CNC. The preforms are produced on this machine does not have a "corrugated" - bend folds in the ground and have identical dimensions.

The final operation of all production is the color of welds special temperature-resistant paint to increase corrosion resistance.

Manufacture of silencers made from stainless steel and silico.

Technological process of manufacturing of exhaust systems made in such a way that the manufacturing operations are carried out consistently and there is no intersection, and returned to their line of movement in production.

The foregoing describes the process model shown in fig. 3.
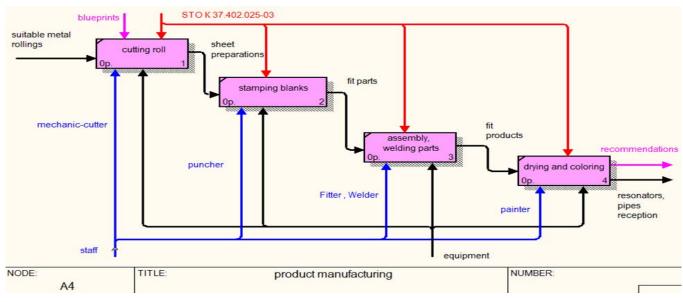
Fig. 3. Process model "Manufacture of production"

If the model AS-IS (as is) found shortcomings, the SADT technology allows to build the model To-Be (as it should be) taking into account the recommendations to address them. [2]

So, when analyzing the model AS-IS Company LLC "Avtozapchast", it was found that the input of metal-roll control is not carried out at the plant. Purchases are based on confidence in the supplier. In this approach, the input material defects found during manufacture, which entails additional costs. During 2015 an analysis of acts of marriage brought a figure of around 10% of low-quality raw materials.

Incoming inspection is further verification of the components before using them in the production of the parameters determining their performance and reliability. This is because the items may have a reduced quality due to unfair control over the output of the supplier, as well as possible long-term storage of finished products in the warehouse provider, accompanied by a deterioration of quality indicators. Furthermore, there is a possibility of damage to the components during transportation etc.

Since the enterprise "Avtozapchast" introduces the JMC activities, developed on the model of GOST R ISO 9001-2001, the incoming inspection procedure should be carried out in accordance with the requirements of this standard.

When the input control of metal-roll will be a visual check for the presence of the material in the indicated and clearly visible information about the type, denomination, admission, technical conditions or the certificate, as well as the lack of product on the scratches, chips, cracks, dents, corrosion.

In addition to visual inspection of rolled metal thickness measurements should be carried out.

Materials that have passed the input control, you need to additionally mark hallmark.

A place that will take to implement the proposed business process "input control", the network of business processes is shown in Figure 4.

Business process decomposition "Entrance monitoring" is carried out in fig. 5.
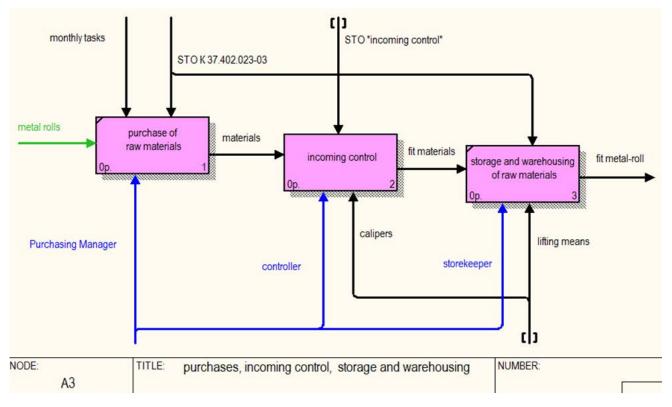
Fig. 4. IDEF0 "Purchases, Entrance Monitoring, Storage and Warehousing" Model
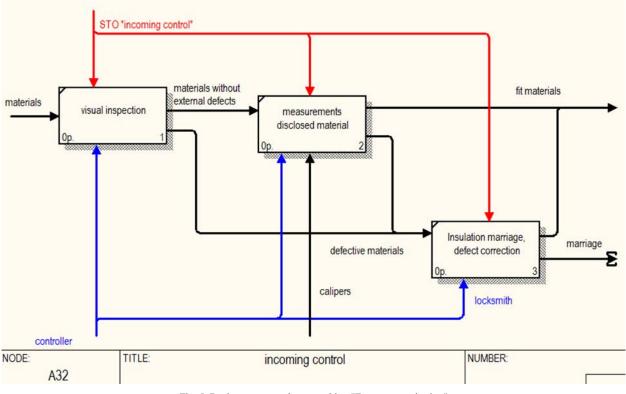
Fig. 5. Business process decomposition "Entrance monitoring"

Visibility of the constructed model "Making parts' process has allowed to understand what objects are the initial data that is the result of the work of each, what are the controlling factors and that it is necessary as a resource. Thus, this technique can be projected for each existing business process of "Avtozapchast", which ultimately enable the company to:

- An analysis of the company as a whole, to show its cooperation with other organizations, customers and suppliers, to increase the efficiency of processes and activities at each individual workplace;

- Anticipate and minimize the risks that arise at different stages of the reorganization of the company;

- To conduct a cost analysis of the enterprise;

- Give a detailed picture of the company's products, which can be modeled, which will see a way to improve their quality;

- Facilitate certification for compliance with quality standards (ISO, etc.).

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Software Errors and Reliability of Embedded Software

Alexey Ivutin
Department of Computer Technology
Tula State University
Tula, Russian Federation
alexey.ivutin@gmail.com

Eugene Larkin
Department of Robotics and Industry Mechanization
Tula State University
Tula, Russian Federation
elarkin@mail.ru

Dmitry Perepelkin
Faculty of Computer Science
Ryazan State Radio Engineering University
Ryazan, Russian Federation
dmitryperepelkin@mail.ru

Abstract— **The problem of software fault-tolerance is described. The fault-tolerance problem is considered as hardware faults and software errors. The software errors classification is proposed. Authors describe the computational process as tree-like directed graph. Errors are bringing in the realisation of the algorithm at the stage of programming. It is cause forming "real" algorithm instead of its "theoretical" realisation. The simple formula of software error probability calculation is described.**

Keywords— *fault-tolerance; software; reliability; errors; hardware*

I. INTRODUCTION

Software fault-tolerance problem in modern computational systems may be described as [1]:

- hardware faults in software storages (RAM, ROM, etc.) and in algorithm interpreters (CPU, ALU, controllers, etc.);
- faults caused by errors in algorithms and software.

First faults mode (if they are not specific run-time faults) is not differ from other equipment faults and can be analysed with Markov models [2], [3], Petri nets [1], [4], [5], Petri-Markov nets [6], etc.

Software faults are run-time errors. They are caused by misinterpretation of code and have the specific character. Software is a sequence of instructions. It is the model of the computational process. There is only one cause of software failure --- produced program text fall short of the algorithm in the requirements specification.

II. MATHEMATICAL MODEL OF ALGORITHM INTERPRETATION

Interpretation of algorithm is generation result R from ensemble of work symbols

$$D = \{d_1, ..., d_m, ..., d_M\},\qquad(1)$$

This result is formed only by algorithm G and source data D:

$$R = R(G, D).\qquad(2)$$

where

$$G = (A, Z);\qquad(3)$$

and A – is the set (alphabet) of operators, Z – relation, describe interaction between operators (or in other words algorithm's structure);

$$A = \{a_{1(a)}, ..., a_{j(a)}, ..., a_{J(a)}\};\qquad(4)$$

$$Z = \{z_{1(z)}, ..., z_{j(z)}, ..., z_{J(z)}\} =$$
$$\{(a_{i(a)}, a_{j(a)}) : a_{i(a)} \in A, a_{j(a)} \in \{A, \varnothing\}\}\qquad(5)$$

Each symbol from set (1) select form alphabet

$$d_m \in \{d_{1(m)}, ..., d_{k(m)}, ..., d_{K(m)}\},\qquad(6)$$

where $d_{k(m)}$ - is the $k(m)$ -th value of symbol d_m; $K(m)$ - total amount of symbols in m-th alphabet; $1 \le m \le M$.

Set of work data form n-dimensional discrete hyperspace Λ with $K(m)$ count in each dimension. Each value of d_m has probability $p_{k(m)}$ of occurrence in message. So probabilities of occurrence of alphabet (1) symbols defined by histogram

$$P_m = \begin{pmatrix} d_m \\ p_m \end{pmatrix} = \begin{pmatrix} d_{1(m)} & \cdots & d_{k(m)} & \cdots & d_{K(m)} \\ p_{1(m)} & \cdots & p_{k(m)} & \cdots & p_{K(m)} \end{pmatrix}.\qquad(7)$$

Occurrence of symbols from (1) form divisible group of incompatible events and for probabilities $p_{k(m)}$ we can write

$$\sum_{k(m)=1(m)}^{K(m)} p_{k(m)} = 1.\qquad(8)$$

Algorithm G is classical, i.e. number of operator of algorithm is finite set (and cardinal number of set (1) is finite). Algorithm G consist only one start operator $\beta \in A$ and set of finish operators $E = \{e_{1(e)}, ..., e_{i(e)}, ..., e_{J(e)}\} \subset A$. Information processing start only in operator b and finish only in operator from subset E.

Aside from structure of algorithm Z computational process may be present as tree-like directed graph (see fig. 1).

$$T = (\{\beta, T_{1[1(e)]}, ..., T_{j[j(e)]}, ..., T_{J[j(e)]}, ..., T_{J[J(e)]}\},$$
$$\{(\beta, T_{1[1(e)]}), ..., (\beta, T_{j[j(e)]}), ..., (\beta, T_{J[J(e)]})\}) \quad (9)$$
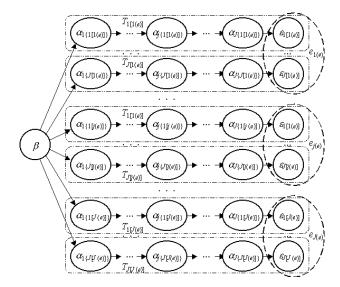
Fig. 1 Tree T of algorithm G realization

Graph tree branches (fig. 1) are algorithm's execution paths
$$T_{j[j(e)]} = (\{\alpha_{1\{j[j(e)]\}}, ..., \alpha_{j\{j[j(e)]\}}, ..., \alpha_{J\{j[j(e)]\}},$$
$$\varepsilon_{j[j(e)]}\}, \{(\alpha_{1\{j[j(e)]\}}, \alpha_{2\{j[j(e)]\}}), ..., (\alpha_{j\{j[j(e)]\}-1},$$
$$\alpha_{j\{j[j(e)]\}}), ..., (\alpha_{J\{j[j(e)]\}}, \varepsilon_{j[j(e)]})\}), \quad (10)$$

where $\alpha_{j\{j[j(e)]\}} \in A$ – algorithm's G executable operators of $j[j(e)]$ execution path; β – start operator which also is the common decision making operator of algorithm G. It unite decision making operators of algorithm G. $1(e) \le j(e) \le J(e)$, $1\{j[j(e)]\} \le j\{j[j(e)]\} \le J\{j[j(e)]\}$, $1[j(e)] \le j[j(e)] \le J[j(e)]$.

Correct engineered algorithm has no infinite loops. It shows in fig. 1 as no branches with an infinite quantity of nodes.

Start operator β select $j[j(e)]$-th branch of tree $T_{j[j(e)]}$ (10) based on analysis of source data (1). In general case, it is execution of operation
$$\text{T} = T_{j[j(e)]}, \text{ if } \varphi(D) \supset \lambda_{j[j(e)]}, \quad (11)$$

where T – is selected execution path of algorithm; $\varphi(D)$ – is the common decision making function; $\lambda_{j[j(e)]} - j[j(e)]$-th area in hyperspace Λ.

So decision making about continue computation process (11) is algorithm $\widetilde{G} \subset G$. Result of $\widetilde{G}$ is execution path and (10) may be present as
$$T = T(\widetilde{G}, D). \quad (12)$$

Execution path selection events are incompatible events due to determinacy of an algorithm. They form divisible group of events thus
$$\lambda_{j[j(e)]} \cap \lambda_{i[i(e)]} = \varnothing \text{ when } i[i(e)] \ne j[j(e)],$$

$$\lambda_{j[j(e)]} \cap \lambda_{i[i(e)]} = \lambda_{j[j(e)]} \text{ when } i[i(e)] = j[j(e)];$$
$$\bigcup_{j(e)=1[j(e)]}^{J[j(e)]} \lambda_{j[j(e)]} = \Lambda. \quad (13)$$

Source data passed to executable unit has $\sigma_D = \prod_{m=1}^{M} K(m)$ different states. It is known that total amount of different states of result's array not exceed total amount of states of source's array thus
$$o_D \ge \sum_{j(e)=1(e)}^{J(e)} J[j(e)]. \quad (14)$$

Algorithm $\widetilde{G}$ is strict deterministic sequence of operations and for defined set of D select defined execution path (10). But external observer sees selection of $T_{j[j(e)]}$ for defined set of D from area $\lambda_{j[j(e)]}$ as random process. Probability of such selection is
$$p_{j[j(e)]} = P(T : T = T(\widetilde{G}, D), D \in \lambda_{j[j(e)]}). \quad (15)$$

It is known that for any result of algorithm execution
$$h_D \ge h_\lambda, \quad (16)$$

where h_D – is source data entropy; h_λ – is entropy of result (or entropy of algorithm execution);
$$h_\lambda = -\sum_{j(e)=1(e)}^{J(e)} \sum_{j[j(e)]=1[j(e)]}^{J[j(e)]} p_{j[j(e)]} \ln p_{j[j(e)]}. \quad (17)$$

III. FAULTS IN REAL SOFTWARE

At stage of programming errors are bringing in realisation of algorithm. It is cause form "real" algorithm instead of its "theoretical" realisation:
$$H = (C, Y), \quad (18)$$

where
$$H \ne G, C \ne A, Y \ne Z; \quad (19)$$
$$C = C_1 \cup C_2 = \{a_{1(a)}, ..., a_{j(a)}, ..., a_{K(a)}\} \cup \{c_{1(c)}, ..., c_{j(c)}, ..., c_{J(c)}\}; \quad (20)$$
$$Y = Y_1 \cup Y_2 = \{z_{1(z)}, ..., z_{j(z)}, ..., z_{K(z)}\} \cup \{y_{1(y)}, ..., y_{j(y)}, ..., y_{J(y)}\}, \quad (21)$$

where C – real set of operators partially coincident with alphabet (4); Y – relation which define a structure partyally coincident with structure (5); C_1, Y_1 – coincident parts of the sets; C_2, Y_2 – uncoincident parts of the sets; $K(a) \le J(a)$; $K(z) \le J(z)$ (without loss of generality it is safe to say that coincident parts of the sets number the indexes with lesser values).

So the graph (18) transform into tree-like directed graph like (10)

$$T'_{j[j(e)]} = \begin{cases} (\{\alpha'_{1\{j[j(e)]\}}, \cdots, \alpha'_{j\{j[j(e)]\}}, \cdots, \\ \quad \alpha'_{J\{j[j(e)]\}}\}, \{(\alpha'_{1\{j[j(e)]\}}, \alpha'_{2\{j[j(e)]\}}), \cdots, \\ \quad (\alpha'_{j\{j[j(e)]\}-1}, \alpha'_{j\{j[j(e)]\}}), \cdots, \\ \quad (\alpha'_{J\{j[j(e)]\}-1}, \alpha'_{J\{j[j(e)]\}})\}), \\ \quad \text{if algorithm has no infinite looping;} \\ (\{\alpha'_{1\{j[j(e)]\}}, \cdots, \{\alpha'_{j\{j[j(e)]\}}, \cdots, \alpha'_{J\{j[j(e)]\}}\}, \\ \quad \cdots, \{\alpha'_{j\{j[j(e)]\}}, \cdots, \alpha'_{J\{j[j(e)]\}}\}, \cdots\}, \\ \quad \{(\alpha'_{1\{j[j(e)]\}}, \alpha'_{2\{j[j(e)]\}}), \cdots, \\ \quad \{(\alpha'_{j\{j[j(e)]\}-1}, \alpha'_{j\{j[j(e)]\}}), \cdots, \\ \quad (\alpha'_{j\{j[j(e)]\}-1}, \alpha'_{j\{j[j(e)]\}})\}, \cdots, \\ \quad \{(\alpha'_{j\{j[j(e)]\}-1}, \alpha'_{j\{j[j(e)]\}}), \cdots, \\ \quad (\alpha'_{j\{j[j(e)]\}-1}, \alpha'_{j\{j[j(e)]\}})\}, \cdots, \}), \\ \quad \text{if algorithm has infinite looping,} \end{cases} \quad (22)$$

$$T' = (\{\beta', T'_{1[1(e)]}, \cdots, T'_{j[j(e)]}, \cdots, T'_{K[K(e)]}, \cdots, T'_{K[K(e)]}\} \\ \{(\beta', T'_{1[1(e)]}), \cdots, (\beta', T'_{j[j(e)]}), \cdots, (\beta', T'_{K[K(e)]})\}). \quad (23)$$

where $\alpha'_{\{j[j(e)]\}} \in B$ – operators of algorithm H executed when its end in $j(e)$-th finish operator at $j[j(e)]$-th execution path or if it has infinite looping in $j(e)$-th choice; β' – start operator which also is the common decision making operator of algorithm H. It unite decision making operators of algorithm H. $1\{j[j(e)]\} \leq j\{j[j(e)]\} \leq K\{j[j(e)]\}$, $1[j(e)] \leq j[j(e)] \leq K[j(e)]$, $1(e) \leq j(e) \leq K(e)$;

$$K\{j[j(e)]\} \begin{cases} < \infty, \text{if algorithm has no infinite looping;} \\ = \infty, \text{if algorithm has infinite looping.} \end{cases} \quad (24)$$

Start operator β' in algorithm H select $j[j(e)]$-th branch of tree $T'_{j[j(e)]}$ (22) based on algorithm $\tilde{H} \subset H$ with result

$$T' = T'(\tilde{H}, D). \quad (25)$$

Analysis shows that errors of algorithm implementation may be divided

1) Algorithm $\tilde{H}$ of select of execution path in operator β' is changed.

2) Structure of nodes $T'_{j[j(e)]}$ selected from alphabet (4) is changed.

3) Sequence of nodes selected from (5) is changed.

Infinite looping caused by minimum one of described errors.

Make re-indexation of graph tree branch (9). Let indexes 1 to K assign to branches without errors in selection and programming and from $(K + 1)$ to M assign to branches with one or more errors in selection and programming ("faulty" graph tree branch), $M = \sum_{j(e)=1(e)}^{K(e)} K[j(e)]$. So probability of software fault defined as

$$p_f = \sum_{i=K+1}^{M} p_i, \quad (26)$$

where p_i - probability of jump in "faulty" graph tree branch (9). It defines as probability of hit of source data in relevant areas of hyperspace Λ.

IV. CONCLUSIONS

So software errors can be detected and corrected with testing and operation testing or in-use. It means increase K with constant M in (26). This explains rise of software fault-tolerance when operation time increase.

Moreover, execution testing in the real environment or in-use can be used for hardware fault detection but can't be used for software error detection. Authors recommend to make control computation with other algorithm or/and other algorithm implementation and to compare these results with the accuracy of ε.

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Sensitivity Model of the Set Interdependent Electrical, Thermal and Mechanical Processes Totality of Electronic Equipment to Change of One of the Internal Parameters

Yury N. Kofanov[1], Svetlana Y. Sotnikova[2]
Department of Electronic Engineering
National Research University Higher School of Economics
Moscow, Russia
[1]y.kofanov@gmail.com, [2]sveta1708@mail.ru

Abstract— **In paper the authors consider creation of a sensitivity model for complex model of the interdependent electric, thermal and mechanical processes proceeding in an electronic equipment. The sensitivity model is formed by means of the principle of additional models creation. Use of complex model gives the chance to receive sensitivity functions of a process submodel variable of one physical nature to change of a process submodel parameter of other physical nature. It allows displaying actual parameters interrelation of heterogeneous physical processes within one design volume of electronic equipment.**

Keywords— Complex model; electronic equipment; physical processes; sensitivity model; topological model

I. Introduction

It is known that the most important electrical, thermal and mechanical models of electronic equipment can be built as the same type of equivalent circuits based on mathematical analogies [1]. This gives the possibility to design electronic products combining models of always mutually influencing each other flowing electrical, thermal and mechanical processes in a single integrated model. As a result, instead of sequential iterative calculations of individual processes models with sufficient computer power could go to a one-time modelling of all processes immediately using an integrated model [2].

Thus there is the possibility to find the sensitivity functions of the submodel process variable value of the same physical nature to the change of submodel process parameter of another physical nature.

To create an integrated model the separate submodels of electrical, thermal and mechanical processes must be represented in a unified undirected graph form [3], [4].

A sensitivity model can be obtained in a simple way based on the use of the creation principle of additional models [1], [5].

II. Sensitivity Model Creation of Interdependent Physical Processes

According to the aforementioned principle the parametric sensitivity can be explored using additional models, built as a result of the original model differentiation on the considered parameter. For topological model it leads to differentiation of the expressions

$$\psi_{ijk} = h_{ijk}\chi_{ij}; \tag{1}$$

$$X_{ijk} = \mu_{bm}^{ijk}\chi_{lm}; \Psi_{ijk} = \mu_{lm}^{ijk}\chi_{lm};$$

$$X_{ijk} = \mu_{lmn}^{ijk}\psi_{lmn}; \Psi_{ijk} = \mu_{lmn}^{ijk}\psi_{lmn}. \tag{2}$$

describing passive and active model branches. The expressions received as a result of differentiation show what transformations in initial model should be executed to turned it into additional. In topological synthesis and analysis, the additional model received the name of the transformed model.

At differentiation (1), it is necessary to consider two cases. The first is bound to the passive branch having the h_{ijt} parameter, which is not depending on primary q_k parameter to which sensitivity is investigated. Then by differentiation (1) on q_k we will receive:

$$A_{q_k}^{\psi_{ijt}} = h_{ijt}A_{q_k}^{\chi_{ij}}. \tag{3}$$

The second case corresponds to dependence of h_{ijt} branch parameter on primary q_k parameter. In this case, the right member (1) is differentiated as performing of two functions dependent on one q_k argument:

$$A_{q_k}^{\psi_{ijt}} = h_{ijt}A_{q_k}^{\chi_{ij}} + h'_{ijt}\chi_{ij}, \tag{4}$$

where $h'_{ijt} = \partial h_{ijt}/\partial q_k$.

Thus, in the transformed model all passive linear branches are left without change and if the parameter of a branch depends on the considered primary parameter, then iju branch is connected parallel to a passive ijt branch with a dependent data-flow active component

$$\Psi_{iju}^T = h'_{ijt}\chi_{ij}. \tag{5}$$

Here the superscript T means that this quantity belongs to the transformed model while the potential difference of c_{ij} applies into initial model.

Let's consider also a case of a non-linear passive branch in initial model which is in case of the former described by dependence, free of primary parameter: $\Psi_{ijt} = f(\chi_{ij})$. Differentiation of this equation in primary parameter gives:

$$A_{q_k}^{\psi_{ijt}} = f'_{\chi_{ij}}(\chi_{ij})A_{q_k}^{\chi_{ij}}, \tag{6}$$

where $f'_{\chi_{ij}}(\chi_{ij}) = \partial f(\chi_{ij})/\partial \chi_{ij}$.

As the potential variable quantity is a function of independent argument ζ (for example, time) and it turns out as a result of the solution of initial topological model, comparing (6) with (3), we come to a conclusion that the non-linear branch of initial model passes into the linear branch with variable parameter $h_{ijt} = f'_{\chi_{ij}}(\chi_{ij})$.

In the second case a non-linear dependence of a branch stream from a potential difference contains primary q_k parameter: $\Psi_{ijt} = f(\chi_{ij}, q_k)$. Then instead of (6) we will have:

$$A_{q_k}^{\psi_{ijt}} = f'_{\chi_{ij}}(\chi_{ij}, q_k)A_{q_k}^{\chi_{ij}} + \\ + f_{q_k}(\chi_{ij}, q_k) \tag{7}$$

where $f'_{q_k}(\chi_{ij}, q_k) = \partial f(\chi_{ij}, q_k)/\partial q_k$ – partial derivative of non-linear functional dependence of a ijt branch of initial model in the considered primary parameter which, as well as an augend in (4), plays a role of a dependent data-flow active component of iju branch entered in the transformed model in parallel to ijt branch:

$$\Psi_{iju}^T = f'_{q_k}(\chi_{ij}, q_k). \tag{8}$$

Injected active component, as well as a passive component of ijt branch which parameter, apparently from (7), is equal to $h_{ijt} = f'_{\chi_{ij}}(\chi_{ij}, q_k)$, depends on a potential variable c_{ij} quantity of initial model, but does not depend on variable quantities of transformed model. Therefore, the transformed model becomes the linear model with variable parameters even in case of nonlinearity of initial model.

This fact is very important for system automation at which many electrical, mechanical and thermal initial models are

non-linear. Linearity of the transformed models allows carrying out synthesis and the analysis of parametrical sensitivity of electronic equipment on more prime and efficient algorithms.

All cases of the transformed model creation for passive branches of initial model considered above are illustrated in fig. 1 and 2. In the same place, transition cases from the active branches of initial model to the corresponding branches of the transformed model are shown.
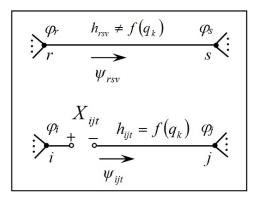
Fig. 1 Initial complex model of electronic equipment
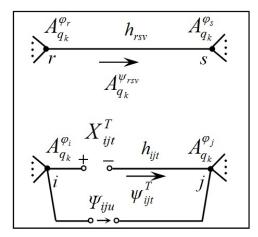
Fig. 2 Sensitivity model of electronic equipment

If in a ijt branch of initial model is only one active potential or a data-flow component, modeling external influence and the parameter of a branch is equal to zero $h_{ijt} = 0$, then in the transformed model the corresponding branch is excluded, and nodes i and j unite or left not integrated. It follows from the fact that in case of the former differentiation of the expression $\chi_{ij} = X_{ijt} \neq f(q_k)$ in the q_k parameter gives:

$$A_{q_k}^{\chi_{ij}} = 0, \tag{9}$$

and in the second case, differentiation of expression $\Psi_{ijt} = \Psi_{ijt} \neq f(q_k)$ in the q_k parameter gives:

$$A_{q_k}^{\psi_{ijt}} = 0. \tag{10}$$

If ijt branch besides the independent active potential X_{ijt} component contains a passive component with the h_{ijt} parameter, which includes primary q_k parameter, then the initial branch equation differentiation:

$$\psi_{ijt} = h_{ijt}\left(\chi_{ij} - X_{ijt}\right) \tag{11}$$

gives

$$A_{q_k}^{\psi_{ijt}} = h_{ijt}A_{q_k}^{\chi_{ij}} + h'_{ijt}\left(\chi_{ij} - X_{ijt}\right). \tag{12}$$

As shown in fig. 2, the first summand in (12) corresponds to ijt branch only with a passive component, and the augend – to iju branches injected into the transformed model in parallel to a ijt branch and containing a dependent data-flow active component:

$$\Psi_{ijt}^{T} = h'_{iju}\left(\chi_{ij} - X_{ijt}\right). \tag{13}$$

Transformation of branches with the dependent active components modeling internal actions of one parts of system on other parts is similarly carried out.

In fig. 1 the dependent potential X_{ijt} component that is in a ijt branch, which is characterized by the h_{ijt} parameter with primary q_k parameter entering it, is considered. At the same time actual cases when q_k does not enter the h_{rsv} parameter of rsv branch are set, but the the active X_{ijt} component depends on a potential or data-flow variable of this branch. At interrelation of electric and thermal processes in electronic equipment four chances provided below meet:

a) $X_{ijt} = \mu_{rs}^{ijt}\chi_{rs}; \mu_{rs}^{ijt} \neq f(q_k)$,

b) $X_{ijt} = \mu_{rs}^{ijt}\chi_{rs}; \mu_{rs}^{ijt} = f(q_k)$,

c) $X_{ijt} = \mu_{rsv}^{ijt}\psi_{rsv}; \mu_{rsv}^{ijt} \neq f(q_k)$,

d) $X_{ijt} = \mu_{rsv}^{ijt}\psi_{rsv}; \mu_{rsv}^{ijt} = f(q_k)$.

In case (a) value of the generated potential size of the active component depends on a potential difference between nodes r and s, and the proportionality constant in this dependence is not bound to the considered primary q_k parameter:

$$X_{ijt} = \mu_{rs}^{ijt}\chi_{rs}; \mu_{rs}^{ijt} \neq f(q_k). \tag{14}$$

In this case ijt branch equation has an appearance (11). Differentiation (11) on q_k taking into account (14) gives expression for absolute sensitive function of a stream:

$$A_{q_k}^{\psi_{ijt}} = h_{ijt}\left(A_{q_k}^{\chi_{ij}} - \mu_{rs}^{ijt}A_{q_k}^{\chi_{rs}}\right) + \\ + h'_{ijt}\left(\chi_{ij} - X_{ijt}\right). \tag{15}$$

The first summand in the received expression represents Ψ_{iju}^{T} stream in a ijt branch of the transformed model in which besides the passive h_{ijt} component there is a potential active component (see fig. 2):

$$X_{ijt}^{T} = \mu_{rs}^{ijt}A_{q_k}^{\chi_{rs}}. \tag{16}$$

Augend similarly (13) represents a data-flow active component in parallel-injected iju branch.

In case (b) in comparison with the first the condition of dependence of a constant of proportionality on primary q_k parameter is added, i.e. in (14) inequality it is replaced with equality. It leads instead of (15) in this case should be written down:

$$A_{q_k}^{\psi_{ijt}} = h_{ijt}(A_{q_k}^{\chi_{ij}} - \mu_{rs}^{ijt}A_{q_k}^{\chi_{rs}} - \\ \left(\mu_{rs}^{ijt}\right)' q_k \chi_{rs}) + h'_{ijt}\left(\chi_{ij} - X_{ijt}\right), \tag{17}$$

i.e. in a ijt branch of the transformed model, the potential active component instead of (16) accepts value:

$$X_{ijt}^{T} = \mu_{rs}^{ijt}A_{q_k}^{\chi_{rs}} + \left(\mu_{rs}^{ijt}\right)' q_k \chi_{rs}. \tag{18}$$

The third (c) and fourth (d) cases differ from the first two that in dependence (14) and consequently, also in the subsequent expressions, there is a ψ_{rsv} stream instead of χ_{rs} potential difference.

Creation of branches of the transformed model in the considered cases was made, as well as earlier, based on results of differentiation on the q_k parameter of expressions for ψ_{rsv} и ψ_{ijt} streams of both branches similar to expressions (11) and (13). Total expressions are given below.

a) $X_{ijt}^{T} = \mu_{rs}^{ijt}A_{q_k}^{\chi_{rs}}; A_{q_k}^{\chi_{rs}} = A_{q_k}^{\varphi_r} - A_{q_k}^{\varphi_s}$,

b) $X_{ijt}^{T} = \mu_{rs}^{ijt}A_{q_k}^{\chi_{rs}} + \left(\mu_{rs}^{ijt}\right)' q_k \chi_{rs}$,

c) $X_{ijt}^{T} = \mu_{rsv}^{ijt}A_{q_k}^{\psi_{rsv}}$,

d) $X_{ijt}^{T} = \mu_{rsv}^{ijt}A_{q_k}^{\psi_{rsv}} + \left(\mu_{rsv}^{ijt}\right)' q_k \psi_{rsv}$,

and $\Psi_{iju}^{T} = h_{ijt}\left(\chi_{ij} - X_{ijt}\right); A_{q_k}^{\psi_{ijt}} = \psi_{ijt}^{T} + \Psi_{iju}^{T}$.

Feature of the considered cases is existence in the transformed model of parallel branches with dependent data-flow components both between nodes r and s, and between nodes i and j. It is also possible to consider a dependent data-flow active component for which four cases in the same order as it was made higher for a potential active component.

Thus, all chances of transformation of the linear and non-linear, passive and active branches of initial topological models of the electric, mechanical and thermal processes,

which are found in practice of synthesis of electronic equipment, are presented. As it was shown above, the transformed model method allows receiving absolute sensitive function of all potential and data-flow variables of models to one q_k parameter. For other parameter it is required to build the new transformed model. However the synthesis and the analysis of electronic equipment by this method can be conducted in any area: functional, the frequency or temporary [6].

III. Conclusions

The synthesis and the analysis of the transformed model can be carried out or along with the synthesis and the analysis of initial model, or after that. In the latter case, it is enough to record the variable of initial model coming to the transformed model in a computer memory. Really, the transformed model is bound to the main only through dependent potential and data-flow active components (5), (8), (13), (18). Therefore for the initial and transformed models united as uniform model the common set of equations, for example, by a method of nodal potentials which decision gives the required potential and data-flow variables playing a role of absolute sensitive function of the corresponding variables of initial model in the transformed model can be made. The same results can be received, solving a set of equations, which is made only for the transformed model if the variables of initial model entering dependent active components of the transformed model will play a role of influence.

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Method of Increasing the Reliability of On-Board Electronic Equipment with an Analysis of Reserves for the Electrical, Thermal and Mechanical Loads

Yury N. Kofanov[1], Svetlana Y. Sotnikova[2], Sergey A. Subbotin[3]

Department of Electronic Engineering

National Research University Higher School of Economics

Moscow, Russia

[1]y.kofanov@gmail.com, [2]sveta1708@mail.ru, [3]subbotinsergeyandreevich@gmail.com

Abstract — **The paper is discussing a method of increasing the reliability of on-board electronic equipment at the early stages of its design. Authors offer to evaluate and provide deterministic reserves for thermal, mechanical and electrical loads to electronic components using special simulation software. Determinacy of reserves loads on the electronic components is achieved by a result of complex modeling as additional indicators of reliability. The main methods of reliability indicators calculation conducted in enterprises are probabilistic, which are averaged and do not lend themselves to practical verification during testing.**

Complex modeling of destabilizing effects on the printing circuit board of designed on-board equipment allows to achieve the required reserves on the electrical, thermal and mechanical loads with respect to the maximum permissible temperatures, vibration and shock acceleration in the electronic components, which leads to the guaranteed provision of high levels of reliability.

Keywords — reliability; electronic equipment; on-board equipment; complex modeling; thermal processes; mechanical stress; automated system ASONIKA; computer-aided design

I. INTRODUCTION

Currently, the material contained in research papers, textbooks and methods for calculating the reliability of on-board electronic equipment present themselves directly describe methods of calculation and estimation of reliability indices. However, they are not published materials on the issues of increasing the reliability by increasing the stability of the on-board equipment to electrical, thermal and mechanical stress. In turn, the literature, illuminating issues of thermal and mechanical effects, published separately, contains insufficient information on the relationship with reliability. But not paying attention to the complex influences of electrical, thermal or mechanical conditions on the reliability, it is impossible to achieve a significant increase in equipment reliability.

In the development of on-board electronics, a problem of destabilizing influences complex influence is very relevant [1]. This is due to hard operating conditions and relatively high power consumption of the equipment. Modern trends in the development of on-board electronic equipments can be characterized by an increase in productivity, accompanied by an increase in loads. Decrease in the size of the equipment, leads to increased density mounting of electronic components in the volume of equipment that emit a lot of heat when operating. In conjunction with increasing mechanical stress levels there is a tendency of increasing failure rate, which is unacceptable, especially for space and defense products.

Used electrical, thermal models have to be rather general and cover a large variety of designs, to be realized mathematically and at the same time adequate to study processes occurring in concrete objects. Performing these conflicting requirements is the main problem of electronic equipments design.

II. COMPLEX MODELING IN THE DESIGN OF ON-BOARD ELECTRONICS

The existing practice of mathematical modeling of electrical, thermal and mechanical processes with computer-aided design of various electronic equipments recommends a phased modeling method because the process of creation of electronic equipment is iterative, i.e., carried out in stages at each hierarchical level layout. This method is often referred to as modeling "top down" [2].

Modern on-board electronic equipment characterized by a great number of elements, nodes and a variety of functional mechanical and thermal connections between them and represents a complex technical system, comprising various functional elements and electronic equipment. The basic method of designing complex systems is a block-hierarchical, wherein in the process of designing the system is considered in sequence at different levels of the hierarchy with gradually increasing levels of detalisation [11]. There is a natural desire to find a method for analyzing the thermal and mechanical conditions, which would be adequate to block hierarchical design method, allowed to be with the required accuracy to obtain the necessary information on the temperature and mechanical field of the object, would have the generality and uniformity of approach.

The experience of calculations the thermal and mechanical regime of a variety of complex electronics objects [4], [7], energy [10], electrical engineering [2], optoelectronic systems [5], and another, has shown the effectiveness of the approach called the method of staged simulations [6]. Rationale and development of this method helps to reduce to a limited number of models used, which can be an implementation mathematical effected.

The changes made to designs of the onboard electronic equipment at design according to the results of thermal modeling, entail changes in the fields of acceleration stress, also play an important role in ensuring the reliability of the designed electronic devices, it is caused by rigid requirements of the operating conditions.

In addition, quality indicators and parameters of electronic components, on which depends the sustainable operation of on-board electronic devices are subject, depending on the temperature conditions and thermal situation during operation elements [8]. Overheating of the electronic components or containing their printing circuit boards, lead to a change in the linear dimensions of parts, deviation of electric indicators, for example, a change in resistance value of resistors.

The advantage is, above all, the simulation using a computer-aided design, not only accelerating the solution of the complex tasks to meet the requirements in terms of quality of equipment functioning at each stage of the iterative process of creating a highly reliable on-board equipment, but also provides comprehensive monitoring of parametric sensitivity of interconnected input and output system characteristics, affecting the quality of the output rate - reliability.

Construction of the difficult on-board equipment, which take place simultaneously in the operation of multiple heterogeneous physical processes (thermal, electrical, mechanical) leads a complex approach to modeling in the design.

Application relevance of complex methods of on-board equipment techniques (designing) modeling from the point of view of reliability is connected with identification of the multiple-factor (system) refusals which are shown only at simultaneous coexistence of set of the interconnected proceeding physical processes.

The experience of solving real problems with automated design shows that the decisive role played the informal search and analysis of options of constructive solves, held by a man [9]. The task of the automated subsystem of thermal design – give the user a tool for rapid calculation of temperature fields with the required degree of detail, allowing you too quickly and easily make corrections in the study design drawings.

Calculation conducting according to the developed method allows by the available thermo-physical characteristics of the electronic device designing and available heat power to determine the temperature of electronic components set on printed circuit boards that make up the on-board electronics devices.

However, reliability-oriented design of on-board electronic equipments, especially space and military, faced with the difficult task:

– lack of appropriate element base with the required high reliability and resistance to operational impacts, especially thermal and mechanical;

– difficulty of providing lightweight operation modes and conditions of use electronic components in view of ever-present random scatter of their parameters, as well as the electrical, thermal and mechanical operating conditions.

The disadvantages of existing techniques to ensure reliability of on-board electronic equipment in the design is the lack of integrated modeling, leading to an error in the appointment of an expert real thermal and mechanical conditions of each electronic component. It is not possible to calculate the value of reliability and output characteristics of the designed parameters of the electronic equipments.

In addition, it is important to take into account mathematical modeling errors at computer-aided design, due to the idealization of the physical processes in describing their mathematical models [3].

In the calculation of reliability is still to rely on manufacturers' data for intensities of electronic components failures. Taking into account the correction factors from the reliability directories it is necessary to consider the fact that the correction factors have statistical errors are published for the average temperature modes of electronic components taken equal 25 °C. Also, in process of thermal processes modeling and calculating mean values of the air temperature surrounding the circuit board components, very probable, not pay attention for a certain spread of temperatures values on thermal conditions picture of circuit board and around the different functional elements.

Correct accounting of the impact of thermal and mechanical modes with statistical reliability calculations should be carried out taking into account the correction factors for the real work of electronic components modes. Therefore, the requirement introduced in this developed method of increasing the reliability of on-board electronic equipment to loads factors reserves of electronic components are sufficiently large compared with the maximum permissible values

Only by achieving of reserves for temperature stress on electronic components by 0.4 – 0.5 compared to the limit, you can proceed to the calculation of probability indicators of reliability of the all the real-mode and the calculations of failure rates.

III. The Method of Increasing a Reliability

The purpose of the offered method of increasing the reliability of on-board electronic equipment is to achieve by an electric, thermal and mechanical loads – to explore the values of all load coefficients of each electronic component. The algorithm of method of increasing the reliability of on-board electronic equipment is shown in Fig. 1.
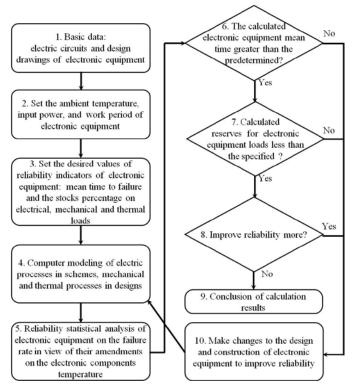
Fig. 1 Method of increasing the reliability of on-board equipment based on the complex simulations

After a complex simulation and follow-up research it is need to check adjudged to value of coefficient of thermal load on the electronic component to the recommended value of 0.5–0.6 with a margin of maximum permissible from technical specifications supplied by the manufacturer of the element base.

Taking into account the need for simulation of electrical, thermal and mechanical processes of on-board equipment the reliability increasing shall be provided with two stages of research.

In the first stage simulated electrical, thermal and mechanical processes of electronic device. The resulting temperature of the electronic component compared with the maximum permissible temperature values for each electronic component, and safety factors are calculated. For example, the safety factor of thermal load on electric component is calculated according to the formula:

$$S_{ei} = (T_{ei} - T_{mi}) / T_{ei}, \qquad (1)$$

where T_{mi} – the temperature obtained by simulation on PC, T_{ei} – the maximum permissible temperature at the electronic component, taken from the datasheet. The more safety factor, the safer working electronic component.

Next stage calculated probability of failure of the electronic equipment in the course of time t according to the formula:

$$P(t) = \exp(-\lambda \times t), \qquad (2)$$

where λ – equipment failure rate, equal to the sum of the failure rates of all electronic components in the electronic equipment:

$$\lambda = \Sigma\, \lambda_i. \qquad (3)$$

The failure rate of each electronic component equal failure rates λ_{io} at normal temperature 25 °C, multiplied by all correction coefficients k_{ie}, k_{it}, k_{im}, which is the real values of the loads: heat release output (voltage or current), temperature and vibration acceleration (shock) – each electronic component while it is working on the equipment:

$$\lambda_i = \lambda_{io} \times k_{ie} \times k_{it} \times k_{im}. \qquad (4)$$

The higher the value of the load factor, the greater the correction factor the lower the probability $P(t)$, that is, the lower the reliability of the equipment.

Therefore, it is necessary to make such changes in the design of electronic equipment to the value of each load factor as small as possible.

Here is an example of the complex on-board simulation block shown in Fig. 2. In a sealed aluminum alloy fixed printing unit (PU), the upper side of which there are electronic components. The device is intended for transmitting and receiving data in a telemetry.
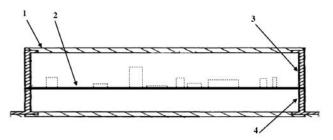
Fig. 2. Sketch (physical model) of one of the units on-board electronic device; 1 – block body; 2 – printed circuit board with electronic components (their dimensions are shown in dotted line); 3, 4 – the upper and the lower parts of the side wall of the body

At the first stage the macrosimulations of thermal block processes as a whole on the basis of data on the power of heat release all electronic components of printed circuit board. Simulation is carried out in the subsystem ASONIKA-T [13]. The result is real data on the thermal operating conditions of the printed circuit board in the block for subsequent individual modeling in order to obtain the temperature of each electronic components in block operating conditions.

General view of the topology of the thermal model of the test block, created in the subsystem ASONIKA-T is shown in Fig. 3. For ease of understanding the model, it is broken into pieces. Modeling subsystem receives duplicate node numbers as one and the same node.
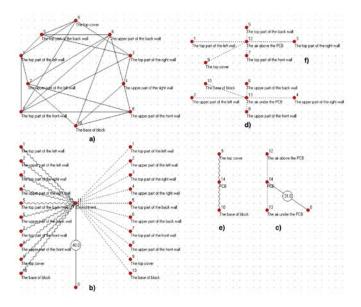
Fig. 3 Topological model of thermal processes ready for the calculation, where *a* – topological submodel of thermal processes conductive housing; *b* – the topological model of the thermal interaction between parts of the body with the environment by means of convection and radiation; *c* – topological model of interaction of the air inside the enclosure with the circuit board; *d* – air under interaction with the circuit board housing walls; *e* – radiative heat transfer to the circuit board top and bottom cover block body; *f* – the interaction of the air over the enclosure walls with circuit board

In the result of simulation we obtain our nodes temperature thermal model that correspond to the simulated body wall temperatures, the circuit board, and air inside the block body. This is clearly seen by the inscriptions in Fig. 3.

In the next stage, the modeling of the thermal regime of the circuit board is carrying out in order to determine the body temperature of each electronic component. Simulation is carried out in the subsystem ASONIKA–TM. According to the simulation results determine whether there is electronic components which the temperature exceeds the limit value. The color picture (fig. 4) of a thermal field allows you to visually with the help of the temperature scale to determine the most heated electronic components. The exact values of the calculated temperatures are shown in the map of thermal conditions. Table I shows a fragment of the map for the most loaded electronic components.

In the analysis of map of temperature modes conclude about the need to make changes in the design of the unit in order to avoid thermal overload of individual electronic components. For example, in Table 1 shows that the resistors *R*80 and *R*76 have a thermal overload. They should be replaced by other resistors with the same nominal values, but with higher values of maximum allowable temperatures.

To improve the reliability of the on-board unit is also necessary to carry out simulation of mechanical processes to obtain data on the fields in the acceleration of circuit board with vibrations and accelerations in the electronic component. Simulation of thermal conditions can lead to changes in the design of the device, which is taken into account during the

next stage of mechanical calculation. Mechanical calculation subsystem ASONIKA–TM allows you to see the effects of the changes and deviation of reserves in terms of overload on the components. If the reserve is not sufficient, it shall take a decision on the need for additional changes to the.
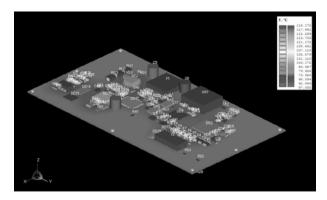
Fig. 4.The temperatures field of circuit board

TABLE I. MAP FRAGMENT OF THERMAL MODES OF ELECTRONIC COMPONENTS

No	Electronic component designation	Electronic component temperature		Coefficient of thermal loading, relative unit	Overheat, °C
		Calculated, °C	Maximum admissible on specifications, °C		
1	R73	118.1	150.0	0.79	0
2	R72	116.9	150.0	0.78	0
3	R74	115.9	150.0	0.77	0
4	R71	113.8	150.0	0.76	0
5	R67	111.8	150.0	0.75	0
6	R69	111.7	150.0	0.74	0
7	R66	109.8	150.0	0.73	0
8	R80	133.1	125.0	1.07	8.1
9	R76	132.7	125.0	1.06	7.7

Calculation results of the mechanical mode circuit board of the block when exposed to 10g harmonic vibration amplitude in the range from 10 to 10,000 Hz shown in Fig. 5. It presents the stress field at a frequency of 1 kHz.

Table II shows the electronic components with the maximum acceleration values calculated for them.

As seen from the results, the acceleration fields are formed wider in the middle of the board. Even without the resonance frequency the acceleration fields cause strong vibration, and as a result, many components receive a significant risk of overload and fail. Dot mounting board by some distance, you can achieve lower frequency accelerations, narrowing the acceleration field and reducing the vibration plate.
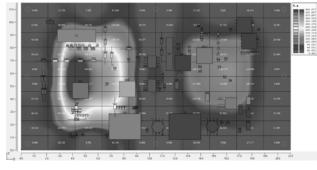
Fig. 5. The stress field at a frequency of 1 kHz

TABLE II.   MAP FRAGMENT OF MECHANICAL MODES OF ELECTRONIC COMPONENTS

No	Electronic component designation	Calculated acceleration, g	Maximum admissible acceleration on specifications, g	Coefficient of mechanical loading, relative unit	Overload
1	C70	430,3	40	10.76	390.28
2	DD2	380,2	40	9.51	340.20
3	C54	369,2	40	9.23	329.25
4	C13	369,2	40	9.23	329.25
5	C58	369,2	40	9.23	329.25
6	R69	369,2	40	9.32	329.25
7	VD13	348,4	40	8.71	308.38
8	R19	348,4	40	8.71	308.38
9	R20	348,4	40	8.71	308.38
10	R21	348,4	40	8.71	308.38

IV. CONCLUSION

The proposed method of increasing the reliability of on-board electronic equipment, compared to the method used in the standard [12], allows you to take into account when predicting factors reliability real-mode and conditions of the electronic components operation that can not only improve simulation accuracy, but also to identify the elements most susceptible to overloads and take designs before production equipment. Furthermore, this method can be used to improve the reliability of other electronic devices.

ACKNOWLEDGMENT

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Modeling of Beam-Plasma Devices Slow-Wave Structures and Analysis of Their Dispersion Characteristics

S.A. Presnyakov, A.D. Kasatkin, N.P. Kravchenko

MIEM HSE

National Research University Higher School of Economics

Moscow, Russia

pressnyak@gmail.com, sanchezonok@mail.ru,
natkrav@inbox.ru

S.V.Mukhin

Moscow, Russia

mukhin_sergey@yahoo.com

Abstract—**In modeling of resonator slow-wave structures, equivalent systems method was used and collisionless plasma was used as the transit channel filler. Comparison of the results obtained demonstrates the accuracy of the developed model. The dispersion characteristics analysis was conducted.**

Keywords— resonator slow-wave structures; equivalent systems method; model of slow-wave structure's cell; plasma filling of transit channel; cell equivalent scheme; dispersion characteristics

I. INTRODUCTION

High-power electronic devices of microwave range are the main sources of electromagnetic energy for many areas of communications technology [1,2]. Traditionally, these are different electrovacuum devices of microwave frequencies [3] such as traveling-wave tubes (TWTs), klystrons, magnetrons, backward-wave tubes, and so on.

Along with the electrovacuum devices, beam-plasma microwave devices have received development microwave [4,5]. The presence of plasma substantially influences the characteristics of devices and allows to improve some of them: for example, the output power and efficiency can be increased and the working bandwidth can be expanded.

II. MODEL OF "CHAIN OF COUPLED RESONATORS"-TYPE SLOW-WAVE STRUCTURE CELL TAKING INTO ACCOUNT TRANSIT CHANNEL

In most cases, the propagation of waves through the central channel is neglected, but this possibility exists and needs to be taken into account when considering slow-wave structures with channels filled with collisionless plasma.
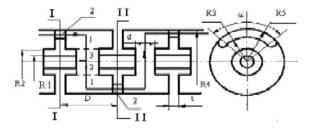
Fig. 1. Slow-wave structure of "chain of coupled resonators"-type

In order to construct the cell's model in the absence of the exiting current, the equivalent systems method is applied and the rectangular slow-wave structures of "winding waveguide"-type are used, which are the most simply described by this method (Fig. 2).

There D is the period of SWS.
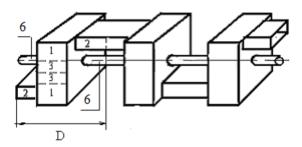
Fig. 2. Slow-wave structure of "winding waveguide"-type

When constructing the model the original slow-wave structure is divided into partial areas by planes perpendicular to the direction of the microwave energy propagation within it. Selected partial areas are replaced by waveguide channel segments with a rectangular and circular cross-section. Such types of cross-section are chosen, because an analytical solution of the inner electrodynamic problem for them is known. In order to describe partial areas of the structure, the equivalents $U_{eq}, I_{eq}, Z_{eq}, \gamma_{eq}$ are introduced. Based on the analysis of fields matching conditions at the boundaries of the partial areas, the quadripoles are combined into equivalent circuit of the investigated slow-wave structure.

The central channel is a periodic structure composed of segments of circular waveguides and interaction gaps. It is assumed that only E_{10} wave travels in circular waveguides. For this wave parameters U_{eq}, I_{eq}, Z_{eq} of the equivalent transmission line defined by the transverse components of the fields E^{τ}, H^{τ} as follows:

$$U_{eq} = -\int_1^2 E^\tau dl \qquad I_{eq} = \oint H^\tau dl \;, \qquad Z_{eq} = \frac{U_{eq}}{I_{eq}} \;,$$

$$\gamma_{eq} = \frac{2\pi}{\lambda} \sqrt{1 - \frac{\lambda^2}{\lambda_{cr}^2}}$$

There λ is a wavelength, λ_{cr} is a critical wavelength.

This line is described by the transmission matrix:

$$CAj(\lambda) := \begin{pmatrix} \cosh(\psi j(\lambda)) & -zj(\lambda) \cdot \sinh(\psi j(\lambda)) \\ \dfrac{-\sinh(\psi j(\lambda))}{zj(\lambda)} & \cosh(\psi j(\lambda)) \end{pmatrix}$$

where

$$zj(\lambda) := \frac{-\sqrt{\dfrac{\mu 0}{\varepsilon 0}} \cdot J0(0) \cdot \sqrt{\left(1 - \dfrac{p^2 \cdot \lambda^2}{r1^2 \cdot 4 \cdot \pi^2}\right)}}{2 \cdot \pi \cdot p \cdot \dfrac{d}{r1} J0(p)} \;,$$

$$\psi j(\lambda) := \frac{2 \cdot i \cdot \pi \cdot l5}{\lambda} \cdot \sqrt{\left(1 - \dfrac{p^2 \cdot \lambda^2}{r1^2 \cdot 4 \cdot \pi^2}\right)} \;,$$

$J0(p)$ is Bessel function of the first kind of zero order, p is the first root of the Bessel function of zero order, r1 is radius of the transit channel.

The components of the electric field in the transit channel are a periodic function of longitudinal coordinate Z. The longitudinal component of the field on the border of the channel exists only in the interaction gap and it is assumed that it is constant. This periodic function is a sum of spatial harmonics:

$$E_0(r, \varphi, z) = \sum_{n=-\infty}^{n=\infty} c_n e^{-i\frac{2\pi n}{D}z}$$
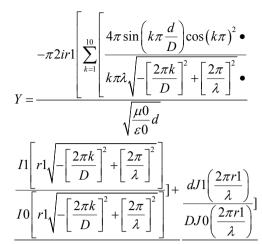
Using the boundary conditions on the channel, the amplitude of the longitudinal component of the electric field and the azimuthal magnetic field component are determined. In a known manner the equivalent current is introduced, and in the center of the gap the resistance, which relates the voltage across the gap and the longitudinal current, defined by the azimuthal magnetic field, is determined by the expression:

$$Z = \frac{E_0 d}{I_{eq}}$$

where E_0 is constant field in the gap of interaction, d is the width of the gap of interaction. The magnitude of the resistance is determined by expression:

$$Z = \frac{1}{Y} \;,$$

where

$$Y = \frac{-\pi 2 ir1 \left[\sum_{k=1}^{10} \frac{4\pi \sin\left(k\pi \dfrac{d}{D}\right) \cos\left(k\pi\right)^2 \bullet}{k\pi\lambda\sqrt{-\left[\dfrac{2\pi k}{D}\right]^2 + \left[\dfrac{2\pi}{\lambda}\right]^2} \bullet} \right]}{\sqrt{\dfrac{\mu 0}{\varepsilon 0}} d}$$

$$\frac{I1\left[r1\sqrt{-\left[\dfrac{2\pi k}{D}\right]^2 + \left[\dfrac{2\pi}{\lambda}\right]^2}\right]}{I0\left[r1\sqrt{-\left[\dfrac{2\pi k}{D}\right]^2 + \left[\dfrac{2\pi}{\lambda}\right]^2}\right]}] + \frac{dJ1\left(\dfrac{2\pi r1}{\lambda}\right)}{DJ0\left(\dfrac{2\pi r1}{\lambda}\right)}]$$

There I0(x), I1(x) are modified Bessel functions.

Construction of an equivalent circuit of the second propagation channel of the microwave energy is carried out in the same way as in the case of consideration of the slow-wave structure cell without the influence of the transit channel. After determination of $U_{eq}, I_{eq}, Z_{eq}, \gamma_{eq}$, waveguide segments are modeled by quadripoles connected in cascade and sequentially.

Transmission matrices, which models segments of waveguide channels, in this case are

$$CAj(\lambda) := \begin{pmatrix} \cosh(\psi j(\lambda)) & -zj(\lambda) \cdot \sinh(\psi i(\lambda)) \\ \dfrac{-\sinh(\psi j(\lambda))}{zj(\lambda)} & \cosh(\psi j(\lambda)) \end{pmatrix}$$

$$zj(\lambda) := \frac{b2 \cdot \sqrt{\dfrac{\mu 0}{\varepsilon 0}}}{a2 \cdot \sqrt{1 - \dfrac{\lambda^2}{4 \cdot a2^2}}} \;,$$

$$\psi j(\lambda) := \frac{2 \cdot i \cdot \pi \cdot lj \cdot \sqrt{1 - \left(\dfrac{\lambda}{2 \cdot a2}\right)^2}}{\lambda}$$

where $b2$ is girth, $a2$ is width and l_j is length of rectangular waveguide segment.

The exciting current or other effects can be connected to the central terminals of this circuit. The resulting equivalent circuit channels of the microwave power transmission in the considered slow-wave structure are combined into a single scheme, taking into account the fact that there is a connection for both voltage and current (magnetic and electric field) between them. The equivalent circuit takes the following form (Fig. 4).
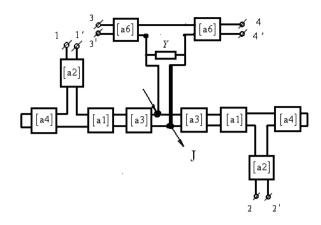
Fig. 4. Equivalent circuit of slow-wave structure cell

The basis of the model construction is the model presented on Fig. 5. The difference is that the division of the original slow-wave structure on cells is carried out by planes perpendicular to the flux of the microwave power in the main channel in the interaction gap.
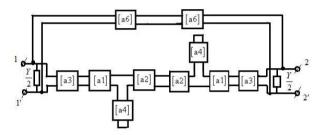
Fig. 5. Equivalent circuit of slow-wave structure cell filled with collisionless plasma

It is assumed, that the transit channel is filled with collisionless plasma. The plasma frequency is determined by the expression:

$$\omega_p = \sqrt{\frac{\nu e^2}{m \varepsilon_0}},$$

where ν is the plasma concentration, e is the electron charge, m is the electron mass.

The cyclotron frequency is determined by the expression:

$$\omega_c = \frac{e \cdot B}{m},$$

where B is the magnetic field intensity. Dielectric constants are found using following equations [7]:

$$\varepsilon_z(\nu,\omega) = 1 - \frac{\omega_p^2(\nu)}{\omega^2}, \quad \varepsilon_r(\nu,\omega) = 1 - \frac{\omega_p^2(\nu)}{\omega^2 - \omega_c^2(\nu)}$$

The dispersion characteristics of the circular waveguide filled with plasma in an infinite magnetic field is determined by the expression:

$$h = \sqrt{\left(\frac{\omega}{c}\right)^2 - \frac{p^2}{a^2 \varepsilon_z(\nu,\omega_p)}}.$$

The dielectric constants are used in the determination of the phase shift and characteristic impedance of the transit channel segments and elements of the corresponding transmission matrices.

$$\psi6(\nu,\lambda) := \frac{2 \cdot i \cdot \pi \cdot l5 \cdot \sqrt{\varepsilon r(\nu,\lambda)}}{\lambda} \cdot \sqrt{\left(1 - \frac{p^2 \cdot \lambda^2}{r1^2 \cdot \varepsilon z(\nu,\lambda) \cdot 4 \cdot \pi^2}\right)}$$

$$z6(\nu,\lambda) := \frac{-\sqrt{\frac{\mu0}{\varepsilon0}} \cdot J0(0) \cdot \sqrt{\left(1 - \frac{p^2 \cdot \lambda^2}{r1^2 \cdot \varepsilon z(\nu,\lambda) \cdot 4 \cdot \pi^2}\right)}}{2 \cdot \pi \cdot \sqrt{\varepsilon r(\nu,\lambda)} \cdot p \cdot \frac{d}{d p} J0(p)}$$

$$CA6(\nu,\lambda) := \begin{pmatrix} \cosh(\psi6(\nu,\lambda)) & z6(\nu,\lambda) \cdot \sinh(\psi6(\nu,\lambda)) \\ \frac{\sinh(\psi6(\nu,\lambda))}{z6(\nu,\lambda)} & \cosh(\psi6(\nu,\lambda)) \end{pmatrix}$$

They are also used when calculating the conductivity Y.

III. INVESTIGATION OF DISPERSION CHARACTERISTICS OF "CHAIN OF COUPLED RESONATORS"-TYPE SLOW-WAVE STRUCTURE CELL WITH TRANSIT CHANNEL

The results of dispersion characteristics calculation of rectangular "chain of coupled resonators" (CCR) with interaction gaps different in height (1.3mm and 4.3mm respectively) at plasma concentrations 6.4h1017 1/m3, as compared to the dispersion characteristics of the rectangular plasma CSC without filling are shown in Fig. 6 a,b, 7 a,b.

In order to assess the adequacy of the developed model the results of calculation of electrodynamic characteristics using strict electrodynamic program HFSS with the results obtained on the developed program were compared. The algorithm of this program is similar to the given above, but uses Z-matrix calculated by 3D simulation results.

The calculations were performed for different radii of the transit channel and interaction gaps and cavities of the same size.
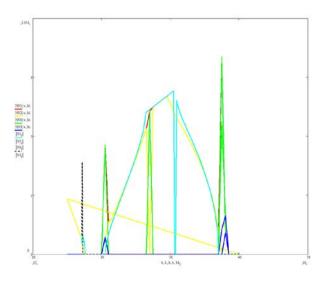
Fig. 6a. Dispersion characteristics of the slow-wave structure interaction gap with height 1.3 mm at a plasma concentration of $0 \times 10^{17} \frac{1}{m^3}$ (1) and $6.4 \times 10^{17} \frac{1}{m^3}$ (2).
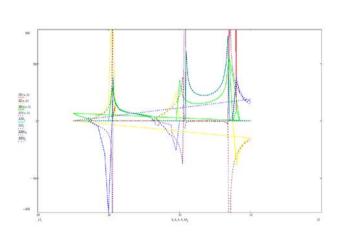
Fig. 7a. Dispersion characteristics of the slow-wave structure interaction gap with height 4.3 mm at a plasma concentration of $0 \times 10^{17} \frac{1}{m^3}$ (1) and $6.4 \times 10^{17} \frac{1}{m^3}$ (2).

Fig. 6b. Actual (solid) and imaginary (dashed) characteristic impedance of the slow-wave structure with interaction gap with height 1.3 mm at a plasma concentration of $0 \times 10^{17} \frac{1}{m^3}$ (1) and $6.4 \times 10^{17} \frac{1}{m^3}$ (2).
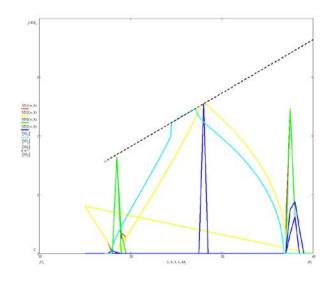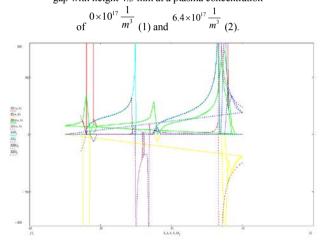
Fig. 7b. Actual (solid) and imaginary (dashed) characteristic impedance of the slow-wave structure with interaction gap with height 1.3 mm at a plasma concentration of $0 \times 10^{17} \frac{1}{m^3}$ (1) and $6.4 \times 10^{17} \frac{1}{m^3}$ (2).

When selecting a particular geometry of the rectangular slow-wave structure, the radius of the transit channel and plasma concentrations, the fusion of the bands and the extending of the slow-wave structure working bands to higher frequencies can be achieved (Fig. 8 a,b). Similar results are obtained when modeling axially symmetric slow-wave structures. The dispersion characteristics of such structure are shown on Fig. 9 a,b.

Analysis of the dispersion characteristics of hybrid slow-wave-structure confirmed the adequacy of the results in relation to the known experimental data and showed that the characteristic impedance increases when plasma injected into the channel.
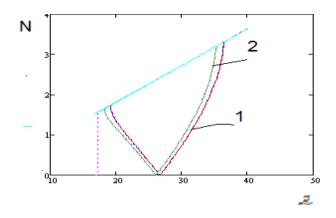
Fig. 8a. Dispersion characteristics of the rectangular slow-wave structure interaction gap with height 4.3 mm at a plasma concentration

of $0 \times 10^{17} \frac{1}{m^3}$ (1) and $3.4 \times 10^{17} \frac{1}{m^3}$ (2).
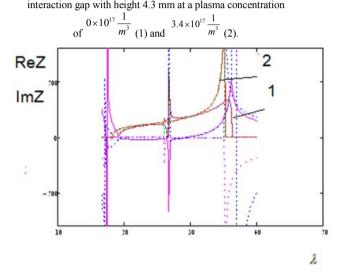
Fig. 8b. Actual (solid) and imaginary (dashed) characteristic impedance of the rectangular slow-wave structure with interaction gap with height 1.3 mm at

a plasma concentration of $0 \times 10^{17} \frac{1}{m^3}$ (1) and $3.4 \times 10^{17} \frac{1}{m^3}$ (2).
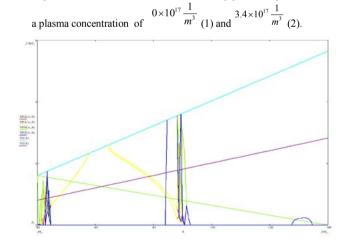
Fig. 9a. Dispersion characteristics of the axially symmetric slow-wave structure interaction gap with height 4.3 mm at a plasma concentration

of $0 \times 10^{17} \frac{1}{m^3}$ (1) and $3.4 \times 10^{17} \frac{1}{m^3}$ (2).
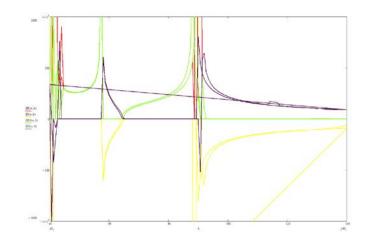
Fig. 9b. Actual (solid) and imaginary (dashed) characteristic impedance of the axially symmetric slow-wave structure with interaction gap with height 1.3

mm at a plasma concentration of $0 \times 10^{17} \frac{1}{m^3}$ (1) and $3.4 \times 10^{17} \frac{1}{m^3}$ (2).

IV.　CONCLUSION

Analysis of the hybrid slow-wave structures confirmed the adequacy of the developed in the first stage slow-wave structure cell model and revealed that the characteristic impedance when injected into the plasma channel increases and at a certain selection of the geometry of slow-wave structure and the plasma concentration the fusion of the bands is possible.

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Method of Study Mechanical and Thermal Processes of Receiver-Computer Unit for Unmanned Aerial Vehicles

Andrey S. Rotkevich[#1], Yury N. Kofanov[#2]
School of Electronic Engineering
National Research University Higher School of Economics
Russia, Moscow
[1]asrotkevich@edu.hse.ru, [2]ykofanov@hse.ru

Abstract— This article applied the methodology proposed for the study of mechanical and thermal processes occurring in the receiver-computer units (RCU) for unmanned aerial vehicles (UAV). This method provides for a mechanical and thermal simulation in two stages by means of subsystems ASONIKA-T, ASONIKA-M-3D (for the study unit with the construction of thermal and mechanical macro models) and ASONIKA-TM (for the study of each printing unit (PU) with automatic building course-difference thermal and mechanical models). Initial data are taken for real RCU. According to a study carried out to optimize the design to the improvement of its performance reliability.

Keywords—thermal study; mechanical study; computer modelling; optimization; onboard equipment; ASONIKA.

I. INTRODUCTION

UAV management is concerned with the processing of large amounts of information. For this purpose the apparatus includes in the computing devices. RCU analyzed in this article, is a member of board UAV control system. RCU receives signals from satellite navigation systems for UAV flight in near-earth space at any time of day and year.

Thus RCU should have high reliability, and to him are increased requirements for strength, stability and resistance to various external influences. One of the most significant factors affecting the reliability of the equipment are the mechanical and thermal factors, which represent the mechanical and thermal effects of the external environment and internal thermal and mechanical processes in operating electronic components. The maximum mechanical stress and temperature, radio components are installed on buildings, affect their reliability. Therefore, to achieve high performance reliability RCU is required to evaluate the mechanical and thermal conditions of each electronic component, and determining reserves for mechanical and thermal loads, find the circuit-design techniques to reduce them. The proposed method is carried out using system ASONIKA-T, ASONIKA-M-3D and ASONIKA-TM and demonstrated on the example of one of the receiver- computer unit for UAV.

II. RCU'S TECHNICAL FEATURES
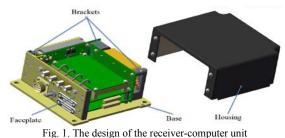
RCU design is shown on Fig. 1. Its body is made of aluminum alloy D16 and AD1. The block includes four PU which are located in two mutually perpendicular planes: two PU for receiving and processing information are set horizontally, and the two power and generator PU - vertically. The material of printed circuit board is FR4 with a thickness of 1.5 to 2 mm. All incoming printed components are fixed at four points with special steel brackets. To provide additional stiffness elements of internal receiver-computer unit all printing units are interconnected by special mainboard rigid connectors.

Receiver-computer unit should be durable and resistant to external mechanical factors (vibration, shock, linear acceleration); be resistant to aggressive media and the influence of different kinds of working solutions; to the effects of static and dynamic dust, molds; to the conditions of the increased humidity of the environment, under the influence of sea fog, precipitation, dew, ice; as well as a possible change in air pressure in accordance with its execution group according to GOST RV 20.39.304-98.

In accordance with the technical specifications RCU should operate in an ambient temperature of - 40 ℃ to + 50 ℃. In the block there is no forced cooling.

In the RCU observed following thermal processes: conduction through the internal fastening elements and between the unit base and the mounting surface to the UAV; radiation and convection from the outside unit and inside it.

As a result of mechanical and thermal simulation decision will be taken to optimize and improve designs available.

Fig. 1. The design of the receiver-computer unit

III.   PREPARATION OF INITIAL DATA AND THE SIMULATION

After analyzing the design features necessary to prepare the raw data required to carry out computer simulations on the mechanical and thermal effects. Software product for modeling of selected automated system to ensure reliability and quality of the equipment (ASONIKA). The system has a certificate of quality issued by the Ministry of Defense of the Russian Federation [1]. The advantage ASONIKA system is the presence of built-in databases, which contain radio components (RC) and structural materials in accordance with national standards [4].

According to the proposed method of block modeling in ASONIKA system is carried out in 2 stages "top - down". Initially the entire block is investigated to calculate mechanical properties at fixing PU and obtaining the average values of all elements heat block structure (PU four, six and air casing surrounding the walls of the PU). The next step is already being seen every single PU to obtain the values of mechanical properties and temperature on each individual RC (at the same time as the initial data come from the values of mechanical influences in PU mounting sites, average temperatures PU, block walls and the air volume produced in the first stage).

For the first phase of the simulation RCU mechanical impact the following data were obtained: geometrical dimensions of the unit and all of its member PU and other structural elements in accordance with the 3D model made in SolidWorks environment; from databases and directories are specified all received physical and mechanical properties of materials RCU housing, PU and other structural elements (density, elastic modulus, Poisson's ratio); set the boundary conditions fix RCU; parameters mechanical action introduced.

For thermal modeling of the initial phase following initial data were prepared: thermal parameters of bearing structures of materials taken from databases and directories (thermal conductivity, heat capacity) [3]; 3D-model design unit, imported from SolidWorks environment; specified thermal parameters of materials and heat generation capacity of PU, as well as specifying the path conductive, convective and radiant heat transfer.

For the initial stage of the subsystem ASONIKA-T block simulation on unsteady heat exposure thermal block model was constructed (see. Fig. 2) [2].
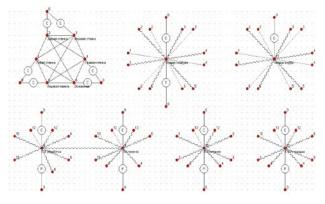
Fig. 2. Thermal topological model of RCU

The first heat calculation showed that the average temperature of the PU have elevated values due to their location close to each other, while a distance from the PU to the unit casing wall has reserves [5]. Therefore, optimization has been performed in the PU's location, which allowed to obtain the final values of temperature shown in the Table 1.

TABLE I. TEMPERATURE VALUES IN ALL NODES OF MODEL

Number of node model	The name of the block constructive	Temperature, ° C
1	The left wall	51,03
2	The back wall	51,00
3	The upper wall	51,13
4	The right wall	51,04
5	Base	50,97
6	Faceplate	51,01
7	The air outside	50,00
8	PU processing	54,01
9	PU reception	59,24
10	PU power	57,56
11	PU generation	55,75
12	The air inside	53,01

Average temperatures all of PU are acceptable compared to the maximum permissible maximum values specified in the technical specifications for the RC.

,Fig. 3 shows the voltage values resulting from the first stage of the simulation and computing unit receiving the effect single mechanical shock subsystem ASONIKA-M-3D.
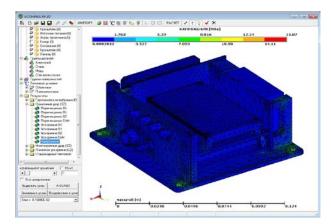
Fig. 3. Stresses in the RCU when exposed to a single strike

The values obtained for the stress and other mechanical characteristics are within specified limits and do not exceed the maximum permissible for the materials and RC.

Thus, you can proceed to the second stage of modeling - the refinement of mechanical characteristics and RC temperature located in each PU. To clarify this, as described in the proposed method is intended subsystem ASONIKA-TM.

For mechanical simulation PU according to the second stage of the proposed method the following input data were prepared: physical and mechanical properties of materials and geometric parameters of the PCB and all the RC, in the calculation; places assemblies fixtures; parameters in the mechanical characteristics of attachment points PU obtained at step 1 modeling.

The modeling was carried out to optimize the design of PU and the entire block associated with an increase in the number of PU mounting points. As a result, values were obtained by mechanical overloads on the RC does not exceed the values specified in the technical specifications (see. Fig. 4 on the example of PU reception). Also, as can be seen on the example of the amplitude-frequency response card acceptance (see. Fig. 5) after optimization managed to get rid of the resonance oscillation in the system.
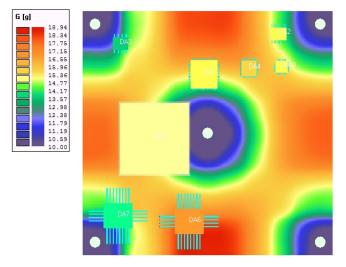
Fig. 4. Fields of the accelerations in the PU reception under the influence of harmonic vibration
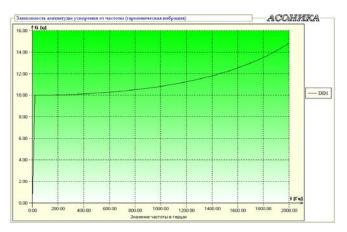
Fig. 5. Amplitude-frequency response on DD1 element (PU reception)

Next to the thermal simulation PU following initial data were prepared in accordance with the second phase of the proposed method: thermal parameters of materials and geometric parameters of the printed circuit board and all the RC; heat generation capacity in each RC; surface conductive and radiative heat transfer; medium temperature and PU block walls, and the air volume around the PU obtained in the first stage simulation.

As a result of simulation PU thermograms were obtained, as well as temperature and reserves of temperatures on each RC. Fig. 6 and Table 2 shows the results of a simulation one of the PU.
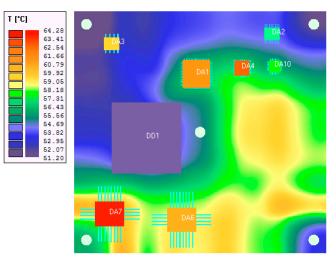
Fig. 6. Thermogram of upper surface PU reception

TABLE II. THERMAL REGIME OF THE RADIO COMPONENTS OF THE PU RECEPTION

RC	RC temperature		Thermal load factor
	Estimated, °C	According to the technical specifications, °C	
DA2	56,91	85,00	0,67
DA9	59,74	85,00	0,7
DA8	55,69	85,00	0,66
DA3	54,52	85,00	0,64
DD1	53,08	85,00	0,62
DD3	60,58	125,00	0,48
DA7	62,41	85,00	0,73
DA6	60,48	125,00	0,48
DA10	56,59	125,00	0,45
DA4	60,78	125,00	0,48
DA1	59,74	85,00	0,7
DA5	60,42	125,00	0,48
D1	60,03	85,00	0,7

As can be seen, the values obtained at temperatures RC does not exceed the permissible values indicated in the technical specifications, while possessing good reserves of thermal stress.

IV. CONCLUSIONS

In this paper, on the basis of the developed method was studied mechanical and thermal processes occurring in the onboard receiver-computer unit for unmanned aerial vehicle. In the preliminary stages of design unit in the research process using subsystem ASONIKA-T and ASONIKA-TM has identified the need to optimize the design of the unit to improve the mechanical and thermal characteristics. The final mechanical and thermal studies assemblies using subsystem ASONIKA-TM showed that the electronic components on printed circuit boards have sufficient supplies for mechanical and thermal loads. This is indicative of providing high reliability of assemblies and all receiver-computer unit as a whole.

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Computer-Aided Estimation of Portfolio Management Quality

Alia M. Sharipova, Valentin U. Arkov
Department of Automated Control and Management Systems
Ufa State Aviation Technical University
Ufa, Russia
a.shamsieva@gmail.com; v_arkov@mail.ru

Abstract— This article presents a practical approach to estimating of the investment strategy robustness. As a quantitative measure of robustness, the objective function smoothness degree is proposed for utilization. After the optimization has been conducted, it is essential to utilize an additional criterion for the selection of strategies that possess better robustness property. The utilization of the quantitative estimate of the strategy robustness enables a better strategy to be chosen in the efficiency analysis of investment systems. This strategy is more stable and provides higher return in various stock market conditions, including the sideways trend and downtrend.

Keywords—portfolio management; robustness; collective investment; investment strategy; strategy efficiency.

I. INTRODUCTION

The efficiency of portfolio management of most asset management companies varies significantly from year to year. Portfolio management results of most mutual funds and asset management companies during the latest financial crisis demonstrated a failure of achieving a positive investment return in downtrend market conditions. For instance, the drop in Russian stock indices RTS and MICEX in 2008 affected the assets value of management companies' portfolios. As a result, the return of investment management was negative and reduced the size of the invested assets. Most asset management companies use only positive return investment periods in their ads. As an illustration of this approach, the following marketing technique is often employed. The asset management company provides its prospective investors with the portfolio management efficiency data over a rather long time period without mentioning the prior recession year. Hence, the average return of the mentioned investment period seems to be positive or higher than the average return in consideration of the recession year.

Conventional portfolio management strategies prove to be efficient in the uptrend market conditions. In order to make a positive return during downtrend and the lack of the price directional movement, it is essential to review the portfolio management concepts. On the basis of the efficiency increase analysis of the portfolio management in downtrend and sideways trend, the problem of portfolio management methods optimization becomes topical. During high volatility periods,

the solution lays in active portfolio management in terms of the investment problem. The appropriate tools are to be developed for valid choice of strategies and asset management principles of portfolio management strategy development.

Consider the active portfolio management in the context of utilization of trading concepts. During unfavorable price movement at the stock market the portfolio manager has an opportunity to temporarily put assets over in cash or bonds. This might be considered equivalent to opening and closing of a long position in conventional trading, applied to much longer timeframes. To compensate for downtrend or sideways trend, a trading strategy as part of active portfolio management can be used.

The active portfolio management requires the valid selection of the investment strategy and asset management principles. Moreover, one of the major efficiency indicators is stability and positive investment result. This requirement refers to investment results of asset management companies and involves the robustness analysis of utilized investment strategy. In this paper, the problem of the quantitative estimation of the investment strategy robustness is considered as an active portfolio management tool. It is essential to determine which estimates of the robustness can be applied to investment strategies as distinct from the known approaches in the modern control theory and statistics.

The efficiency of the active portfolio management in various conditions of the stock market appears an actual problem. From our prospective, it is essential to develop the method of the investment strategy "stability" analysis for the selection of asset management company and the investment strategy. The criterion of the investment strategy stability is increasingly mentioned among professional traders. One of the major problems of the investment strategy design is the estimation of the investment system robustness. Though there is no specific methodology to identify the robustness of the investment strategy. Today, under the robustness requirement is regarded that the system demonstrates stable performance of the investment strategy algorithm.

Theoretical methods of the automatic objects stability study are widely used in solving various practical problems.

The research of the system stability (robustness) is associated with the uncertainty of the object performance and with a variety of unaccounted environment factors. The term robustness is borrowed from the field of the control theory and statistics. It is not clear enough how to apply this criterion for the investment strategy design. In such a way, it is essential first to determine what the robustness means in various fields of social and economic systems.

II. OPTIMAL STRATEGY: SOLUTION SURFACE ANALYSIS

As analysis of world citation databases shows, starting from the 1990s onwards the exponential growth of publications is observed, concerning robustness issues. In the social and economic domain, there is still no agreed upon definition of robustness and methods of its quantitative determination. According to the dynamics of publications on research of the robustness concept, it is possible to say that currently the research results are presented mostly at the theoretical level. In the papers mentioned in the reference list, the term "robustness" is mostly related to solving optimization problems and decision making, including portfolio management. The concept of "robust optimization" appeared as an attempt of the reduction of parametric and stochastic uncertainties in decision making problems [15].

The general idea of the robustness properties estimation is based on the requirement of low sensitivity to the uncertainty of various system parameters or environment conditions. In the context of investment strategies, the term robustness means stability of the system expressed in the steady positive deposit dynamics. One of the basic methods of the investment strategy estimation is its backtesting with the determination of all potential deals on the basis of the strategy algorithm and the calculation of major efficiency indicators. The investment strategy robustness assumes that the system applied to various markets, financial instruments and time periods, has a capacity of maintaining efficiency indicators values in some average range.

The robust investment strategy should be that demonstrating low variance of efficiency indicators, instead of achieving higher indicators values. This means that the system maintains stable output under varied parameters values.

The major purpose of the investment strategy development is the selection of optimal values. It is possible to construct an objective function for one or several varied parameters of the investment strategy algorithm during the analysis of the investment strategy properties.

For the investment strategy optimization problem, the analysis of the objective function properties has to be conducted. It is additionally proposed to introduce constraints on the character of the objective function. These constraints are assumed as quantitative estimates of the smoothness of the solution surface. The robustness estimation of the investment strategy enables to evaluate the sensitivity of the obtained values to the object uncertainty. The intended robustness property consists to a greater extent of the objective function smoothness.

The surface area can possess various smoothness degrees. In [14], it is supposed that if the objective function is characterized by larger smoothness, then it is usually more stable (robust). This approach to solving the optimization problem of the investment strategy assumes the desired robustness property. However, this requirement is stated in the verbal form. For the correct investment strategy efficiency analysis, it is essential to develop quantitative estimates of this robustness property expressed in terms of the objective function form.

In this paper, the research of optimization results is conducted using the analysis of the objective function surface. The objective function surface characterizes the investment strategy performance in several historical data samples with different sets of parameters values. For the comparison of the various investment strategies, the annual return is utilized as the main efficiency criterion.

One of the most essential stages of the optimization process is the validation of the obtained optimal parameters values using another sample. According to the analysis of the validation set testing results, it is possible to say that obtained parameters are useful and efficient in various market conditions. In this paper, the major idea of validation set testing is the determination of the objective function surface characteristic.

For the property investigation of the objective function, it is necessary to conduct the analysis of the return diagrams. The visual analysis on quantitative level gives only a general concept of the objective function form because of the following. First, investment strategy efficiency indicators are evaluated for a discrete set of parameters values. The second reason is the high complexity of the investment strategy testing process with different parameters values combinations, particularly in case of the necessity of manual run of the system rules sets with specified parameters. For this problem, the expression for the objective function in analytical form is a challenging task.

In such a way, the utilization of investment strategies as the active portfolio management tool assumes periodical review of strategies and the determination of optimal parameters in the return maximization or the deposit drawdown minimization problem. Also, the search for the optimal investment strategy with various parameters combination is a time consuming process. Consequently, for the optimization of the ill-formalized investment strategy algorithm, it is necessary to select carefully varied parameters, in order to decrease the complexity down to an acceptable level robustness measure development.

In the paper, two investment strategies based on technical analysis are considered as the tool for active portfolio management, namely visual-graphical analysis (VGA) and moving averages crossover strategy (MAC).

VGA is a trend-following investment strategy based on breakout and bounce of the price. The main concept lies in drawing the price trajectory for the instrument, drawing of trend/channel lines and support/resistance levels, followed by the identification of the most optimal moments of buying/selling securities.

The parameters affecting the price trajectory of financial instrument are the following:
− the number of candlesticks, M;
− the price range at each side of local extremum, N,%.
   The parameters for the identification of the most optimal investment moments:
− the width of the support/resistance level zone L,% ($L/2$ % at each side of the price local minimum);
− the price filter P,%.
−

The analysis of the optimization results is the essential part of the investment strategy development in the context of the robustness estimation. The main difficulty of the strategy parameters optimization is the representation of investment strategy rules as the formalized algorithm for its implementation in strategy testing and optimization software. For instance, the VGA investment strategy is conducted using computer-aided procedures as distinct from fully automatic systems (trading robots), based on the application of technical indicators values. In this case, the testing and optimization process for the computer-aided investment strategy requires a large amount of manual operations for each run (iteration). Consequently, it is important to select most significant parameters for strategy optimization.

The selection of investment strategy parameters is based on the major strategy rules producing trading signals. The VGA strategy parameters to be optimized are as follows: $\{x_1=M, x_2=N, x_3=L, x_4=P\}$. The most significant parameter of the VGA strategy is the price filter P, utilized in the determination of the order price a position and, consequently, this parameter affects the profit. Also, the price filter is applied for the closing position and influences the capital drawdown in the protective stop utilization. The size of the support/resistance level L is utilized in the determination of the order price and the price filter plotting from the support/resistance level boundary.

The considered moving average crossover strategy uses the exponential moving average of the stock closing price. Varied parameters of this investment strategy are the smoothing periods of the fast (Tf) and slow (Ts) moving averages. For the order price, the investment signals are affected by the smoothing period value. In such a way, these signals impact both the expected profit and the deposit drawdown.

The shape of the solution surface (objective function) characterizes the investment system performance with different set of parameters values in several historical data samples, see Fig. 1-2. For the comparison of the investment strategies efficiency, the annual return was used. The value of the objective function reaches its extremum under given constraints in the investment strategy parameters testing.

Consider the quantitative estimation of the objective function smoothness degree. In exhibits 1-2, the objective function diagrams (annual return) present results of the optimization of VGA and MAC strategies with two varied parameters in 01.02.2012–30.04.2012 (sample I) and 01.09.2012–30.11.2012 (sample II).

Qualitative characteristics of the algorithm robustness (the objective function smoothness) might be examined visually by diagrams. For the quantitative validation of one or another investment strategy, it is essential to estimate the investment strategy testing results in various time ranges over normalized values. The quantitative estimation of the investment strategy robustness is based on the smoothness degree of the objective function, which can be considered as the finite-difference measure of the function derivative.

The smoothness degree evaluation of the objective function is characterized by the following estimate:

$$I_{sm} = \overline{\left\{ \sqrt{\left(\frac{\Delta Sx_1}{\Delta x_1} \right)^2 + \left(\frac{\Delta Sx_2}{\Delta x_2} \right)^2} \right\}},$$

where I_{sm} is mean gradient modulus (finite-difference equation), Δx_1 and Δx_2 are the increments of arguments, and ΔSx_i is the increment of the function.

After the smoothness degree indicator has been evaluated with normalized values of strategy parameters in each sample, the objective function smoothness estimates in samples I and II are calculated. On the basis of the objective function smoothness estimate of the considered VGA and MAC investment systems, the following values of I_{sm} are obtained (Table I).

TABLE I. RESULTS OF OBJECTIVE FUNCTION SMOOTHNESS DEGREE ESTIMATION OF VGA AND MAC

	VGA	MAC
SampleI	155,4	711,24
Sample II	46,55	704,95

The results of the objective function smoothness calculation indicate that VGA strategy is characterized by higher robustness than MAC strategy. Larger values of the smoothness degree of MAC strategy in comparison to VGA demonstrate that the inclination of the objective function is greater, consequently, the objective function surface is less gently sloping than the VGA surface. This conclusion is supported by visual analysis of the objective function

diagrams in both samples of considered investment systems (Fig. 1-2).

Sample I   Sample II
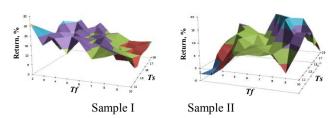
Fig. 1. Objective function of VGA strategy in samples I – II

Sample I   Sample II
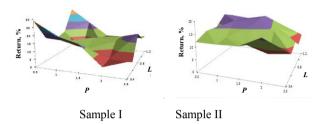
Fig.2. Objective function of MAC strategy in samples I - II

III. INVESTMENT STRATEGY EFFICIENCY VALIDATION

For the robustness analysis of the investment strategy optimization results, simulation software tools were utilized such as Metastock and Matlab. Source data are daily market prices of "Gazprom" financial instrument in 2011-2013. Assume that in mutual funds management, short sell orders are not allowed. Only long positions deals were considered for the simulation of the investment strategy performance. For the estimation of the efficiency of the investment strategy and the robust estimate utilization, the algorithm of VGA strategy is analyzed with the optimal parameters values. Tables II-III demonstrate all deals during the investment period along with some basic statistics in 2013.

Profitable portfolio management during sideways and downtrend conditions requires additional tools for the determination of short-term moments of stock price increase during the global trend. For instance, year 2013 is characterized generally by the sideways trend. However, there was a mid-term uptrend during July through October. The active portfolio management in this case would include periodic revision of the portfolio every six months. As a result, the proposed investment strategy demonstrated the stable deposit growth, as compared to the "buy-and-hold" one.

Table III presents the investment results of VGA strategy and the annual return as the major efficiency indicator. The analysis of the simulation results leads to the conclusion that the investment system possesses robustness, which resulted in the positive deposit dynamics. The annual returns in 2011, 2012 and 2013 investment periods differ due to the trend direction. In the conventional portfolio management, this would result in investors' losses.

TABLE II. MODELING RESULTS OF VISUAL GRAPHIC ANALYSIS INVESTMENT STRATEGY IN 2013

№	Date	Deal type	Price, rub.	Quantity	Investment result, RUR 000's
1	24.04.2013	open «long»	121,02	41316	
2	13.05.2013	close «long»	129,09		333,65
3	25.06.2013	open «long»	108,14	49322	
4	19.07.2013	close «long»	129,09		1033,6
5	05.09.2013	open «long»	136,30	46713	
6	13.09.2013	close «long»	143,04		314,72
Total					6681,98
Annual return, %					33,64

TABLE III. VGA STRATEGY INVESTMENT RESULTS (2011-2013)

Year	Annual return AR, %	Number of trades	Trend direction
2011	86,67	10	downtrend
2012	34,74	6	downtrend
2013	33,64	6	sideways trend

IV. CONCLUSION

The problem of active portfolio management has been considered, with the emphasis the robustness property of the objective function (annual return). Concerning mutual and pension funds, only long deals are taken into account, performed on the basis of mid-term portfolio revision. The desired robustness property is proposed to be characterized with the solution surface smoothness. MOEX-based examples demonstrated positive return, even during the sideways and downtrend periods, as opposed to the conventional buy-and-hold strategy. This makes the emerging markets, such as BRICS, more attractive investment tools, when combined with active robust portfolio management. One should also take to account the volumes of shares circulating at the exchange, in order to avoid market manipulation situations.

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Problems of Quality Management Technical Products Complex

Vasilyev V.A., Letuchev G.M., Aleksandrova S.V., Aleksandrov M.N.
Moscow Aviation Institute (National Research University)
Moscow, Russia
uks@mati.ru

Abstract— **The article provides an analysis of the most well-known approaches to quality management and organization of production of competitive products, particular attention is paid to quality management systems. As information sources used by official standards, numerous articles, monographs, textbooks and manuals. The modern methods and tools of quality management. Showing the possible directions of improvement of personnel potential of high-tech industries in the field of production and quality management.**

Keywords— quality; innovation; competitiveness; human resources

Quality management of high-tech products-duty is the most important direction of technology development. Use of traditional (read-obsolete) methods of organization of production quality assurance is only due to multiple control economically inefficient and does not guarantee against defects (inconsistencies). Even the creation and implementation of a formal quality management system (eg, based on ISO 9000) is not a guarantee against problems with the quality of the finished product. Errors can also accumulate on all stages of the product lifecycle - from concept to recycling. It is believed that the quality depends on the production process. This is largely justified. In the production of raw materials or the workpiece is transformed by technology, equipment and personnel in the finished product. It is enough to prevent the deviation from the set of process parameters without notice problems with equipment or hardware configuration or to take into account the human factor and appears nonconforming product.

With most problems industrials have learned over many decades and even centuries to fight successfully. Even in 19 century the means and methods of control used to date. In the early twentieth century with the advent of the assembly line and mass production created new methods of control, including statistics. Changed and the organization of production -poyavilsya scientific or classical management.

Further development of production require new organizational approaches, including the transition from the control of finished products to quality management. The effect was quite significant - if under the control of the finished product is only separated from the defective product fit (the number of which may be significant), then the emphasis on quality control prevents the occurrence of nonconforming products. There were also developed quality management. The transition from the quality of management control (management) to count as received from the 1950s. A turning point in the history of the development of quality is considered to be a lecture in front of leading industrialists Japanese Americans E. Deming and J. Juran, developed a program that the basic idea can be summarized as follows: the basis of product quality - quality of work and quality management at all levels.

In 1960-70. scientists and experts around the world have confirmed the conclusion that the quality can not be ensured only through control of finished products. It should be provided much sooner, in the process of studying the market requirements at the stage of design and development, when selecting suppliers of raw materials and components at all stages of production, and then in the subsequent implementation of the product and its maintenance in service by the consumer. Thus was born a new ideology - ensuring the quality of products through the development and implementation of quality systems.

The first step in the formation of an integrated approach to quality management in our country was the creation in the 1950s of the Saratov system of defect-free products manufacturing (BIP). BIP system is a set of interrelated technical, organizational, economic, and other measures aimed at ensuring the release of defect-free products in accordance with the requirements of normative and technical documentation. Abroad (in Japan), a similar system called "zero defects".

BIP system required to improve the technical condition of manufacturing equipment, tooling, tools, instrumentation and technical documentation, the precise organization of labor and production as a whole.
Lviv option Saratov BIP system - a system of defect-free labor (SBT) has allowed to evaluate the quality of any work (not only in the production units).

Systems BIP and SBT, marked the beginning of a systematic approach to the organization of work on product quality management and includes constituent parts in other, more advanced quality system.

KANARSPI system (quality, reliability, service life with the first product) has been aimed at creating conditions ensuring a high level of design and technological preparation of production, as well as to achieve the tight deadlines required quality product with the first industrial samples. The main objective of KANARSPI system is to identify at the design stage and construction products the maximum number of causes of failures and their elimination in the pre-production period. At the production stage KANARSPI System used methods of BIP and SBT.

In the 70s a number of enterprises in Lviv region was implemented designed VNIIS State Standard of the USSR integrated quality management system (KSUKP), which incorporates elements of the BIP, SBT, KANARSPI, norms and other experience in quality management. KSUKP - a set of measures, methods and tools aimed at the establishment, provision and maintenance of the required level of product quality at all stages of the product life cycle (design, manufacture, maintenance and others.). KSUKP is based on systems theory and science of management. The structure of the system has an input control object, the subject (body) control, comparing the actual state with the authority given, feedback and output (result). The system sets the order of the actions of all enterprise services, regulates the relationship and regulates the duties performers at all levels of management quality. In KSUKP resolved in the prescribed manner the economic and social issues related to the improvement of the quality of work performed in the company.

In KSUKP was embodied the idea of total quality management products based on standards, organically connected to an integrated approach to the problem of quality, quality management system and regulatory framework of the management - enterprise standards (STF), governing the construction and operation of this system.

In 80-ies gained experience in different countries has led to the emergence of new standards that set requirements for the QMS, and propose standard model. The appearance of the standard model has created a system of certification for compliance with ISO 9001. The continuous improvement of the QMS models require regular updating of standards 9000. Acting now ISO 9000-2015 standard has the best theoretical and practical developments

Creating a QMS based on ISO 9000 standards - it is an opportunity to enter the world of quality. This kind of guarantee the company's ability to provide the required quality. But the competition does not end, but only begins. To win the competition in the field of quality developed dozens of methods and tools. In some cases, they are summarized in a "brand" name. Sometimes, the same elements in different combinations form a competing system or model. Here are some methods and models based on them.

An effective tool for converting expectations of customer requirements in the best technical characteristics of the new

(or upgraded) product is the methodology of QFD (Quality Function Deployment). The literal translation of the Russian language: - "quality function deployment". This method is known as a "quality house" because of the similarity of the graphic QFD with the projection of the house. At the core of QFD is the idea of linking the parameters of quality of the product and the process of its creation with the expectations of the consumer.

"Six Sigma" - a system of analytical, organizational and statistical methods for improving the activity, regular use of which allows the company to embark on a path of sustainable development. As world practice shows the last decades, the introduction of "Six Sigma" system guarantees the stability of the enterprise world-class leadership. The system of "Six Sigma" can be viewed from different perspectives: as a statistical approach to quality as improvement cycle is a set of tools, etc. Every facet of the system is important and all of them are closely interrelated with each other. "Six Sigma" can be regarded as reproduced universal cycle improvement.

TPM - «universal care equipment" mainly serves as a method of improving the quality of equipment, focused on the most efficient use of the equipment through preventive maintenance system. This system is aimed at the prevention and early detection of equipment defects that could lead to more serious problems.

Method for analysis of species and the effects of potential failures (FMEA) - is an effective tool to improve the quality of technical objects developed, aimed at preventing failures, defects or reduce negative effects from them. This is achieved by predicting the possible defects and / or failures and their analysis conducted at the stages of design engineering and manufacturing processes. The method can also be used to refine and improve designs and processes that are running in production.

Kaizen - continuous improvement, since the elements of production and ending with the top management, from an ordinary worker to the director. Kaizen philosophy presumes that our lives as a whole should focus on continuous improvement.

Lean. This modern concept of quality management, focused on the reduction of losses, simplify production processes and accelerate production. At the present time, this idea is popular among Russian managers because of its focus on the continuous improvement of processes and the ever increasing number of competitive advantages, improving economic efficiency of production by reducing losses. The relevance of lean production system driven by the simple principle that governs almost every entrepreneur - with a minimum use of resources to obtain maximum results.
The ideology of lean manufacturing involves the optimization of production processes with maximum focus on the market and taking into account the motivation of each employee. Lean manufacturing is the foundation of a new

culture and management philosophy. This wide management concept aimed at the elimination of waste and the optimization of business processes from the stage of product development, production, and to communicate with suppliers and customers. The use of modern CALS - technologies and information support products (IPI-technologies).

In today's market competitiveness increase means a reduction in terms of development of new products, reducing the cost of its production, improving product quality. The most effective areas of focus in order to achieve these objectives are the dissemination of IPI-technologies at all stages of the life cycle of products and the penetration of the ideas of building a quality management system (QMS) at all levels of the organizational and technological enterprise.

Integration of CALS and QMS systems involves a number of organizational and technical measures, reorganize operations departments. These actions are preferably integrated with the construction of a quality management system that supports the main production processes.

The above methods of quality management create the necessary prerequisites for the creation of a competitive business or organization. For their implementation need high-level professionals. It is known that in an era of change "cadres decide everything". Not only the resources, money, infrastructure, and above all personnel to implement an innovative way of development. First of all, we need experts who understand the meaning and the technology associated with the creation, implementation and reproduction of innovations, including quality management. Strategy Training should address not personnel officers. They focus on the current business model and extrapolate it into the future. Therefore, the appeal is only guided by the views of employers with personnel order is not entirely correct. This obviously leads to a backlog from real life for a period of specialist training. Development model determined the environment and should be developed by senior management with the support of science.

Quality assurance of technical and organizational measures (control, process approach, etc.) Should be supplemented by staff motivation. Lack of motivation and low morale will inevitably lead to a lower quality even in total control. This thesis can be illustrated by many historical examples from the slave system to the present day.

Quality Control - another very important aspect of quality management. Known rule of thumb is a tenfold increase in the cost of correcting errors at each stage of the product life cycle. The logical consequence of this rule is the maximum price of a mistake in the initial stages. Thus, the greatest danger lies in the wrong goal, wrongly formulated problems. To minimize these problems need to improve the quality of management and quality of decisions. We can assume that the top management (and not just a single company or organization) must have an appropriate level of education and the necessary

competence. This is usually achieved good basic higher education, innate abilities and experiences. To accelerate this process can be further advanced training in various forms. Speaking about increasing the qualification of senior management must be borne in mind not only a variety of short courses, but serious long-job training from the basic work. This refers to the distance learning in graduate school and working on his thesis. This training allows you to organize a deep knowledge and to develop a scientific approach. It is strange that this kind of intellectual development potential leaders are not encouraged by the state. Instead of encouraging commitment to the thesis defense and the acquisition of a new skill level, create artificial barriers in the way. In recent years dramatically reduced the amount of protection masters and doctorate in technical sciences. Systematically reduced the number of dissertation councils, opening of new becomes more complex. Good goal - to improve the quality of theses, but with the water and you can throw out the baby. You can draw an analogy with the fight against doping in Russian sports - in both cases, suffer innocent scientists and athletes. The greatest need for highly qualified personnel experience high-tech industries - aerospace, military production and technical products, etc. These industries barely survived the collapse of the Soviet Union and retained their potential to the present day.. Their further development depends on scientific and personnel support. Industry Science greatly reduced in comparison with the Soviet period, the academic is also going through hard times. Science at universities, which in developed countries is a powerful source of new knowledge and innovation, we still far from such a level. Among the reasons are lack of funding, poor management, weak links with industry. But some of these problems can be solved without additional costs at the same time with the preparation of highly qualified personnel. Involvement of the scientific work of specialists and managers of industrial enterprises strengthens the connection with the production, increases the level of control and efficiency through new knowledge, increase the scientific potential of universities and creating prerequisites for innovative development.

In terms of quality control are promising specialty 05.02.23. "Standardization and product quality control" and 05.02.22. "Production" (engineering science). By the number of theses defenses in these specialties possible to assess the prospects of development and improve the quality of our best engineering companies. Status of these particular areas of science determines the competitiveness of our future developments. What do we see today? Specialty 05.02.22. "Production" (engineering science) today in Moscow, there is not one of the Dissertation Council. Cancel protection theses marked "For Official Use Only" and no "closed" tips cut off the ability to protect theses experts "defense". Under current protection rules must be published on the Internet, not only abstract but also the full text dissertations. For works on jurisprudence, philosophy, sociology, it is logical, but it means a giveaway "know-how" to everyone for the technical sciences. Links to foreign experience does not take into account the difference in the tradition of preparing theses. Our dissertators

accustomed to in their work honestly describe technological details processes. Another feature of our time - the need for all members of dissertation councils regularly publish their research results in international journals. It is an understandable desire of officials to increase the number of publications in international journals sometimes comes into conflict with the logic, such as experts from the "closed" councils and organizations.

At the end of this section there is a rhetorical question - we need a real performance or competitiveness of new techniques and technologies? As mentioned earlier - you go or "checkered"?

Another of the most promising ways to improve the human resource capacity of high-tech industries can become a certification of qualifications. Under development (including the authors of the paper) a national system of assessment and certification of qualifications aims to ensure the maintenance of conformity of the quality of labor (skilled workers) the needs of the economy and society by matching employers' positions, the education system and authorities in the field of qualifications. The main objective of the system - to provide objective, recognized by all the professional community (employers), conformity assessment qualifications of the employee (his knowledge, skills and competence) requirements of production and business, established by the relevant professional standards, and to confirm the readiness of the employee to perform certain types of work, regardless of where , time and route of qualification.

The Russian industry has long operated technology assessment of professional knowledge of staff through its certification. However, certification of personnel is estimated directly by management or organization which, as a rule, has already formed an opinion about the merits or shortcomings of the expert, and therefore, the assessment can not be guaranteed to be objective. At the same time, there is no evaluation of education and practice from the perspective of the graduate preparedness for a future profession, not only by the level of required knowledge, but also by the level of skills.

The possibility of an independent formal recognition and certification of qualifications bears certain advantages and benefits to the various stakeholders. For citizens, they are to increase employment opportunities and competitiveness in the labor market, and incentives to continue their education and training. It provides enterprises the ability to increase the capacity in terms of human resource management and optimization of staff training costs. At the state level the existence of such a system helps to reduce the level and duration of unemployment, improve the efficiency of education and training, addressing economic problems, optimization of costs for education and training, because the cost of certification is less than the cost of a full course of study.

For society as a whole, the availability of such a system is the promotion of citizens' equal access to qualifications, facilitate the transition from school to work and from work to continue learning, and strengthening co-operation of stakeholders (employees, employers, employment services).

As part held under the auspices of Rosobrnadzor studies determined the path of development of this sphere of activity towards the creation and functioning of the certification system of professional qualifications. The basis of the formation of the system following principles: advanced character - the development of advanced knowledge and skills in accordance with the strategy of development of high-tech industries; continuity - constant updating of knowledge and the development of all categories of staff using a variety of methods, including self-education and training in the workplace; consistency and the ability to obtain a permanent updating of knowledge and irrespective of the training courses; systematic identification of training needs and development on the basis of certification of the results of the regular activities of the staff and associated current and the required level of professional qualification; targeted and personalized approach - the construction of the development programs in accordance with the needs of target groups, the formation of individual staff development plans; corporatism - basing qualifications certification system on the values and norms of corporate culture, contributing to their maintenance and development; efficiency - the ratio of costs control of resources and the required quality of training and development programs on the basis of qualifications certification; quality - the requirements for the professionalism of experts, methods of preparation and implementation, technical equipment, organizational support and practical orientation of the certification process, the active use of information technologies in the system of certification of qualifications; relevance of the certification test materials (SIM) - Sims mobility changes, periodic updating of the changes occurring in the external and internal environment, legislation; rationality - to avoid duplication of the same sims and techniques in different periods of the certification; the unity of methodology and the content of the Kim (control measurement issues) - regardless of the place of work and certification to obtain a single volume and content of the Kims.

The main objective of the evaluation and certification system of qualifications is an objective recognized by all the professional community (employers) conformity assessment of employee qualifications (his knowledge, skills and competences) of production and business requirements established by the relevant professional and corporate standards, and confirm the employee the right to perform certain types of work activity, regardless of location, time and method of obtaining qualifications.

CONCLUSIONS

We once again emphasize the need to develop human resource capacity of high-tech industries for the efficient use and development of existing methods and means of production and quality management.

The New Aspects for the Instantaneous Information Security Audit

Ilya I. Livshitz#,[1] Kseniya A. Nikiforova#[2]
JSC Gazinformservice
Saint Petersburg, Russia
[1] livshitz.il@yandex.ru, [2] nikiforova.k.a@yandex.ru

Pavel A. Lontsikh#[1], Sergey Karasev#[2]
National Research Irkutsk State
Technical University, Irkutsk, Russia
[1] palon@list.ru, [2]sergei-karasev@yandex.ru

Abstract—**This publication discusses the problem concerning the concept of the instantaneous information security (IT-Security) audits directed, including providing protection against "zero-day" threats. It is noted that effective "zero-day" counteraction based on implementation a set of preventive IT-Security controls, but not limited new technical facilities installation only. A key feature of this concept of instantaneous IT-Security audits is to assess how the left limit of the protection level in the process of IT-Security audits performing. Methodological basis of the concept of instantaneous IT-Security audits are ISO 27001 and 19011 standards series, supplemented by many (expandable) IT-Security metrics to quantify the object protection level. The obtained results can find application in create of models and methods of IT-Security audits performing and continuous improvement of an object protection under the influence of IT-Security violation threats.**

Keywords—Information security; Information Security Management System; audit; risk management; threats; vulnerabilities; Standards.

I. INTRODUCTION

The problem of performing audits (process evaluation) for large and/or complex systems were considered in the classical works of N. Wiener, R. Keeney, H. Raiffa, I. Prigogine [1-4]. These postulates can be effectively applied in the solution of actual problems in the field of information security (IT-Security). Currently, there are a variety of materials on the actual problem of countering threats to "zero day". In particular, notes that "any processes that are managed by people unreliable", so the largest providers of information security services offer the "only" option – only the constant improvement of technical means of information protection (control), in particular, Check Point Threat Emulation and Qualys Continuous Monitoring [5-7].

This assessment appears to be commercially viable, but very far from a solution are well known technical problems – confrontation "controls" as "armor" and threats like "shell". It is obvious that the "arms race" between the target attacks ("advanced persistent threats" APT) will not in the near future to increase the protection level of objects, and this has been noted by many experts [6-9]. In this situation it is proposed to apply not only the technical approach (controls) to counter "zero-day" threats, but to propose a combined method based on the concept of instantaneous information security audits.

Methodological basis of the concept of instantaneous audits is a family of standards ISO 27001 and 19011, with a variety of (extensible) information security metrics for the quantitative estimation of the security of the object [10 – 13].

To successfully address industry challenges information security must be taken into account additionally specific industry standards, in particular for airfield complexes – IATA [15]. It should be noted that the process of the audits (including IT-Security) is well known and is a mandatory requirement of all the ISO standards (of the Russian Federation adopted as GOST R ISO) and the discretion of the organization given the planning issues (frequency) of execution of audits and the scope [14]. It is on the audit process, controlled by frequency, responsible for the operational (near-real-time) identify vulnerabilities in the information systems (is), which can be used to implement "zero-day" threats.

For the formation of the concept of instantaneous information security audits, as a means of combating APT, it is useful to apply a known mathematical concept of limit of a function, more precisely, the limit on the left, which will generate a quantitative assessment of security in the process of performing IT- security audits.

II. TASK DEFINITION

As noted above, at present, to solve the problem of combating zero-day threats offered "only" option – only the constant improvement of the technical IT-Security control, equipped with a new ("virtual", "scanning", "analysis", etc.) modules, able to withstand the arts [8 – 10]. At the same time, it is assumed that a process of continuous improvement only technical IT-Security control will lead to visible success, as it covers only a part (technical vulnerabilities) security infrastructure. In particular, the methodology of the management system information security (ISMS), significantly more levels of the hierarchy of protection and types of objects (in the terminology of the ISO – "assets"), respectively, is proposed and significantly more measures (tools) information security (in the terminology of ISO "control") [10]. The expansion of the list of applicable ISO standards to implement a comprehensive security system for critical objects in augmented ISMS requirements specified in ISO standards [10 – 13].

Equally in these ISO standards and reflects the demand for performance audit, and security requirements that can be implemented within an ISMS, integrated security system [16 - 18]. These requirements in the proposed concept is complemented by another important parameter is the periodicity of inspections with the aim of maximizing awareness and speed the adoption of adequate decisions about the vulnerabilities that can be used to implement the APT about an objective assessment of current level of security. Under these conditions, the problem statement is formulated as follows – development of the concept of instantaneous audits information security at the methodological basis of risk-oriented ISO standards, to ensure an integrated approach to the assessment of the security value for business objects with any desired frequency.

III. THE CONCEPT OF INSTANTANEOUS AUDITS OF ISMS

The concept of instantaneous audits involves the implementation of the principle of the implementation of information security audits with a frequency determined by senior management (decision makers) and depending on a previous state left the security of the object [15, 18, 24]. In other words, if the previous Audit_1 held, say, a month ago (mark t_0) revealed a number of inconsistencies in terms used [10, 14]) and showed that 40% of computers still running Windows XP with SP2, 60% of workstations users have administrator rights on 70% of the laptops update antivirus are not met and/or disabled, the rating (mark t_1) current level of security $R_{base} \mid t_1 <= R_{base} \mid t_0$, i.e. not higher than the previous.

It is also unlikely and not economically feasible to conduct Audit_2' in the hope to achieve at the level of t_1, the target level of protection R_{target}, for example, 95%. Accordingly, the current protection of the object (marker t_1) $R_{target} \mid t_1$) corresponding to the left (marked t_0) $R_{base} \mid t_0$ in the absence of changes in condition of protected object identified by the previous Audit_1. When you change on the interval ($t_0 - t_1$), composition measures (means) of IT-Security, the closure identified in Audit_1 inconsistencies (e.g. further training) with the next audit (Audit_2') may make sense to achieve R_{target}.

It is important that the frequency of audits is determined IT-Security, including a valid reduction of the interval ($t_0 - t_1$), for example, with annual as is the case in ISMS, PCI DSS, IATA) monthly or more often – by requirement of the decision maker.

The problem of determining the optimal frequencies of information security audits determined by the decision of the Top management on the basis of the received sets of security and the analysis conducted in the framework of the standard procedure of Management review [10, 15]. It is obvious that it is pointless to perform information security audits in a row one behind the other, without having to correct identified discrepancies, without having to fully implement a range of remedial measures. In particular, the metric for "start" of the next audit should be the rate of "circuit" mini-PDCA cycle,

which objectively forms the limit $\lim (t_k - t_i)$. Accordingly, to achieve R_{target} period of information security audits can be reduced as $\lim (t_k - t_i) \rightarrow 0$.

In addition, an effective response to APT is necessary to reduce the period of identification, analysis and closure of nonconformity, as the successful implementation of this process is much faster than the selection, purchase, delivery, installation and configuration of new IT-Security control. In this case, first, met all the requirements of ISO, second, additionally it fulfills the requirements of the Top management (not wanting to wait a whole year to bring the IT-Security to the required business level security), and thirdly, issues of operational modern threats (in the limit of "reaction time" of ISMS ($t_k - t_i$) $\rightarrow 0$).

IV. JUSTIFICATION OF THE MATHEMATICAL BASES OF THE CONCEPT OF INSTANTANEOUS AUDITS.

For the formation evaluation of the security audit information security it is necessary to apply accurate mathematical concepts, giving the rationale for the proposed concepts, in particular the unilateral limit (more precisely, the limit of the function at the left). The number $a \in R$ is called the left limit (or left limit) of the function f(x) at the point a if for every positive number ε will be found suitable for him positive number δ such that for all points x from the interval $(a - \delta, a)$ the following inequality holds [23]:

$$\mid f(x) - A \mid < \varepsilon. \tag{1}$$

The derivative of the function f (x):

$$\lim_{\Delta x \rightarrow 0} = \frac{f(x + \Delta x) - f(x)}{\Delta x} = \lim \frac{d}{dx} f(x) = f'(x). \tag{2}$$

The appropriate one-sided limit is called the left derivative, denoted f_' (x) [23, 24]. The left derivative allows us to estimate the desired interval, where the valid (in time) can be made necessary changes to the ISMS and justified the conduct of the new audit. For the purpose of counteraction of "zero day threats" consider a valid function variables:

$$y = f(x_1, x_2, x_3, ..., x_n), \tag{3}$$

where, for example, the first 4 variables describe the attributes of information security audits:

x_1 – the frequency of audits, defined as the ratio of the number of ISMS audits in the observed period.

x_2 – the volume of program audits, defined as the ratio of the number of covered processes to the total count of processes in the declared certification scope of ISMS;

x_3 – metric level of protection, defined as a measure of the effectiveness of the ISMS R_{base} / R_{Max};

x_4 – metric corrective action planned for the interval of conducting information security audits.

Then the private derivative of the first order by the first variable x_1 is:

$$\lim_{\Delta x_1 \to 0} = \frac{f(x_1 + \Delta x_1, x_2, x_3, \ldots, x_k) - f(x_1, x_2, x_3, \ldots, x_k)}{\Delta x_1} = \frac{\partial}{\partial x_1} f(x). \tag{4}$$

For one variable x_1 (e.g., frequency of conducting information security audits) will assess the practical value of the partial derivative (at an invariance of other variables), we estimate the rate of growth of the level of security ISMS:

$$\frac{\partial}{\partial x_1} = f'x_1(x_1, x_2, x_3, \ldots, x_n) = \frac{\Delta R_k}{\Delta t k}. \tag{5}$$

The implementation of the concept of instantaneous audits to assess the security of valuable business assets with any required frequency can be demonstrated as reduced period (increased frequency) of audits of information security when using the left limit of the function variables. Note that the full "speed of reaction" ISMS is determined by the frequency of information security audits, which greatly exceeds the speed of a full cycle of updates, even the best industry solutions, CheckPoint [6, 7]. This objective increases the ability of a system (ISMS or ISM) effectively counter the "zero day threats " in a mode close to real time. In the example for one variable x_1, the demonstrated growth rate increases the level of security ISMS $\frac{\Delta R_k}{\Delta t k}$ at known process variables of information security audits (see Fig. 1).
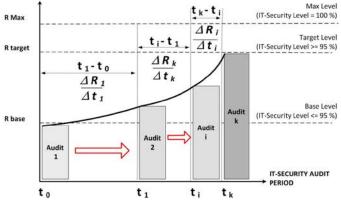
Fig. 3. An example of the increase of the rate of growth of the level of protection

IV. CONCLUSIONS

The proposed concept of instantaneous information security audits based on the formation of the "left limit" of a function of variables that characterize the process of performing information security audits, and aims to create a continuous system of complex support of information security, including protection from "zero-day threats".

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The Optimization of the Integrated Management System Audit Program

Ilya I. Livshitz[1], Kseniya A. Nikiforova[2]
JSC Gazinformservice
Saint Petersburg, Russia
[1] livshitz.il@yandex.ru,
[2] nikiforova.k.a@yandex.ru

Pavel A. Lontsikh[1], Elena Y.Drolova[2],
Natalia P. Lontsikh
National Research Irkutsk State Technical University,
Irkutsk, Russia
[1] palon@list.ru, [2] elena_uspeh@mail.ru

Abstract—**The application of Integrated Management Systems (IMS) is now attracting the attention of TOP management of a variety of organizations: refineries, machinery, instrument-making, aviation, defense, etc. However, now the major problem is still the performance of IMS audits as full implementation of complex checks from different ISO standards with a substantial limitation or reduction of available resources.**

At the same time, the continuous improvement of management principles and in particular – the transition to risk-based thinking provide a greater interest in the rational use of ISO standards. In this issue cover a technique of optimization IMS audits program, based on principles of continuous adaptation when entering data in a single micro-cycle audit. An additional advantage of proposed technique is the use of numerical IT-security metrics of audit, contributing to continuous improvement of the IT-security level of organizations.

Keywords—Information security; Information Security Management System; audit; risk management; threats; vulnerabilities; Standards.

I. INTRODUCTION

Recently, the application of integrated management systems (IMS) attracts the attention of senior management (decision makers – decision makers of various organizations. Occur almost isolated cases, when the modern organization of diverse industry sector (oil, instrument, aircraft and defense) implement only one system management (SM), by contrast, now typically implemented the projects of IMS. Consider some of the largest Russian organizations, in which authors over a long period 2010-2015 had the opportunity to perform audits:

However, at the moment remains an important issue ensuring the implementation of the audit programme in management systems information security (ISMS) – implementation of the full set of checks on various ISO standards, with a significant reduction in available resources. Largely this problem is to ensure the IMS audit program for audits of information security (IT-Security), as the negative effects of incidents can result in significant damage to the organization until the end of activities. At the same time, continuous improvement management principles and, in particular, the transition to a thinking, risk-based, provide

increased interest in the rational use of modern risk-oriented standards [1 - 5].

Accordingly, of particular interest to the study of problems in the execution of the IMS audit, as well as finding ways to optimize the program IMS audit based on the principles of continuous adaptation of the data within one micro-cycle PDCA (Plan-Do-Check-Act), one of the basic audit cycle. On the basis of the practice of IMS audits it is proposed a new method to optimize the program audits, which will enable a more rational decision making for decision makers in today's complex economic environment [6 – 8].

II. AUDIT TASK DEFINITION

As previously noted, to ensure the stable development of modern organizations in the context of the presence of risks of different origin, it seems reasonable to use the risk-based standards and the introduction of IMS [9 - 11]. From the point of view of the management audit of IMS in the proposed technique, we note the need to address the following important practical problems (in parentheses indicate the paragraphs of the standard audit SM – ISO 19011 [18]):

A. The problem of resource allocation for the program audits:

- The development of a programme of audits (5.1),

- Identification and risk assessment audit programs (5.3.4),

- Identification of resources for program audits (5.3.6).

B. The task of taking into account factors that affect depth program audits – leakage incidents, the manifestation of criminal actions, previously identified inconsistencies and, therefore, to determine the scope of programme of audits (5.3.3).

C. The task of collecting verifiable information (6.4.6).

D. The task of providing special knowledge and skills of auditors (7.2.3.3), or the involvement of technical experts:

- Types of activity,

- Requirements of stakeholders,

- Knowledge of security process,

- Knowledge of the technical means and measures to ensure information security.

Additionally, we note that the IMS should be taken into account and recommendations of the PAS-99 [5], which allows to take into account the specific requirements of execution of combined audits, risk-based, flexible management of the volume of the IMS audit program taking into account previous results and the importance of processes [19 - 21].

III. THE PRINCIPLES OF FLEXIBLE AUDITS

The proposed method of optimization program IMS audit based on the following basic principles:

- Introduces the concept of integrated assessment mark (IAM) of IT-Security, which includes a specific indicator group evaluation of all submitted for audit processes – R_{ISMS}. This group index is determined using the weighted sum of partial indicators where the weights determine the importance of the R_{PR} process, the organization of IT-security specific object of assessment (OA)

- After the initial (primary) audit check for each process is evaluated as to compliance with the requirements of the audit criteria (ISO, GOST, STO Gazprom, etc.), as well as its effect on IAM level for specific OA.

- Subsequent information security audits are conducted according to the proposed method, using a flexible approach: the most detailed and carefully checked the processes on which the previous audit revealed significant inconsistencies (e.g., in notation of ISO 17021 – "major" [22]) and which have the highest priority in IOS for a particular OA.

- The frequency and detail that needs to be differentiated for different check processes, is also linked to IAM. For example, certain groups of processes that have IAM priority (e.g., critical IT-Security processes for Top management) are subjected to audits in more detail and more often. The processes with low priority IAM for a specific OA are checked less and less detail.

- The depth of verification and frequency of audits every time for the k-th audit the PDCA micro-cycle depends on the approximation of the function specific IAM to OA to some agreed target – R_{tar} (in the limit, obviously, equal to 1) for a comprehensive security assessment of a specific OA.

Additionally, we note the importance of the implementation of the new standard, ISO 55000 [2-4] – because many assets are not managed properly (in particular, by the use of an outdated internal procedures, such as STO Gazprom, in principle, does not operate assets such as staff, buildings, and structures).

Accordingly, the application of the requirements already implemented standard (e.g. ISO 27001) greatly facilitates the solution of typical safety tasks, which are solved in parallel (accounting and asset protection, risk management, competency assessment, etc.), it is recommended to parallel the test in the framework of the joint audit of all management system or IMS [22 - 24].

IV. JUSTIFICATION OF THE MATHEMATICAL BASES OF THE FLEXIBLE AUDITS

For the evaluation of a degree of providing ISMS conformance on the IMS audits to presented requirements of IT-Security we use private and group IT-Security indexes. For the purposes of realizing IMS audits in the aspect of providing IT-Security we suggest to use the index of effectiveness of MS IT-Security R_{ISMS} , which we can calculate in each cycle of k-audit using the additive formula with the account of α-weight coefficients and index of effectiveness of each concrete process of IT-Security – R_{PR}

$$R_{ISMS} = \sum_{i=1}^{n} \alpha_i \bullet R_{\mathrm{Pr}\, i} \qquad (1)$$

in this case :

$$\sum_{i=1}^{n} \alpha_i = 1$$

In its turn, indexes of effectiveness of each concrete i-process of IT-Security – R_{PR} are calculated by additive formula with the account of β-weight coefficients and indexes of IT-Security metrics for each concrete i-process of IT-Security – K_{KPI}:

$$R_{\mathrm{Pr}_i} = \sum_{j=1}^{m} \beta_j \bullet K_{PKIj} \qquad (2)$$

in this case:

$$\sum_{j=1}^{m} \beta_j = 1$$

The coefficients of relevancy of private indexes of IT-Security, that are used by calculation of IT-Security group indexes, must be equal to 1 that provides norm balancing of all indexes in additive formula above (1) and (2). Accordingly, the final index of effectiveness of MS IT-Security R_{ISMS} must maximize reaching 1:

$$R_{ISMS} = \sum_{i=1}^{n} \alpha_i \bullet R_{\mathrm{Pr}\, i} \to 1 \qquad (3)$$

In the process of IMS audits, the constant measuring of current nonconformance for k-audit R_{ISMS} is measured as discrepancy with the objective (maximal) index:

$$\Delta R = 1 - R_{ISMS} = \sum_{i=1}^{n} \left[\alpha_i \bullet (1 - R_{\mathrm{Pr}\, i}) \right] \qquad (4)$$

Regarding the results of all audits, that are carried out in a strict accordance with IMS audit program, we fill in the following matrix with the account of IT-Security processes – PR, IT-Security audits – k-audits and IT-Security metrics – KPI.

V. THE TASK FOR OPTIMIZATION

The specific optimization problem may be related to the type of problems of the static optimization of the control processes occurring in the steady state. You must implement an optimization model for a process audit of IMS in terms of deterministic constraints, and constrained optimization (the minimum "residual"):

$$F(y) \to \min \qquad (5)$$

where:

$$F(y) \in R^m,$$

$$f(y) \in R^1$$

$f(y)$ – is the objective function of the m-dimensional vector argument y, such that:

$$y = (y_1, y_2, \dots y_m)$$

where: $y \in D \subset R^m$

The range of permissible values:

$$g_i(y) \ge 0; i = \overline{1, N}$$

The parameters of the m-dimensional vector argument y may be, for example:

- T– the period of information security audits;

- S– the planned cost of information security audits;

- V is the volume of information security audits (number of units);

- F– a list of the functional issues of information

- O – list of visited objects of information security audits.

On the basis of auditing standards (in particular [18]) and industrial practices (STO BR IBBS, STO Gazprom, etc.), suggest a method of multi-stage optimization process IMS audit for a complex industrial facilities (CIF), which allows to provide a system of coordination, allocation of resources and prompt delivery of audits of IMS.

The proposed method is scientifically grounded and focused operational functioning of the IT-Security subsystems in the composition of the IMS, different from the existing methods for cyclic continuous evaluation of the effectiveness R_{ISMS} on the basis of an optimal system of numerical indicators (metrics) of IT-Security $\{KPI_{ik}\}$. The proposed method consists of 2-cycles associated program optimization audits IMS, characterized by the presence of new units:

A. The basic optimization cycle, which characterizes the effective implementation of audits of IMS in terms of estimation performance for each of the PRi process and IT-Security each KPIj–metrics, and defines the cycles of optimization of resources in the audit program: depth ("scope"), size of the audit sample, the number of involved auditors (experts), etc.

B. Quick evaluation unit of the effectiveness of corrective and remedial actions in the current k-th audit affecting change – as the following IT-Security process, and the following (k+1) audit. Also provided a quick transition to the

assessment of performance indicators IMS – R_{ISMS} in k-m audit and (k+1) audit for the permanent and operational optimization of the entire program of IMS audit.
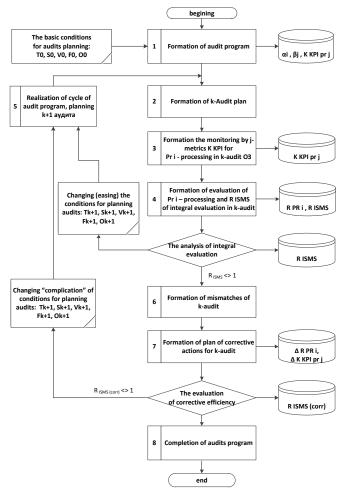
Fig. 1 – the Basic optimization cycle of the program IMS audit

Let's consider the basic optimization cycle of IMS audit program that was built with the account of audit's formal ISO standards requirements and ISAGO standards supported with new components (see fig. 1):

- Formation efficiency evaluation of each k-audit;

- Formation of fast efficiency evaluation of correction (corrective actions);

- Formation of quick back link in the current audit cycle;

- Formation of system reaction – complication or easing depending on current integral evaluation in current audit cycle.

CONCLUSIONS

The methods of optimization program IMS audit based on modern risk-based standards and ensures constant optimization program perform information security audits based on the associated flexible adaptive algorithms. Experimental verification of the proposed method is made in the implementation of several projects in the period 2014-

2016. The use of these specific blocks of optimization the methodology for other IMS might require different parameters (for example, selecting as criteria other industry standards or other quantity and composition argument vector optimization).

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Motivation of Application, Analysis and Inconsistencies Standard GOST R 56002-2014 "Evaluation of Experience and Business Reputation of the Construction Organizations"

Pavel A. Lontsikh [1], Elena Y.Drolova [2],
Elena A. Vovseenko [3], Egor P. Kunakov[4]
National Research Irkutsk State Technical University
Irkutsk, Russia
[1]palon@list.ru, [2]elena_uspeh@mail.ru,
[3]vea1963@mail.ru, [4]egor-kunakov@mail.ru

Ilia I. Livshitz[1], Ksenia A. Nikiforova[2]
LLC «Gazinformservice»
Saint Petersburg, Russia
[1] livshitz.il@yandex.ru, [2]nikiforova.k.a@yandex.ru

Arkady V. Vladimirchev
Certification Association "Russian Register"
Saint Petersburg, Russia
rr-head@rusregister.ru

Abstract — **In accordance with Federal law №44- "About contract system in the procurement of goods, works and services for state and municipal needs" customers are given the opportunity to consider the factors of experience and reputation in the selection of the contractor in the implementation of procurement within the "business criteria reputation "procurement participant. The normative basis for the evaluation of business entities, based on an assessment of their financial performance, resource availability, human resources potential, quality of management decisions is the standard GOST R 56002-2014 "Evaluation of experience and business reputation of the construction companies." An analysis of the practice of GOST R 56002-2014 identified a number of shortcomings, which can significantly distort the final results of rating. The article presents the results of the standard in the process of appraisal activity AS "Russian Register", registered as a certification body for voluntary certification systems in the Register Rosstandart.**

Keywords — Federal Law №44- "About contract system in the procurement"; the standard GOST R 56002-2014 "Evaluation of experience and business reputation of the construction companies' registry Rosstandart.

I.   INTRODUCTION

In accordance with the Federal Law of 05.04.2013 №44-"About contract system in the procurement of goods, works and services for state and municipal needs" customers are given the opportunity to consider the factors of experience and reputation in the selection of the contractor in the implementation of procurement under criterion "goodwill" party procurement [1]. The normative basis for the evaluation of business entities, based on an assessment of their financial performance, resource availability, human resources potential, quality of management decisions is the standard GOST R 56002-2014.

National Standard GOST R 56002-2014 "Evaluation of experience and business reputation of the construction companies" entered into force on 01.09.2014, in accordance with the Order №366-Art from 17.04.2014g. [2]. Federal Agency for Technical Regulation and Metrology (Rosstandart). The standard specifies the requirements, models and criteria for assessing the business reputation of the building organizations on the basis of their work experience. This standard allows a single and objective approach in ranking and selecting a construction company in tenders and competitions.

The standard allows the public and private customers to use professional tools to simplify the pre-selection of bidders by establishing objective procedures for conformity assessment procedures, approved in the methodology for assessing the business reputation of the construction company. [1] (Appendix D to the GOST R 56002-2014).

The next step was the approval and enactment of the Order of the Federal Agency for Technical Regulation and Metrology (Rosstandart) on July 10, 2015 № 895 Art. GOST R 66.0.01-2015 "Evaluation of experience and business reputation of the business entities. The National Standards System. General provisions, requirements and guidelines. " (Has also been developed and submitted to the Technical Committee for Standardization TC 066 "Assessment of experience and business reputation of companies") [3]. This standard specifies the terms and structure of the national system of standards to assess the experience and reputation

of business entities. The standard contains the basic methodology and is fundamental in the system of evaluation standards of experience and business reputation of business entities. Standard GOST R 66.0.01-2015 "Evaluation of experience and business reputation of the business entities. The National Standards System. General provisions, requirements and guidelines "came into force on October 1, 2015.

With the introduction of standard GOST R 56002-2014 "Evaluation of experience and business reputation of the construction companies" must take into account the following three main points:

1. Experience in the development and implementation of the first Russian national standard GOST R 56002-2014 "Evaluation of experience and business reputation of the construction companies," developed by TK-066 on the initiative of the SRO NP "Building life". National Standard GOST R 56002-2014 "Evaluation of experience and business reputation of the construction organizations" establishes requirements, models and criteria for assessing the business reputation of the building organizations on the basis of their work experience. The standard allows a single and objective approach in ranking and selecting a construction company in tenders and competitions. In accordance with Appendix D to GOST R 56002-2014, the certification body for conformity assessment analyzes the following factors affecting the level of goodwill certified organization [2]:

A. the number of years on the market;
B. rhythm of work (a smooth, gradual growth of the organization);
C. availability of the required level of sufficiency of material-technical base;
D. financial autonomy;
E. The volume of construction in progress;
F. human resource capacity of the organization;
G. mention of the organization in the media;
H. The number of violations in the construction and efficiency of their elimination;
I. timing delay delivery of construction projects;
J. The number of accidents at construction sites;
K. the availability of certified management systems (quality, environmental, occupational health and occupational safety);
L. the number of positive reviews and commendations from customers.

GOST R 56002-2014 peculiarity is the presence of the requirements for certification bodies for internal verification of documents and information provided by the applicant. certification experts check the authenticity of the information on the location of the applicant organization in the case of providing false information may refuse to issue a certificate of conformity.

oluntary Certification System, registered in the prescribed manner, form requirements directly to the conformity assessment procedure on this standard.

Standard GOST R 66.0.01-2015 "Evaluation of experience and business reputation of the business entities. The National Standards System. General provisions, requirements and guidelines "establishes the terms and structure of the national system of standards to assess the experience and reputation of business entities. This standard contains the basic methodology and is fundamental in the system of evaluation standards of experience and business reputation of business entities.

According to the standard work on assessing the experience and reputation of business entities based on the following principles:

A. voluntary;
B. openness;
C. bezdiskriminatsionny access to the applicants when assessing the experience and business reputation;
D. objectivity and accuracy of the estimates and the reproducibility of its results;
E. confidentiality of information;
F. protection of the interests of the applicants;
G. availability of information on the results of the evaluation to stakeholders;
H. expert competence.

System of standards to assess the experience and reputation of business entities is the regulatory framework for evaluating the performance of business entities based on an assessment of their financial performance, human resource capacity, resource availability and quality of management decisions.

System Standards for evaluating the experience and reputation of business entities set factor models and requirements for assessing the experience and reputation of businesses, depending on the type of economic activity [12].

II.   ANALYSIS OF THE PRACTICE OF THE GOST R 56002-2014 "EVALUATION OF EXPERIENCE AND BUSINESS REPUTATION OF THE CONSTRUCTION COMPANIES." 66.1.01-2015 GOST R, GOST R 66.1.02-2015

Under current conditions in the market for one of the key factors in assessing the risks that are associated with the choice of contractor is a goodwill organization in a professional environment. supplier selection problem, ensuring the quality of work at the minimum value of the contract, is acute. The damage can amount to tens of billions of rubles. Now federal law from 05.04.2013 №44-FZ "About contract system" provided an opportunity for customers to take into account the factors of experience and business reputation of a market participant in the selection of the contractor in the implementation of procurement for state and municipal needs under the criterion of "goodwill"

procurement participant. The normative basis for the evaluation of business entities, based on an assessment of their financial performance, resource availability, human resources potential, quality of management decisions are developed by the Technical Committee for Standardization TC 066 standards for assessing experience and business reputation:

a. GOST R 56002-2014 - Evaluation of experience and business reputation of the construction companies;
b. GOST R 66.1.01-2015 - Evaluation of experience and business reputation of the business entities. Evaluation of experience and business reputation of persons engaged in architectural and structural design;
c. GOST R 66.1.02-2015 - Evaluation of experience and business reputation of the business entities. Evaluation of experience and business reputation of persons carrying out engineering surveys.

In development are the standards for the evaluation of other business entities, such as in the field of production and services to agriculture, education and science, health and medicine.

On the basis of GOST R 56002-2014 in addition to national standards for the assessment of goodwill architects, designers, engineers, surveyors, also approved a standard for the manufacturer of fire-technical products.

Evaluation of experience and business reputation is based on the factor model, which takes into account:

a. History-duration entrepreneur-tion of the subject the presence of activity in the market in its profile of economic activity and the amount of work performed by them, services rendered, the amount of output;
b. Means -Provide business entity with material resources necessary for the production and delivery of goods, works and services;
c. Personnel-existence of a business entity QUALIFICATIONS-qualified specialists and managers;
d. Image-perception of a business entity clients and society in order;
e. Reliability, completeness and accuracy of the information provided by the organizations.
f. The benefits of an independent assessment of the experience and reputation are clear and allow for:
g. comparison of the level of development of the company with its competitors, adequate positioning themselves in the market;
h. independent confirmation of the competence and professional success of the organization, including for participation in tenders for public and private order within 44-FZ and 223-FZ;
i. helping consumers in competent selection of suppliers of goods, services and works;
j. increasing the competitiveness of business entities;
k. Formation of business reputation management system.

l. Evaluation of the results of experience and goodwill are as follows:
m. Auditors groups with the calculation of the index of business reputation and a certificate attesting to the accuracy of the information;
n. Certificate of assessment carried out in accordance with the requirements of GOST R 56002-2014, GOST R and GOST R 66.1.01-2015 66.1.02-2015 with the final index of goodwill.

III. "IMPROVING THE METHODOLOGY FOR ASSESSING THE BUSINESS REPUTATION (GOODWILL) FOR THE PURPOSE OF CREATING AND IMPLEMENTING CROSS-SECTORAL STANDARD REPUTATION IN PROVIDING ALL KINDS OF SERVICES AND EXPANSION OF ITS SCOPE."

In the practical implementation of the standard GOST R large number of information sources 56002-2014bylo analyzed. The greatest interest was an article published in the journal "Natural Gas Industry" April 21, 2015. Some of the material "Rating by contractors - factor to minimize investment risks", authored by B.V.Budzulyak, A.A.Apostolov, L.P.Moiseev (NP "SRO OSGiNK", Moscow, Russia), NN Alekseenko (rating agency building complex "RASK", Moscow, Russia), as well as N.F.Seleznev, chairman of the Committee of innovative technologies in construction NOSTROY, used in the preparation of this article.

It is known that in the field of public investment activity is regulated by the Decree of the State Construction Committee of Russia on June 8, 2001 № 58 "Regulations on the customer in the construction of facilities for public use in the Russian Federation" [8], which defines the main functions of the customer, among them - the pre-selection designers, contractors, manufacturers and suppliers of equipment.

Town Planning Code of the Russian Federation of December 29, 2004 № 190FZ (par. 1, Art. 55.8) [9] provides for the ability to perform work, which affect the security of capital construction, only if the self-regulatory organization issued a certificate of admission to the works [7].

Returning to the question of risk, we note a significant reserve to reduce them will be the actual use of new methodologies for assessing the construction companies to carry out construction and installation work during the preliminary selection. In turn, this will lead to the overall improvement of the efficiency of the investors and customers of capital construction in the part of the procedure of organization of competitive bidding (Procurement).

The current position in the assessment of the construction companies ranking.

From our experience, competitive bidding for selection of contractors carried out in two stages: preliminary selection of participants and the selection of the most favorable

contractor on the basis of their proposals (as a rule, the process of selecting a contractor for the second stage based on the principle: the lower the contract price, the better contractor). In this preliminary phase of trading (assessment of the main indicators of their activity) remains without due attention.

With regard to the calculation - subfactor "financial autonomy", it is not clear from what considerations form the recommended table with those figures in it. In order to get a value for this subfactor equal to 1, it is necessary in the calculation to get the maximum number that satisfies a value equal to 6. It is difficult to agree with such a measure, as the common standard value indicator "financial autonomy" in Russia and abroad, ranging from 0 3 (in Japan) to 0.7 (in some European countries). For Russia, this value is 0.5-0.6 [7].

Subfactors "financial autonomy" x22 is determined depending on the value of "K = 1" Shareholders' equity "/" Borrowings "in Table 5. Knowing that financial autonomy is the ratio of equity to total assets, the rate of x22 subfactor is calculated in the standard as equity / borrowed capital, and there is not given any explanation that we should consider this extra capital, as the sum of short-term, long-term liabilities and accounts payable; the standard does not explain that the borrowed capital should be seen as an indicator, generated from internal and external sources of borrowing.

Indeed, as calculated by the financial autonomy ratio by conventional means? The formula for calculating this indicator is very simple: all you need to do - is to find the ratio of equity to total assets of the company: Ca = Cc / Ca, where Cc - total capital, the source of which is authorized, additional, redundant kapital, retained earnings and other reserves. The new reporting form "Balance" Section 3 "Capital and reserves" the entire section refers to equity. This line - 1300; Ca - total assets, which are specified in a row in 1700 form 1 (balance sheet). Based on the proposed standard GOST R 56002 calculation

method subfactor "Rhythm of work" x_{12} is supposed to determine its dependence on the volume of the coefficient of variation of work for N years

$$\mu = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(Z_i - \bar{Z})^2}, \tag{3}$$

Where

$$\bar{Z} = \frac{1}{N}\sum_{i=1}^{N} Z_i, \tag{4}$$

Z_i - the amount of work performed per-year of

Explains that the proposed method can not determine the coefficient of variation as it:

First - this is the wrong formula for the calculation of the standard deviation, below is a true mathematical formula for calculating this ratio:

Standard deviation:

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2}. \tag{1}$$

secondly - coefficient of variation is calculated using the following formula::

$$V = \frac{\sigma}{\bar{X}} \times 100\% , \tag{2}$$

where V - the required rate, σ - standard deviation, $\bar{X}$ - average size.

During the practical application of the standard also have questions about subfaktoru- x_{33} "Awards and titles", which takes into account the availability of employees with an academic degree and (or) honorary titles.

Developers of the standard were limited to only two awards "Honorary builder" and "Honored Builder". If we talk about the list of awards and medals in the field of construction, it is necessary to be guided by the Decree of the USSR Supreme Soviet Presidium of the number 360 7.3.79 X was approved The general situation of orders, medals and honorary titles of the USSR and the Presidential Decree of September 7, 2010 N 1099 "on measures to improve the state award of the Russian Federation" (as amended) [10,11].

According to these Decrees (rev. And ext.) Were set higher degree of differences, orders, medals and honorary titles, including in the field of construction.

In particular, the medal "For the construction of the Baikal-Amur Railway" is a departmental distinction in their work, in accordance with the Polo zheniem a medal "For the construction of the Baikal-Amur Mainline", approved by the Decree of the Supreme Soviet of the USSR from 08.10.1976 years, this award He served as encouragement to employees, engineering and technical staff and employees who have worked on the construction of the Baikal-Amur Mainline and its maintenance for at least three years. This medal was

awarded to active participants in the construction of the Baikal-Amur Railway up the good work in the construction, high-quality design and survey work, honest work in enterprises, institutions and organizations directly serving the building and construction workers. Also, when calculating the subfactor "Awards and the title of" the standard GOST R 56002-2014 did not specify what kind of academic degree is entitled to an employee - the candidate of technical, physical and mathematical, historical, educational or economic sciences, etc.? For example, the degree of Candidate of Technical Sciences can be obtained as a result of defending a thesis on the subject of physical infrastructure, which includes external water supply and sanitation, including hydraulic structures, which include the type of activity under OKVED - 42.13 Bridges and tunnels; construction work on the construction of bridges and tunnels; or Ph.D., received the degree of protection in the field of Mechanical Engineering and Mechanical Engineering. And you can get a Ph.D. and still have a great experience in the construction industry.

All of the above comments on the factorial method of valuation of goodwill of construction companies can significantly distort the final results of the evaluation.

If we talk about the actual application of such a measure as goodwill, which must be taken into account and reflected in the financial statements, addressing financial stability criterion, it must be quantified. There are the following methods for assessing the reputation (goodwill)

1. Method of excess profits or comparative method.

$$V = MA + GW = MA + (NOI\text{-}MA \times Re) / Rg \quad \square ,$$

where V - the value of the organization;
MA - value of tangible assets;
GW - cost gydvilla;
NOI - Net Operating Income;
Re - capitalization rate of net income from operations;
Rg - rate capitalization of intangible assets.
This method involves the further contrast between its values with the values of companies - competitors or similar industry.

2. Metod surplus resources as a modification of the method of excess profits.

When calculating the value created goodwill is taken into account the effect of using not only their own, but also raised funds.
Given this addition, the cost of goodwill is calculated as follows:

$$GW = (M / R\text{-}TA) \times w,$$

where M - the net profit;
R - return on total assets;
TA - the value of total assets;
w - the share of equity in the structure of the organization liabilities.

3. Evaluation of goodwill based on the indicator of the volume of sales.

IA Blanc offers a count value of the goodwill as follows [5]:

$$GW = (M\text{-}ABIT \times Rq) / a \quad \square ,$$

where M - the average value of the estimated net profit of the organization;
ABIT - average annual revenue estimated economic entity;
Rq - the industry average rate of profitability of production;
a - the leverage ratio of excessive profits, provides a set of intangible benefits.

4. Kvalimetricheskoj method.

Economic content kvalimetricheskogo method lies in the analogy between the value created gydvilla and usefulness of the organization.
utility ratio (or quality) is calculated by the formula:

$$Kf = (qf\text{-}qmax) / (qmax\text{-}qmin) \quad \square ,$$

where Kf - utility ratio (or quality) of the object being evaluated;
qf - the actual value of the index of utility (quality) of the estimated object.
q max - the best result among the analogs evaluated object;
q min - the worst figure among peers evaluated object.
The cost of goodwill is determined as the difference between the obtained value and the physical depreciation of fixed assets, and the value of intangible assets recorded in the financial statements:

$$GW = W\text{-}Wf\text{-}IA,$$

where: GW - the value of goodwill;
W - the cumulative depreciation of the organization;
Wf - physical depreciation of fixed assets;
IA - the cost of traditional intangible assets.
At present, more extensive practical application got two ways to determine the amount of goodwill:
The method of excess profits (comparative) - involves submission evaluation of goodwill, as a source of additional income revenues. According to this method, there is a direct contrast between profitability levels being evaluated competitors (or similar industry), followed by capitalization of the share that cannot be explained by tangible assets.

Balance method based on the account of the results of specific transactions. The size of the acquired goodwill (goodwill), it is, as the size of the difference between the amount paid for that service, and the aggregate value of the assets and liabilities of the enterprise, which is fixed in the final accounting statement or balance sheet.

The comparative method is considered more reliable, since the assessment of goodwill in the business must be financially tangible - in fact it explains why the products are

"branded" companies worth more than any other similar products.

Existing at present methods for determining the value of the business reputation of the organization are not universal. We cannot say for sure that their calculated value of goodwill using the exact figure, since there is still no method that would take into account in the goodwill value of its components such as the qualification of workers, their reputation, favorable economic situation and others. [5].

What documents are required for assessment of goodwill?
a. Financial statements for the last 3 years (or possible number of previous periods);
b. The audit reports on the financial statements of the company (if any);
c. A list of the basic material assets of the company at the date of assessment;
d. Information on all existing enterprise assets (real estate, stocks of other organizations, notes, stocks, patents, licenses, etc...) With details and explanations;
e. Breakdown of accounts receivable of the company;
f. Information on subsidiaries and the financial statements on them.

IV. RESULTS

One of the most important characteristics of the organization and the individual employee as a whole - goodwill. It reflects not only the results, but also characterizes human capital. The result is that the management of business reputation becomes, in some cases extremely important object of positioning the organization in all aspects of its operations.

An analysis of the practice of GOST R 56002-2014 identified a number of shortcomings, which can significantly distort the final results of rating.

Analysis of the methodological assessment criteria, as well as standard mathematical apparatus indicates that there were a number of significant deficiencies, which in the end can reverse the results of calculations. As a consequence, lost the objectivity of the customer risk assessment.

For Russian companies, whose interests include improving its financial stability, to attract investors, the expansion of operations, access to the world market (the relevance of this issue gives the recent Russian accession to the WTO), goodwill becomes an object of special attention. Therefore, the allocation of "goodwill" on a separate line can be quite increase the attractiveness of Russian companies. Moreover, the proposal does not entail any additional costs, because intangible assets of organizations are already reflected in the balance sheet on the line in 1110, and the allocation of a separate line of business reputation in the line "including" of intangible assets does not entail changes in the amounts in

the line "Total Section I», and, consequently, the balance of the organization whole.

AS "Russian Register" is registered as a certification body of voluntary certification systems in the Register Rosstandart № RU.M335.04BE00 Russia from 05.08.2015. Certificate Number №15.000.2D.RR and authorized to work on the assessment of the experience and reputation for compliance with GOST R 56002-2014 and GOST R 66.0.01, GOST R and GOST R 66.1.01-2015 66.1.02-2015. Since that time, the AU "Russian Register" was the practice of "evaluation experience and business reputation", said the need to update the standard, eliminating obvious inconsistencies and is in favor of the application of this standard.

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Staff Loyalty Formation as a Management Tool in International Business

Olga Shvetsova

School of Industrial management

Korean University of Technology and Education (KOREATECH)

Cheonan, Chungnam,Republic of Korea

shvetsova@koreatech.ac.kr

Abstract—**Human resources management is one of the main tasks of chief executive offices. The issue of staff loyalty formation as one of the most significant factors of human recourses management that has a great impact on organizational performance is an actual problem of management nowadays especially in the circumstances of unstable external environment. The relevance of this problem is caused by the absence of clear definition for staff loyalty. Author depicts the examples of staff loyalty formation and improvement in international companies. Authors also describe cause-and-effect relations between employee commitment and the major factors of company's performance. The article presents the results of the analysis of the main approaches to the definition of staff loyalty, background for high employee commitment formation and the study of organizational loyalty in different cultures as well.**

Keywords— Human resources management; staff loyalty; employee commitment; staff loyalty effects; staff loyalty background

I. INTRODUCTION

Managing corporate culture is an important feature to improve economic performance and enhance the effectiveness of its functioning as a whole. A strong corporate culture motivates employees, generates they have internal installation for effective employment to achieve the highest result, leading to increased productivity, increased employee loyalty to the company. Correct principles of building relationships within the team, informed choice, the approach to pay non-material motivation methods, style of management in the company, forming the corresponding hierarchy are the most important tasks of the organizational culture, providing a direct impact on interest and efficiency of company's personnel.

II. CONCEPTS OF STAFF LOYALTY

Human resources of the company are the main tool in the implementation of all business processes, carrying out basic activities forming the development strategy, as well as defining its competitive advantage. The President of Virgin Group Richard Benson once said: "If you are a businessman, put your staff in the first place, in the second-consumers, and in the third place - shareholders" [1.27].

Any competent manager understands he needs to pay special attention to the resource companies, since the staff of the company is able to both contribute to the successful development of the company and cause irreparable damage to its activities, particularly in the context of climate variability and instability. That's why every modern organization should be directed at the formation and implementation of such policies, in which the true purpose of its main staff will be the main objectives of the company [3, p.35]. Because only devoted to his company, tolerant and committed to its goals, staff will assume responsibility, will defend the interests of the company, to take the initiative to promote its development, as well as try to reduce all possible risks and reduce costs.

The urgency of the problem is caused by the lack of a clear definition of the term \loyalty\, and as a consequence, the very understanding of this notion gives rise to the problem of forming effective policies of the firm that promotes employee loyalty to the organization. High interest in loyalty management in Russia began to occur with increasing globalization, later, with the development of the economy and increased competition. In practice, however, most Russian companies demonstrate their commitment to an effective policy to promote staff loyalty only on the declared level [2, p. 68].

III. WHY DOES THE COMPANY NEED STAFF LOYALTY?

All companies want loyal employees. The value loyal employees bring to business is undisputed which is why manager can find a multitude of articles and blog posts on how to create and implement successful employee loyalty programmes. But has the manager ever stopped and delved into the 'Why' of staff loyalty schemes?

Implementing an employee loyalty scheme isn't a standalone task; it needs to be considered along with other employee-based initiatives such as:
- ✓ Employee benefits
- ✓ Recognition programmes
- ✓ Incentive and reward schemes

In other words, it needs to be a major part of the human resource strategy.

Why manager need a staff loyalty scheme can be organised in five pillars which all connect together to form the employee loyalty strategy:

1. Loyal employees are the best employees.
2. Align culture and commitment to the business goals.
3. Employee engagement makes a difference.
4. Get the right recognition and rewards.
5. Communication is key.

Here's an in-depth look at each pillar.

1. Loyal employees are the best employees

Loyal employees are those employees who aren't looking to change companies in the near future and who are enthusiastic about their work. These are employees who are emotionally and socially committed to the success of the business which means that the business benefits from:

✓ Increased productivity
✓ Higher levels of customer service
✓ Reduced employee absence
✓ Better working environment
✓ Improved business image
✓ Reduced employee turnover
✓ Enhanced consistency in team performance
✓ Improved ability of the business to adapt and change to new business opportunities.

2. Align employee loyalty to the business goals

All employee loyalty schemes need to start by aligning the business goals with the scheme goals. Perhaps a business goal is to reduce HR recruitment costs, this can be achieved by reducing employee turnover through the employee loyalty scheme. Use your business data and staff surveys to find out what drives employee loyalty or what doesn't. Do your exit surveys show people leaving at after a similar amount of time with the company or for similar reasons?

3. Employee engagement makes a difference

Loyal employees are also engaged employees which is why employee engagement is a key pillar of employee loyalty. You can increase employee engagement by providing opportunities for your staff to become involved in the business by:

✓ Listening to their suggestions and issues
✓ Communicating with them and being transparent in your decisions
✓ Providing them with opportunities to develop their skills and knowledge
✓ Recognising employee contributions

4. Get the right recognition and rewards

It's essential that employees get the right recognition and rewards. Long service awards are great for improving employee loyalty but they need to be timed right. Don't make your employees wait ten years to get a loyalty award if they regularly leave after three years. Rewards don't have to cost the earth either; you can recognise employees' loyalty at an awards ceremony, reward them with extra holiday for that year or offer them a gift card to spend as they wish.

5. Communication is key

Without a communications plan employee loyalty programmes stand no chance of success. Create a business that is open and tells employees about its programme. Shout about the success of individual employees, organise events and celebrations and keep everyone updated on changes to the programmes.

The keys to a successful staff loyalty programme are fairly simple; senior management buy in, aligning with the business goals, measure and monitor, award with the right reward and communicate. Because you're not just creating employee loyalty, you're building a business that people want to work with and be part of its success.

IV. STAFF LOYALTY PROGRAM

The employee loyalty program usually is designed to promote employee motivation and secure the best performers of the company so company will continue to grow. Not only will employee loyalty help maintain customer loyalty, but loyal employees generally help recruit other top performers to the business. Increasingly, companies are looking for new and creative ways to boost employee morale instead of an old fashioned monetary bonus. Motivating employees with direct financial compensation can actually have adverse effects. Many countries have tax laws that penalize financial bonuses, causing the incentive to be less than impressive. Generally, tax laws are much more favourable towards non-monetary rewards. This is why the Loyalty Gator Employee Loyalty Program is such a hit. It is important that employee incentive programs can usually be written off as a business expense too.

For example, to date as a result of the globalization of the company becomes international, and open their branches worldwide, food business has become one of the profitable segments of the food market. The product of this company are services, i.e. full satisfaction of wishes every visitor quick-service restaurant [1, p. 58]. One of the important objectives of human resource management in the catering industry is the development of effective motivation for employees aimed at customer focus. When working with the staff, there is a need for a unified system of values, rules and standards of conduct, i.e., corporate culture, which is the Foundation of a cohesive team and level of staff loyalty to the company. Organizational culture determines the level of development of the relations between the members of the team, which carries out the function of the labour market, and, therefore, affects the final result of the functioning of the Organization. So, on the basis of the above, we can conclude that corporate culture is a set of values, ideas and rules of the Organization, it is defined as the base set of views that are separated by company employees, affect the decision-making process, as well as new participants passed the team (see table 1).

TABLE I
STAFF LOYALTY PROGRAM OF FOOD SERVICE COMPANY

Element	Description
Certification	Motivating staff for training and certification can be very effective. Now you can track employee courses and recognize their achievements.
Referrals	Your employees are a great resource for new customer referrals (via their friends, family, and social media) but also a great starting point when you're recruiting new hires.
Performance	Properly tracking staff performance and production ensures accountability, allowing your company to reward top performers and provide extra training to others.
Suggestions	As your frontline, your staff will no doubt be able to provide some really valuable insights, suggested improvements, and customer feedback

28% of customers reported that they are "extremely likely" to increase their visits to a business if they have a loyalty reward card for them. Over 60% of households say, that loyalty card programs are important in their shopping decisions.

V. STAFF LOYALTY IN FOOD SERVICE INDUSTRY

For example, in the food service industry has developed special mandatory rules of customer service, there are also standards define the level of customer service.

A. McDonald's case study

For example, consider particularities of McDonald's corporate culture. To guide the chain restaurants successful organizational was not only to present standard of service [2, p. 239]. In the restaurants of the network clients not only receive personal service and attention, and fast service. In any of the restaurants McDonald's, regardless of which country in the world it is in, you can see the familiar surroundings, the identical menu-all these make up the image of one of the most successful organizations in the world.

McDonald's sees itself not just as a successful company, in which good governance. This organization has managed to create the philosophy followed by every employee of any restaurant anywhere in the world. At the core of the corporate culture is based on the following elements – social and psychological climates collective, philosophy, values, attitude toward employees and customers, the management style.

The whole philosophy of service is set out in the corporate code, with which all employees are acquainted in hiring, it is also a tool to familiarize staff with the company's values.

Treatment of staff and customers is service principles: quality, culture, cleanliness, and availability. At McDonalds employees are the most important resource in ensuring the effectiveness of the company. Applying the principles of trust, honesty, respect, they develop and improve talents for the benefit of each employee and the company as a whole. Every

year the company spent about 140 million dollars for staff training. For example, the system of training and development of employees in the company is built in such a way that the company develops and promotes only its own staff. For maintaining a corporate spirit guide constantly organizes contests and competitions between employees of restaurants and awarded the winners of the prize, or gifts with symbolic images of the company. Successful catering has sound corporate culture, which are in the process of delivering high quality services. Companies that create and maintain favourable conditions for the functioning of the corporate culture, show focus on long-term success.

Thus, McDonald's corporate culture creates favourable working Wednesday, and directly affects the embodiment of development plans in life. Without a sound and correctly implemented system of values in the company it is not possible to carry out effective management of the personnel.

B. Staff motivation. Rules for food service companies.

To become one of those lucky companies, take time to understand what your employees need and provide it for them. "As in any relationship, if you get what you need, you're more likely to stay," Bergeron says [4, p. 78].

Loyalty is largely inspired by flexibility and individual attention. These four techniques can help you offer that to every employee:

1. Invest more time in the hiring process. Hiring takes a lot of time, but a rigorous process pays off when you find the right person. "Person/organization fit is huge," Bergeron says. "If you're selective on the front end, you lose fewer people later." Well-matched employees are naturally more loyal, so retaining them takes less effort.

As you hire, introduce the candidate to several people on your team, ask them to complete a project or share samples of past work, and screen for personality. "Make sure their values match the values of the organization," Bergeron adds. A good match will blend naturally with the others on your team, rounding out their skills and fitting in with the overall culture.

2. Make your employees marketable. A good working relationship must be beneficial for both of you, meaning that employees need regular opportunities to enhance their professional skills. Many companies worry about investing too much in employees in case they leave, but you want to do just the opposite. "The more [employees] feel they can leave, the more likely they are to stay," Bergeron says.

Managers are the most important source of growth and inspiration. "The relationship with the manager is the number one predictor of whether or not someone stays [at a job]," Bergeron says. Make sure your managers are trained to inspire their employees, share their expertise, and offer opportunities for growth.

3. Allow many paths to promotion. Your employees' needs are ever evolving, so you can help them grow and inspire loyalty by offering opportunities for advancement tailored to their skills and goals. For example, many computer programmers want to move up without shifting

into management, so tech companies often offer a choice between a technical or managerial career path.

Go one step further by helping an employee create a new job based on their skill set, or allowing them to rotate between different roles. "If people have the flexibility to tailor their job to their needs, they're less likely to leave to find what they need," Bergeron says.

4. Empower employees to make choices. Inspire loyalty by giving employees a sense of freedom and control. "When people feel that they're trusted, they respond to that," Bergeron says. You might let employees work from home when needed, make decisions autonomously, or adjust their work schedule to balance family. Those freedoms show confidence and help employees tailor the job to their needs.

"Trust is this basic component of society," Bergeron says. "Without it, [organizations] cease to function." Trusting companies have less rigid management, greater creativity, and higher employee satisfaction.

VI. How increase staff loyalty

Fostering employee loyalty is essential for the long-term success of any business. Not only will it decrease turnover costs, it can also boost productivity, increase efficiency, and provide a much more stable work environment for everyone. When employees begin to build a sense of loyalty, they begin to empathize with their management or the company as a whole. They begin to see the priorities of the business as their own and may even (to some extent) place the needs of the business above their own. This means you'll get better results, increased employee satisfaction, and better employee relations. But building loyalty is a tricky thing—it's intangible. Below you'll find ten steps that will help you do just that.

1. Increase Confidence in Leadership

The results of a 2003 Darwin Survey of mid-level management show that one of the most important components of employee loyalty is confidence in leadership [4, p. 67]. Your employees want to feel that the management team knows what it's doing and they want to work for a company that is at least trying to be the best in its field. To do this, you have to ensure that your personal game is at its best. Take every opportunity you can to become better at what you do. Seek training, encourage feedback, and look for ways to maximize your own potential. When employees see the management team excelling and the company doing well, that positive energy will flow downhill and enthuse even the most jaded employee.

2. Improve Company Culture

Company culture is really a combination of the personal interaction between management and employees and personal interaction between employees. There is a certain amount of job competency that comes into play but generally it's more about attitudes, personalities, and how well we all get along. As a manager, it's your responsibility to keep your finger on the pulse of the company's culture and address any interpersonal problems that arise without "meddling" in personal affairs. The first step is modeling good behavior yourself. Weed out the cattiness, the "bad days," and personal prejudices. Next, look at your management team and then employees. If necessary, call out (privately) individual employees and explain to them that poor attitudes and bad behavior will not be tolerated.

3. Manage Employee Engagement

Kyle LaMalfa, Loyalty Expert and Allegiance Best Practices Manager, says that employee engagement is the number one component of loyalty [5, p. 99]. While LaMalfa recommends using actual analytical tools like the Likert Scale (a numerical scale of agreement) small business managers can generally get a feel for engagement without impersonal surveys. Just keep your eyes and ears open. Listen to the water cooler gossip, watch who participates during meetings and training sessions, see who does the lion's share of the work during co-op projects, get to know your employees on a personal (or at least individual) level. And because engagement plays across all aspects of an employee's performance, you can use "secret shoppers" (even in non-retail organizations) to get an unbiased sneak peek into how customers view your company through the interactions they have with your employees.

4. Enhance Education and Equipment

Frustration is insidious. Once it sets in, it's incredibly hard to weed out and, like a pebble in your shoe, only seems to create more problems the longer it's in there. One of the most common sources of employee frustration is not having adequate training or resources to get the job done. If you're constantly throwing employees into situations in which they don't feel comfortable or expecting them to meet goals with broken, outdated, or less-than-useful equipment, there will be problems. And those problems—no matter what you might like to think—are your responsibility.

5. Structured Dispute Resolution

When problems arise, how well you deal with them plays an important part on shaping your employee's attitudes. Having a structured system of dispute resolution is essential for creating a fair and balanced management style. If your employees know exactly what to expect during the dispute process, they're more likely to accept the outcome whether they "like" it or not. On the other hand, if your dispute system is the least bit arbitrary, you'll find yourself facing charges of favoritism, exclusion, and possibly even discrimination.

6. Nip Problems in the Bud

You don't want issues to fester until they explode like hand grenades in the break room. Keep your eyes and ears open (and tell your management to do the same). Look for warning signs before things come to a head. And when you spot an issue, deal with it sooner than later but deal with it fairly.

7. Maintain Neutrality

Fairness is a function of neutrality. Calvin Sun of TechRepublic maintains that neutrality can be a manager's best friend [6, p. 34]. When an employee comes to you with a problem or concern, your immediate response may be either to join their cause or to shoot down their concern without a second thought. However, this puts you in the position of compatriot rather than supervisor. While employees want to feel they can approach their boss, you must set yourself apart

and look at the issue objectively. By doing so you can not only zero in on what's best for the company, you can see what needs to be done in order to put the employee's mind at ease without playing favorites. Remember, you're the boss and employees don't have to like your orders, they just have to respect them.

8. Give and Expect to Receive Respect

Respect is a two-way street and while many managers demand it of their employees, they often "play" at giving it back. Employees can see through false statements and deeds like radar through fog. The last thing you want is for everyone under you to tag you as a fake. That's why everything you do—good or bad—should always be genuine. Relate to your employees on a more equal plane and give them, their suggestions, and their personal lives the respect they deserve without spouting platitudes.

9. Avoid Micromanagement

Part of earning an employee's loyalty is showing them that you trust them to do their job. If you're constantly looking over their shoulder, you're not letting them grow. While taking charge of everything may seem like a good idea, it's a surefire way to generate animosity and distrust in your subordinates. Instead, set reachable goals, ensure employees have the skills and resources to get the job done, and give feedback during and after the fact in order to mold performance positively.

10. Reward Appropriately

Rewards can be powerful loyalty builders but they must be appropriate to the action or else they'll create an impression of imbalance or unfairness. Be sure to reward your employees liberally (either with praise or simple "freebies"), but ensure the reward matches the deed.

You don't have to implement all of these practices at once. Start small and work up from there. Loyalty builds cumulatively—employees gradually respond to changes in behavior, management style, and company performance. So every little bit, every positive action, every improvement, every appropriate response to a challenge adds up. It's important to take stock of where you're at, where you want to be, and how you plan to get there but it's more important to act. Build on good behaviors and go forward from there.

VII. CONCLUSIONS

This paper includes the result of research done in period 2015-2016. The tasks of research are investigating the different concepts of staff loyalty, how it influences on company's activity and why it is so popular to create the staff loyalty programs in international companies. In this case paper includes the case study of international food service company and practical issues how to manage and improve the staff loyalty.

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The Basic Requirements for the Training of Engineers in the Change of Technological Structures

Vladimir N. Azarov
National Research University Higher School of Economics
Moscow, Russia
vazarov@hse.ru

Umar D. Batyrov[1], Martin M. Yakhutlov[2]
Kabardino-Balkarian State University (KBSU)
Nalchik, Russia
[1] ubatyrov@yandex.ru, [2] martin_yah@mail.ru

Abstract— The paper formulates main requirements to organization of educational process for the preparation of engineering personnel in the transition of the industry from one technological wave to the next. Identified measures to support and develop the industrial efficiency of the country.

Keywords— *industrial production; technological practice; engineering staff; educational process; high technologyvehicles;*

In the last three to four decades in the rhetoric of our country's leaders consistently present the thesis about necessity of transition from commodity-based economy to one based on innovative technologies in industry and other sectors. This created the Corporation, opened the whole of the state program of development of the individual, regarded as the most important, industries such as automobile industry; has established grants for research and OKR (experimental design work), etc. This was facilitated by the fold increase in that time the price of energy, oil, gas, etc. However, nested in the country's economy a lot of money tangible effect was not given, as today, the state of the economy, the implementation of announced the social obligations are directly dependent on commodity prices of the country. In order for the economy of the country stood firmly on its feet, it is necessary to master the production of a wide range of complex high-tech products, not only for military purposes.

It is known that mankind in its development has passed five technological structures and presently began the development of a sixth [1]. Analysis of the development of industrial production in Russia during last two century (when the global scale was the scientific and technological revolution, made scientific discoveries, carried out the transition from one technological mode to another) shows that our country has almost always been playing catch-up. At the forefront, often were and are the industrialized countries of Europe, USA, Japan, and in recent years, the countries of South-East Asia.

The situation in the industrial production of our country at present is not much different from previous stages of development. Industrialized countries of the world, we have gone from Russia is far ahead in its development. Russian industrial production still relies, to a large extent, on the technology of the fourth technological order (over 50%). Technologies of the fifth order is approximately 10% and it falls mainly on the most developed industries: military-industrial complex and the aerospace industry. Moreover, about 30% are technology of the third way. On the sixth technological way our researchers and producers just talk, but in the US, for example, for 5% of the technologies of the sixth order.

If the state and society is not clearly aware of the need for a timely transition from one technological wave to the next, as a rule, there is an economic crisis. To prevent or exit from this crisis (if it happened) the necessary political will of the government in the development or the development of breakthrough, better yet, revolutionary technologies. The result should be launched production of a wide range of complex high-tech products and not only military or dual-purpose.

Often one of the main causes of underdevelopment in the industrial production of advanced countries is the shortage of financial resources: in science, production, innovation in production. However, as mentioned above, in these industries in recent times have invested huge funds and no positive result. This means that the successful development of industrial production is not only Finance. Analysis of the reasons for the small effect of invested huge amounts of money clearly shows that the reason for this is the lack of staff, especially engineering, competent in the latest achievements of science and technology.

Analysis of a number of works devoted to training, including engineering, shows that for the most part, they are dedicated to finding answers to the questions "who?" and "who needs to cook?" (e.g. [2]), and the responses to the questions "how?" and "what database?" remain on the second and further plans. At the same time on the last questions the answers should give the state, i.e. the system of training should be organized by the state.

Still did not criticize the Soviet system of professional education, it is at certain stages of development of the country provide the necessary science and production personnel in sufficient quantity.

This created a balanced educational environment, depending on the professional orientation of training, in which the main parameters were:

- Highly qualified, specially trained teaching staff; if they are not enough, the educational process involved highly qualified personnel with a production or academic institutions (30 years of the post-war years of the twentieth century); by the end of the twentieth century, most engineering schools were equipped with teaching staff of the required level, most of which were candidates and doctors of Sciences; contributed to the creation and continuous improvement of the system of training of highly qualified specialists through postgraduate, doctoral studies and competition; effectively worked and informal system of professional development, and the state considered this question of paramount importance and has created the necessary conditions.

- Designed and supported by the state system the establishment and improvement of material-technical base of training, especially engineering, technical universities, specialized laboratories, which had a variety of technological equipment, tools, appliances, various purpose, stands, layouts and much more, allowing students to master the basic knowledge, skills or competences as presented in the GEF-Oh; and this material base is constantly updated; essential competencies contributed to the practical training not only in laboratories but also in industrial enterprises; the practice of students organized in a national scale and was conducted on the basis of the largest and most modern industrial enterprises, such as the training center of the largest automobile plant of the USSR facilitated the practice more than 5,000 students per year); the geography of practice were broad and material was provided by the state.

- High school science at that time was at a very high level and, often, by her conduct created a breakthrough technology, allowing industrial enterprises to produce a wide range of products of world level; science was quite competitive and was comparable to the results with the academic; have been widely developed system of economic agreements between universities and industrial enterprises to conduct scientific research aimed at addressing "bottlenecks" in the technological processes of production and improving its quality; this work has allowed University professors to be aware of trends in the development of world engineering was developed in the laboratories of departments of universities at the expense of new equipment domestic and foreign production.

All of the above allowed to create the educational environment of engineering training, appropriate technological system that was used in the industry currently. Of course, there were difficulties as the lack of adequate number of teachers with the right skills, and the lack of the necessary material-technical base. But in these cases the state has found a solution: the industry (engineers) and University professors were sent to study abroad (in spite of the acute shortage of hard currency), invited foreign experts and scholars in our country and they passed on their knowledge and experience to local experts. Practiced the exchange of students between universities, which significantly expanded the horizons of our students. In acute and catastrophic shortage of teachers the government deliberately sent the most prepared part of the engineering staff in universities on teaching: on a permanent basis or part-time.

It should be noted that even during the great Patriotic war, the training of engineers for industry did not stop.

This state attention to the issue of training allowed in record time to restore the war-damaged industry, to keep up and in some areas (e.g., space exploration and many others), and to overtake the United States and other developed countries of the world.

The situation began to deteriorate starting in the early 80-ies of XX century and created over the years, the engineering education system started to collapse since the early 90-ies of XX century. At this time the state had no system of professional education (and not only). In addition, it is gone from the real sector of the economy.

At this time, when the technical universities only survived and could not think of any development in the industrialized countries, successful mastering of the fifth technological way. At this time in science and technology was another revolution. Accuracy, and, consequently, the quality of the products increased so much that the producers of industrial products began to introduce artificial limitations in the duration of the life cycle stage "operation". The performance of manufacturing equipment increased by orders of magnitude, and there is a problem of overproduction of a wide range of high quality products.

Russia at this time have lost many of their forward positions, even in industries such as aerospace, machine tool, military industry and many others. Universities were not able to switch to prepare the necessary industry personnel due to the lack of relevant teaching staff, material and technical base, structured sources of information, i.e. the necessary staff to cook, there was nobody, there was nothing. In times of high oil prices, in Russia were imported technological equipment for various purposes to hundreds of billions of dollars. The majority of managers of industrial enterprises had the illusion that by purchasing modern equipment, will be resolved all the complex issues of production, and will serve it graduates of vocational schools. However, this equipment was so complex that it demanded for its development and operation to a completely new level of competence of personnel that have not appeared. Therefore, even today, after more than a decade, most of that equipment is not running (no one to serve), or if it is working, is so inefficient that never pays off. To avoid this, we needed the state program on training and retraining of the faculty and staff of educational institutions of different levels; refurbishment of laboratories with modern equipment; for the production of the necessary technical literature, including the reference.

Thus, the preceding analysis showed that the priority task of the successful development of technological structures, as

well as to successfully transition from one lifestyle to another, is the timely preparation of the necessary personnel. The best results are obtained when training for the industry in educational institutions is carried out ahead of or in parallel with the introduction of new innovative technologies into production. This happens in developed countries, where the government, realizing the importance of the issue of training, and the financial difficulties of educational institutions in buying the latest expensive equipment, involved in the development of the education system, providing her with equipment and technology. Having new equipment and technology, and time on retraining and professional development of their teachers and the staff of the educational institutions organize such work in a timely manner. In addition, the industry has the adequate to the new requirements of the personnel on time. In addition, it happens all the time. When the government for whatever reason cannot produce the designated event, then it loses the pace of development and its place in the market with the ensuing consequences. To catch up with forward in the development of science and technology and in the development of innovative technologies of the country is almost impossible or this process will require long time and huge financial resources, even with the persistent influence of the state.

Russia currently is in a state of catch-up countries, which, unfortunately, has no clearly defined concepts and programs of development of the most important sectors (although there is a list of priority areas of scientific research, developed a number of technological platforms, etc.). Most importantly – there are no government programs creation of training systems for various industries. And it is the latter does not allow the industry to evolve at an accelerated pace.

As a solution to the problem at this stage can be used the recommendations presented in [3]-[6].

In General, the analysis gives grounds to assert that for a successful transition from one technological wave to the next it must promptly provide the following basic principles in the major industries:

- pro-actively provide training, retraining and improvement of qualification of human resources in universities;
- pro-actively provide laboratory departments of universities, innovation and technology; if it is impossible to simultaneously solve for all the technical universities, to create a special innovation centers [3] according to the territorial principle; the facilities to carry out work on professional development and retraining of engineering personnel and top managers of industrial enterprises in the region, operating centers;
- to organize a state system for the development, approval and publication required for the efficient functioning of industrial enterprises and educational institutions of different levels of effective regulatory, reference and educational literature.

Compared to the cost of purchasing equipment, which is either inefficiently used or acquired, but not used in connection with the lack of necessary personnel, the costs of timely training, retraining and advanced training for the state will be negligible, but they will give significant effect in the whole industry.

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Methodology of Creation of Electronic Learning Services and their Integration into IT-infrastructure

Vladimir N. Azarov[1],Yury I. Gudkov[2], Gleb A. Dobrov

School of Computer Engineering
National Research University Higher School of Economics
Moscow, Russia
[1] vazarov@hse.ru, [2] ygudkov@hse.ru

Abstract— **Based on the analysis of international practices in the field of E-learning the classification of models of electronic-distance environments is proposed. The concept of system integration of education is introduced. The standardization background in IT management is analyzed. The universal methodology of building the IT-infrastructure, which can be applied in the development of major integration systems in the field of education, as well as in the design of specialized services and IT services focused on the use of electron-distance education is proposed.**

Keywords— electron-distance education environment; e-learning; learning content management system; learning management system; IT services; business-process

I. INTRODUCTION

The rapid development of information technology has given a powerful impetus to the development of e-learning (e-learning), which allows you to quickly respond to labor market needs, provides opportunities for staff training without departing from the professional activity and get high-quality knowledge to people living in remote places, and people with disabilities. Today, there are a number of educational universities, which to some extent can be attributed to e-learning, namely online training courses, smart education, distance education, Open University, etc. All these concepts are united by the use of various technological components of electron-distance learning environments. The analysis showed that these components are distinguished by different methodological approaches, making it difficult to integrate them into a single set of e-learning environment. The aim of this work is to develop a universal methodology of IT-infrastructure, which can become the basis for the development of major integration systems and automation of business processes in the field of electronic learning.

II. CLASSIFICATION OF ELECTRON-DISTANCE ENVIRONMENTS

Electron-distance environments - a set of educational and management technologies, aimed at gaining knowledge. The fundamental difference of this environment from correspondence university is the use of education technology, which corresponds to the classical full-time education. That is, the full educational cycle, which involves the interaction of a "teacher" and a "student" in the interactive mode is realized in the electron-distance environment [1].

Based on the analysis of best practices in the world of educational structures 3 models of organizing the e-learning can be distinguished:

1. The basic model - the center of distance education of a university. The center provides educational programs in the field of basic university and individual licensed training courses. At the same time students are enrolled in basic university and receive a diploma (certificate) on its graduation. This model is implemented in the University of Pennsylvania, USA, Monash University of Austria, Institute of DE TGK in Russia.

2. The brokerage model - the association (consortium) of universities using a common educational environment. Educational programs and licensed courses of any university participant are remotely implemented in this model. Students are enrolled in one of the university participant, are trained according to the program of this university and receive a diploma on graduation. This model is implemented in the Open Learning Agency of Australia, the National Technological University, USA, the Consortium of colleges and universities MarylandOnline.

3. Stand-alone model - a virtual university without the basic university. Virtual university has its own licenses for educational programs and specialties. Students are enrolled in the Open University, are trained on the program, composed of educational modules of the university and its branches, and receive a diploma of Open Education University. An example of the implementation of this E-learning models are the National Centre for Distance Education, the Dutch Open University, the Canadian Open University, the UK Open University.

Here are the basic requirements and the steps that must be implemented in a project to create an e-learning environment based on each of the models discussed above:

* Distance learning center of university:

➢ Creation of distance learning center within the structure of the basic university.
➢ Creation of regional branches of the university.
➢ Preparing of training materials for distance learning.
➢ Training of teachers for regional branches.
➢ Creation of a corporate information network for distance education.

* Consortium:
➢ Preparing of training materials for distance learning.
➢ Creation of the organization that owns the information network, and has branches in the regions, or the use of one of the universities participants in the consortium as such an organization.

* Universal open education:
➢ Developing and licensing of its own educational programs.
➢ Preparing of training materials for distance learning.
➢ Creating of its own information network of distance education.
➢ Accreditation of national agencies for the certification of personnel with regional branches.

Thus, regardless of the organizational model, e-learning environment can be created on the basis of a universal platform (integrated system), which includes the components of development and educational content management, standard libraries of specialized IT services for the implementation of e-learning services and infrastructure management methodology for information network of distance education.

The main technology platforms for the development and management of educational content is LMS and LCMS.

The LCMS is based on the concept of learning content as a set of reusable learning objects for the various categories of students and specific context of use. Most LCMS manufacturers include these functions for the general management training [2]. The course consists of a content, methods of content delivery to users and evaluation means of its study. A learning object is an independent part of the learning information and may contain appropriate evaluation methods. After studying the learning object evaluation of outcomes of its mastering is held. The entire course consists of a set of such learning objects. The main components of any LCMS, are:

• Storage of learning objects.
• Applications for the rapid creation of learning objects.
• Application for gathering the learning objects in a course.
• Interactive interface of the course learning.

LMS is an integrated environment for automating the management of the educational process and [3], as a rule, includes the following components and modules:

• Forming of curricula and plans for lectures and seminars.
• Forming of individual student's program of learning.
• Forming of schedule.
• Managing of activities of teacher.
• Managing of student's activities.
• Control of access to educational content.
• Monitoring of users' activity.
• Processing of users' requests.

E-learning is an IT service, and requires a more complex IT infrastructure compared to traditional education. Therefore, for the sustainable operation of the electron-distance environment is necessary to ensure "transparent" interaction of two different but interrelated information systems, one of which is designed for content creation, while the second provides automation of educational activity.

When planning the organization, development and implementation of information technologies, aims faced by IT professionals, are often so complicated that their automation at the current level of technology either is not possible or is not cost-effective. That is, the complexity of business processes has reached the level where it is difficult to get a quick and guaranteed result at their automation and automated systems are beginning to show unpredictable results. This phenomenon in the information technology industry began to emerge long ago and has now assumed the character of a well-known crisis, which led to the release of the two trends of the development of information technologies:

• Developing of the methods of effective information systems management, with particular emphasis on their "human" component.
• Developing of the methods of formalized description of real-world objects in languages, close to human, but quite strict in terms of further machine representation of the object parameters and running processes.

The development of the first trend led to the establishment of standards, a set of recommendations and models for the management of IT services, in particular, ISO 20000, COBIT, Information Technology Infrastructure Library, Capability maturity model, etc. [4,5,6,7]. The basic principle of this approach - "the best practice is to follow best practices ". The "best practices" are fixed in the constantly evolving standards, the development of which is accompanied by a refinement of methods of objective evaluation of compliance with the requirements of their organizations. However, the libraries of the best world practices in the field of e-learning development and organization do not exist. Therefore, the emergence of standards in this area is the most important.

In the second trend a substantial reserve in the form of the paradigm of the object-oriented design, which means the use of automated systems in the languages of the formalized description of processes and objects (eg, UML) and the universal description format (XML) is created. The advantage of the universal formats is that they provide the processing methods description as a part of documents and enable you to create more complex description of all business processes and

objects by evolutionary development, and combinations of the previously described.

III. AUTOMATING OF BUSINESS PROCESSES IN E-LEARNING

The basis for the system analysis and design are functional and block diagrams. Block diagrams contain information about the elements of the system and the presence relationship between them without communication functions and elements. The appointment of these schemes is to describe the structure system at the current clarifying level. Function diagrams are detailed information about the functions of each of the system components and their relationships. In practice, a large number of standard diagrams illustrating the flow of processes is used. These standards include, for example, IDEF0 - diagrams that allow the standard graphical language to describe the sequence of operations. That is why the methodology IDEF, which is the most universal and understandable to those of varying levels of IT competency for the creation of a typical electron-educational environment was chosen. An important advantage of this methodology can be considered as the presence of additional notation for describing the internal information flow in the system (IDEF1), detailing a relational data structure (IDEF1X), describing the processes of development of the system (IDEF2), documenting the technical processes (IDEF3), preparing the data for the object-oriented design (IDEF4), etc. [8]. Using this methodology you can, considering the system as a whole, fulfill its decomposition on a limited number of sub-systems that will be subjected to individual analysis as "black boxes" in the next stage. Such representation decomposition of a projected or analyzed system can be carried out repeatedly to the desired level of detailing, creating thus a hierarchy of concepts, which at each level are available for the perception of the analyst of the appropriate qualification [9]. Fig. 1 shows a diagram of the top-level for a business process of e-learning services.
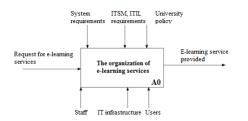
Fig.1. Process of organization of e-learning services

Decomposition of the main process allows you to build a diagram of the lower level, which describes the interaction of content creation systems and systems for management of learning (Fig. 2). The diagram shows that the relationship of systems is proved by identical resources and controlling actions, as well as the same inputs and outputs of business processes.
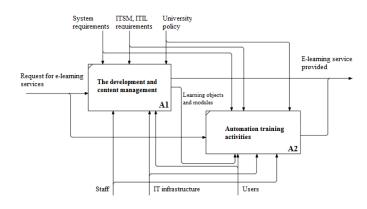
Fig.2. Diagram of processes of creation and content management and training activities automation

As the result of the detailed description of e-learning business process a catalog services of the life cycle of IT infrastructure necessary to create an electron-distance educational environment was created. On the basis of the developed typical diagrams of the description of all levels of business processes a common approach to the planning, implementation and technical support of the components of the electron-distance education environments as IT services, the choice of LMS and LCMS functional modules was suggested. It will avoid unplanned time and money and ensure the continuity of the electronic learning process.

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Updating Optimize the Training of Teachers - Tutors in the Preparation and Retraining of Personnel for the Information Society in the Light of Modern Requirements

S. N. Balkarova, Z. Y. Dzhankulaeva, M. J. Kuchmezova, I. V. Tazheva

Nalchik, Russia

Abstract— **The requirements of modern society imposed upon individuals are such that their process of education during their existence within the society must be continuous and adaptive. Given the fact that staff of enterprises and educational establishments is made up of adults, the training and continuing education of the personnel should be conducted with consideration for age, social-psychological characteristics and other aspects.**

We decided to review the peculiarities of usage of technical means of education, e-learning, smart-education in training (including adults). The main concept of the current system of education is that the leading role in the educational process is being played not by the trainer (teacher), but by the trainee. The main function of the trainer (teacher) is to help the trainees. Provisions are made for practical lessons (often of experimental nature), discussions, business games, case studies, solving specific production problems and issues using mostly remote learning with the assistance of teachers (tutors) and with switching to variability and individualization of educational programs for children and adults.

*Keywords— Digital education; digital pedagogy; tutor; open education; smart education; information society*introduction

Our modern society requires new demands on teachers. Who are creative, able to build goal setting and achieving results that predict the potential risks and who can optimize their operations, modeling of educational process the teacher-tutor is the guarantor of the task. Now increased the demand for highly skilled, creative, socially active and competitive teaching staff, they are able to bring the graduate of the modern school to the model of a successfully socialized individual. It should be noted that the priori the development of society, its level are closely linked with the level of professionalism of the modern teacher, on the willingness of the mentor to learn and develop themselfes in order to participate in the creation of competitive personality. Today no one doubts that the quality of teachers is the most important component of the educational system, as the development of all other components is impossible without the participation of human resources, which are provided with one or the other of the educational system [1]. Especially teachers should be a function of the implementation of educational programs of new generation on the basis of advanced educational technologies, teachers defined the mission of preparing the younger generation for life in the future and education of a person with modern thinking, ready to realize successfully themselves in life. It should be noted that the attention to the problem of training teachers is affected by many factors [2]:
• increasing volume of scientific information;
• permanent progress in the field of engineering and technology;
• integration of education, science and production;
• increasing global (demographic, economic, energy, and economic problems.

Of course, a legitimate statement that in the beginning of the XXI century ends the stage of familiarity with information and communication technologies (ICT), the development of their learning environments and the creation of modern information infrastructure, the production of fundamentally new multimedia training products. At this stage cannot fail to raise questions: how to evaluate the experience and what to do next? The fact that the traditional understanding of the educational process is difficult to consistent with the use of ICT and these difficulties are not overcome, and constantly increasing, for example, the creation of world computer network is completely informal educational communities; the displacement of schools, "real" "virtual". The problem of rational use of information technology in education is far more fundamental than it might seem at first glance. Today ICT applying for a place in the very essence of learning.

We want to note that at this stage you should pay attention to Smart education (smart education), which is able to upgrade all educational processes as well as methods and technologies used in these processes [3]. The Smart concept allows the use of technologies such as smart Board, smart screens, access to the Internet from anywhere. Each of these technologies helps to optimize the content development process, its delivery and updating. Thanks to the smart learning process of education acquires significant mobility, as it becomes possible not only in the classroom, office, and anywhere. The main element linking the educational process, allowing teachers including to

improve the skills not to the detriment of core activities, becoming an active educational content, which creates a single repository, which allows to remove constraints of time and space. Despite the availability of several innovations that facilitate the delivery of relevant knowledge at the present stage of ICT development increasingly have needs that are unable to meet, not only educational technology, but the current e-learning technologies. Here the object of choice should be the concept of Smart-education – flexibility, combining the presence of a large number of sources, the maximum variety of media, the ability to quickly and simply adjusted to suit the level and needs of the listener.

In today's world of permanent development of competence throughout a career is becoming more and more popular in the modern educational system, and in the process of retraining of teachers.

At the moment it is not enough to income only human capital, it is necessary to qualitatively change the educational environment should be changed and the education, its content, methods and tools. The time when a very productive transition to a smart education has come. After all, today in training, we need to develop such competence at students of analytical skills solve complex problems, innovation – ability to develop new ideas and implementation skills intercultural communication. We are interested in the quotation of Professor MESI V. P. Tikhomirov, where it is very accurately expressed the position of education development today: "the Old system of education on any parameters does not prepare people for work and life in SMART society. Without the SMART technologies innovative activity is impossible. If the education system is lagging behind these growth areas, then it goes into the brake" [4].

The penetration of the concept of SMART in education in our life due to the existence of a variety of smart devices that facilitate the process of professional activity and personal life (smart phone, smart home, smarter – intelligent auto, smartboard – interactive intelligent whiteboard, SMART self-diagnostic system hard disk). SMART allows you to increase the level of intelligence of the devices that form the environment for a particular activity. I want to note that the transfer of this concept to education is now in the initial stage, the terms and concepts only in the process of formation. We found that the understanding of SMART with respect to education ranges from the use of smartphones and other similar devices for delivering knowledge to learners prior to the formation of integrated intelligent virtual learning environment, including using the SMART devices category. Of course, in modern society, many new technologies, appery with great speed every year new devices for professional activities and communications. Today's SMART technologies require the changes of the platforms using for the transfer of knowledge and wide use of SMART devices. In our view, vocational education should be one of the most rapidly renewable industries, in terms of both content and from the

point of view of technology and teaching methods. The update rate of knowledge and technology should be considered as a criterion for the quality of the education system.

Today is considered the norm training with the use of multimedia presentations made with programs such as Microsoft Power Point or Macromedia Flash. However, along with the usual presentation technology (Microsoft Power Point, Macromedia Flash), in education penetrate new, so-called interactive technologies that allow you to walk away from the presentation as a slide show. What does it mean? Gaining popularity as a new form of presenting the material using the interactive equipment (interactive whiteboards, SMART Boards, Sympodium interactive displays), this form is a presentation of the lecturer during his speech - the presentation that is created here and now. On interactive whiteboard SMART Boards you can write with special marker to show educational material to make written comments over the image on the screen. All written on an interactive whiteboard SMART Board is transmitted to students, stored on electronic media, printed, sent by e-mail absent. Educational material created during a lecture on an interactive whiteboard SMART Board and recorded by a built-in video recorder and can be reproduced repeatedly.

It should be noted that there are several technologies to make interactive [5]. One technology - touch resistive, the other DViT technology SMART Technologies. It uses special digital cameras located at the corners of the screen. In addition, using a special nozzle, you can turn any plasma screen into an interactive whiteboard. Of course, to maximize all the properties of interactive boards SMART Boards created by special software (SMART Notebook, Bridgit, SynhronEyes). Each of these programs has its own peculiarities. SMART Notebook allows you to work with text and objects, to store information and to transform the written text into print. Through the program, Bridgit, you can quickly and easily deliver presentations to partners around the world, get feedback on your document. It is necessary to highlight the key positions of his speech on the General desktop, and the program immediately in real time displays all the notes on the screens of the other participants of the conference. With the software SynhronEyes tutor can monitor what students are doing, withdraw all the working monitors participants in the educational process on the Board to block the monitors of the students, distribute interactive whiteboard teaching material, for example, a test on all computers. While working on interactive whiteboards improves concentration in students, to quickly assimilate the learning material, and have resulted in improved academic performance of each students. The introduction of new technologies in education leads to the transition from the old scheme of reproductive knowledge transfer to a new, creative form of education and retraining of teachers. One of the main tasks of modern education is the creation of sustainable motivation among the participants of the learning process to acquire knowledge, the other is the search for new forms and instruments of development of this

knowledge through creative solutions. Smart education includes a new concept of digital pedagogy [6]:
- open educational resources (OER)
- a massive open online course (mooc)
- learning platform (Learning Management System/ LMS)
- electronic textbooks (smart book/ e-book)
- electronic library (e - library)
- open licences (e.g., CC license)
- mobile learning
- cloud based educational systems and online services (Web 3.0)
- digital communications
- global media
- automated systems of management of educational organizations (e.g., ACS schools 'smart systems')
- electronic portfolio and personal electronic classrooms...

Now let's move on to what is productive for teachers ' use of the above technologies, as well as for the creation of new educational standards based on current realities, for the development and validation of methods for their use in educational activities, updating of competences of teachers required digital pedagogy. It is her prerogative in the process of upgrading education in terms of embedding innovation. And it should be noted that this process is top-down. First change of the responded high school: smart University - this is the current state of the universities, it all started with distance learning at the University. The University is a systematic mechanism for compact control and digital school in the region is a global territorial system of hundreds of educational institutions in the unified management of the region through a network of municipal clusters.

Today we can speak of digital schools as the pioneers of smart education. We are talking about individual pilot schools implementing digital services and resources of education. The whole world builds digital schools as a smart education in the territories. Selected different models: the coverage of each single territorial schools educational online platform (model of the schools in Singapore), to a global cloud environment that is open to everyone via mobile devices (model transformation of education in Africa).

On the implementation of new models of smart education it is really possible to speak as about the taken place process of digital society in a few decades. Currently, our task is to build this system, it is very important and knowledge-intensive process based including on new ICTs, which provide technological solutions for smart education and, of course, give a lot of educational innovations. It is important that educational community in this process has embraced the new ICT in education not as a spectator, but as a creative community of creators-minded. A risk factor is the personnel readiness of teachers to the construction site smart education. This factor can both increase the pace and strongly inhibit that observed in different regions of the country today.

A special role in the system of smart education is given to teachers tutoral. It is the people who directly embed innovation smart education in the educational process. The role of the family in the process of designing smart education is also very important, because the feature of digital schools of the territory is its penetration into the family, the ability to cover digital resources, and access to all areas of a child or an adult at home or any place of his stay. Now it is impossible not to notice how high the readiness of school teachers in the country to work with objects smart education and the requirement of the families on smart education. Every school today has more than half of the teachers who are already using elements of digital learning environment. This readiness of schools is the key system to a good result.

Development, globalization and smart resource management digital school via cloud services, including personalized, in the region of: electronic diary for all schools in the territory - one diagnostic management of student achievement, e-books as a content system - a single point of access to the territory, and in integration with electronic diary; open educational content and development of the students; ACS schools in the territory - as a single mechanism logistical and financial accounting, global digital video network learning – massive open online courses in the cloud of the region of integration with universities for children and teachers, primarily a variety of extracurricular courses that are available for the development of creativity, research activities in the areas of children's interests.

Perhaps the introduction of different models of access to the resources of the digital school site: one-to-one (requires equipping each student's mobile computing device), one – to-many (teacher – group of students needs access to the portal of education - courses and video services for everyone - an interactive educational channel, can be clustered allocation to municipalities /schools/ groups of students), "many – one" is the ability of any participant of educational process in the territory to get advice from many mentors, coaches, Tutors this model actually implements an individual trajectory for students because it allows you to choose one to learn from; and finally, the "many – to-many" is a network of educational communities in creative areas by combining remote users - children and adults: libraries, clubs, competitions, network studios, the network of intellectual schools, online exhibitions, global media, etc. While such a network of creative communities develop spontaneously, they need to allocate space in the local web space, for example, to create a "single window" to all the teachers and students could use them directly.

The digital education platform includes complex system solutions in the digital environment: banks of pupils and teachers, collections of educational materials, the educational environment of communication, means of educational process management, subsystems, financial and logistical limitations, educational and analytics environment for diagnostics, the

portfolio of the participants of the educational process. There is a need of designing with the possibility of combining subsystems according to the General technology requirements. In the meantime we have to perform: to choose from a set of system solutions, how to put the selected designs into a common platform smart education, how to ensure its functioning as a global accessible educational environment in the territory. This global platform of digital education in the territory will allow for strategic analysis: to see the ratings of demand resources, that is to "strip code" educational activity for the children and teachers in different services and to build on the basis of this analysis of future trajectories of development or modernization of digital schools in the region, and also in parallel to determine the actual order for the professional development of teachers in specific areas.

Summarising, I want to strese that there is a high need for massive open online courses on new ICT competences of teachers in the digital school. These courses should provide guidance to teachers on ICT competence according to the method of expanding environment of digital education. In addition, the role of Tutors, able to provide high-quality training and retraining of teaching staff, meets the requirements of modern realities. Moreover, this preparation preferrs without departing from the main activity, it is desirable to use remote methods of learning and knowledge control, significantly saving time and money.

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The Role and Importance of Multimedia Educational Technologies in the Training of Engineers

Asiyat.M. Bozieva

Polytechnic Institute
Kabardino-Balkarian State University
Nalchik, Russia
bozieva.asya@mail.ru

Abstract—**Analyzed the basic requirements for engineering personnel in the modern hi-tech mechanical production. Based the necessity of the integration of multimedia technologies in the educational process to significantly improve its effectiveness.**

Keywords—informatization; media technology; engineering education; virtual laboratories

I. INTRODUCTION

Modern machinery production has changed so much over the last three decades that it demanded entirely new staffing at all stages of the life cycle of products. Marketing research has become significantly deeper and more intense, project and survey work is so intensified that a new modification of products or new types of products appear on the market in a very short time, if the organization of their production will not be this process to keep.

To avoid this on the market constantly supplied with equipment and technological capabilities that are practically unlimited or quality of products or performance or reliability. There are no restrictions on cutting tools, measuring instruments and technological tooling for various purposes. As a result of the technological revolution that occurred in these years, there were technology cutting edge nanoscale processing of surfaces of details.

The most serious problem in these conditions was the training of competent modern engineering technology engineering staff. In modern conditions the engineers should be competent in several related areas: machine operator-programmer-metrologist; designer-machinist-toolmaker; programmer, technologist, etc. Educational standards that are now used in universities to some extent, focus on training such specialists, but educational institutions are not always and not in all ready. Therefore, today about 70% of Russian industrial enterprises are experiencing an acute shortage of the necessary engineering personnel, which does not allow their products to fully compete with the products of the enterprises of the industrialized countries of the world: USA, Europe, Japan, Southeast Asia, etc.

The main reasons for this - lack of in universities the required level of teaching staff, material and technical provision of the educational process, not enough high school level of University applicants. However, even in these conditions it is possible to raise the level of training of specialists in universities. It's widespread use in educational process of modern information and communication technologies and multimedia tools, which dramatically increases the effectiveness of lessons through increasing the quality and quantity of information, denounced by to students.

II. OBJECT OF STUDY

The use of multimedia technologies in education is reflected in the scientific works of a large number of researchers, most of which focus on the development of multimedia support classes in specific areas, mainly language, for the definition of new content and presenting multimedia content. Great attention is paid to the study of promising features of multimedia means in educational process in terms of their continuous development. At the same time, the lack of reflection found the problem of the formation of models of integration of multimedia technologies in the educational process and determine the impact of multimedia technologies on various aspects of the educational process.
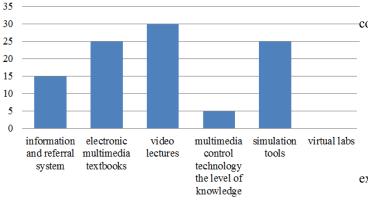
In this study, the goal was to identify the main range used in practice multimedia educational tools and to determine their influence on the indicators of educational process (on the basis of the Polytechnic Institute of the Kabardino-Balkarian state University, Kabardino-Balkarian state University).

For a modern engineering education, where the volume required for study materials is great, the media are of special value because they allow solving the problem of effective implementation of information exchange between subjects of the educational process. Throughout the training students of engineering study the objects, processes and phenomena, without a visual overview of which is difficult to make a correct representation of their nature.

As an example, let us analyze the methodological aspects of using multimedia in the study of disciplines "descriptive geometry and Engineering graphics" and "Computer graphics", which is one of the fundamental in the training of engineers. Here are the features in the form of the necessity of presenting the audience a large number of graphic materials in a relatively short time. When creating multimedia during lessons must take into account aspects such as visual quality, speed, accurate traceability of the sequence of the drawing or sketch. The essential tool in becoming a different kind of computer-aided design (CAD), which allow a variety of manipulations with objects: creation of 3D models, zooming, analysis of the individual elements, actuated, etc. the Use of CAD allows the use of three-dimensional simulations instead of physical models. This approach allows us to develop spatial and abstract thinking.

III. METOD OF RESEARCH

The survey, conducted among 20 professors of the Institute showed a wide range used in the training of multimedia learning tools (figure 1). Educational multimedia merged in a common group, the height of a column shows what percentage of the interviewed teachers uses this tool in the educational process. Thus, 15 % used information and referral system, 25 % – electronic multimedia textbooks, 30% of the video lectures, 5 % – multimedia control technology the level of knowledge, 25% - simulation tools, virtual labs do not apply.

Fig.1 The results of a survey among the teachers of the Polytechnic Institute of the Kabardino-Balkarian state University.

In this case, all respondents noted the positive impact of multimedia on learning. To achieve the objectives of the study were the degree of influence of properties of multimedia tools on different aspects of the educational process. The study was conducted by the method of a priori ranking based on expert assessment survey [4]. This method allows evaluating the studied phenomenon in the form of the generalized opinions of experts on the subject. Appreciation of the importance of each of the indicators by experts was conducted on a 5-point scale (results are presented in table 1).

The order of the calculation:
1. Individual assessment indicators bring to the table.
2. Determined by the sum of ranks R;
3. Determine the average sum of ranks $\overline{R}$:

$$\overline{R} = \frac{1}{k} * \sum_{k=1}^{k} R_k = \frac{15+24+26+14+17}{5} = 19,2$$

where $R_{k1...k5}$ – the sum of the ranks for the measure; k – number of parameters.

4. Determine the deviation of the sum of ranks of each indicator of the average amount of ranks $R_k^`$:

$$R_k^` = R_k - \overline{R}$$

Where $\overline{R}$ – the average sum of ranks.

5. Determining the degree of consistency of experts with the help of the coefficient of concordance of Kendall (0-not applicable matching, 1 - absolute consistency of opinion):

$$K = \frac{12 * \left(R_k^`\right)^2}{k^2 * \left(m^3 - m\right)} = \frac{12 * 118,8}{25 * \left(216 - 6\right)} = 0,272$$

K=0,272 corresponds to the low level of consensus.

6. Check the statistical significance of the obtained coefficient of concordance using the Pearson criterion:

$$\chi_{расч}^2 = \frac{12 * R_k^`}{k * m * \left(m - 1\right)} = \frac{12 * 118,8}{5 * 6 * 5} = 9,504$$

$$\chi_{крит}^2 = 1,311$$

There is statistical significance of the consistency of experts.

TABLE   THE RESULTS OF THE EXPERT SURVEY

The possibilities of multimedia	Conditional experts numbers, m						The sum of the ranks, R	$R_k^`$ Deviation sum of ranks,	The squared deviation	Place
	1	2	3	4	5	6				
	Grades assessment, от 1 до 5									
Individualization of education	2	2	3	3	2	3	15	-4,2	17,64	4
Increasing the quantity and digestibility	3	4	5	5	5	2	24	4,8	23,04	2

of the information										
The increase of extracurricular work	5	5	4	4	3	5	26	6,8	46,24	1
The increasing interest in learning	1	1	2	2	4	4	14	-5,2	27,04	5
Saving time on learning the educational material	4	5	5	1	1	1	17	-2,2	4,84	3
Total	15	17	19	17	15	15	96	-	118,8	

IV. RESALT AND DISCUSSION

Thus, according to the survey, indicators of influence were as follows:

1st place – raising the level of independent work;
2nd place – increase the number of digest information
3rd place – save time on learning;
4th place – individualization of education;
5 increase the interest in learning.

The main thing that determines the learning efficiency in a multimedia-mediated learning environment is not very technical tool, but how and for what purpose it is used by the teacher. It is important that the teacher have a clear idea of what he was doing, why and how of the chosen multimedia tool helps to solve the tasks.

Full and complete multimedia course in the discipline must be designed for all forms of learning activities - lecture, practical classes, laboratory work, to provide for the control unit to monitor the progress of students.

In engineering education is of great importance of practical training. The quality of teaching is exceptional influenced by the availability and accessibility of modern research and technological equipment, but not all universities are able to equip laboratories with modern equipment; the limitations of the experimental base often does not allow to fully realize the potential of laboratory classes. In such conditions, the effective use of virtual laboratories based on interactive multimedia technologies.

The use of virtual laboratories Kabardino-Balkarian state University in the framework of the training of engineers and technicians is promising. They improve the quality of training through interactive visualization study on the laboratory and practical training processes that will provide a more complete understanding of them.

The use of virtual laboratories will solve the following tasks:

- will increase the activity of students;
- enables a complete and objective control of the degree of absorption of the material of laboratory works by automating control;
- simplify the process of re-performance of works;
- provide the possibility of using lab resources in the framework of the self-study;
- will more effectively realize the implementation of distance learning, for example, in the framework of "Open University".

Virtual lab compared to real laboratories will provide the following benefits:
- eliminating the need to purchase expensive equipment, necessary accessories and consumables;
- the possibility of studying processes, the observation of which is impossible in real systems;
- the possibility of considering processes for a long time or in a matter of seconds;
- individualization of student work;
- implementation of a greater number of laboratory works under the same spending study time;
- possibility to change conditions of experiments;
- security that provides a range of manipulations without risk to life and health;
- the speed calculation works, for example, based on parameters from each other especially in the context of a series of experiments.

The use of virtual laboratories in education will be effective for students full-time tuition and correspondence, for the latter, primarily in connection with the launch of the distance learning system "Open University".

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Fast Modular Multiplication Execution in Residue Number System

N. Chervyakov[1], M. Babenko[2], V. Kuchukov[3],
M. Deryabin[4], N. Kuchukova[5]

Mathematics and Mathematical Modelling
North-Caucasus Federal University
Stavropol, Russia
[1]k-fmf-primath@stavsu.ru; [2]mgbabenko@ncfu.ru;
[3]viktor-kuchukov@yandex.ru; [4]maderiabin@ncfu.ru [5]knn.storage@yandex.ru

A. Tchernykh
CICESE Research Center
Ensenada, Baja California, Mexico
chernykh@cicese.mx

Abstract — **In the paper, we propose a new method of modular multiplication computation, based on Residue Number System. We use an approximate method to find the approximate method a residue from division of a multiplication on the given module. We substitute expensive modular operations, by fast bit right shift operations and taking low bits. The carried-out simulation on Kintex7 XC7K70T board showed that the offered method allows to win in time on average for 75%, and in the area -- on average for 80% relatively to modified method from work [1] that makes it more applicable for the hardware implementation of the cryptography primitives constructed over a simple finite field.**

Keywords— approximate method; FPGA; Montgomery algorithm; residue number system.

I. INTRODUCTION

Finding remainder of division of a number by the fixed module is basic operation of a large number of algorithms implementation: information security ([1]-[5]), digital signal processing [6], wireless systems [7], etc. During development of the hardware decisions for the modern information systems special attention is paid to technical characteristics: speeds of operation, area, etc. Use of the Residue Number System (RNS) allows to execute addition and multiplication of numbers on parallel computing channels without bit carrying between channels that allows to increase the speed of arithmetical operations execution. In the paper a new method of modular multiplication computation, based on finding by the approximate method a residue of division of a multiplication by the given module in Residue Number System (RNS) is proposed. Due to use of approximate method from work [8] for finding a remainder of division expensive modular operations which are replaced with fast bit right shift operations and taking low bits aren't required.

II. RESIDUE NUMBER SYSTEM

The theory of congruence relation and Chinese Remainder Theorem are the cornerstone of RNS. Arithmetical operations (addition, multiplication) in RNS are executed parallely independently on L channels and without carrying between computing channels. It's worth noticing that in each separate computing RNS channel we carry out operation with numbers of smaller size − with number remainders of division on the RNS module that leadds to reduction of carries number and reliability and the speed of arithmetical operations with numbers execution augmentation. RNS is defined by pairwise coprime numbers $m_1, m_2, ..., m_L$, called modules. RNS range can be computed by the formula $M = \prod_{i=1}^{L} m_i$. Any integer A belonging to a segment $[0, M-1]$ is represented unambiguously in RNS with a tuple $(a_1, a_2, ..., a_L)$ where for all $i = \overline{1,n}$ congruence $a_i = A \bmod m_i$ is true.

According to Chinese Remainder Theorem number A can be recovered with the use of formula:

$$A = \left| \sum_{i=1}^{L} \frac{M}{m_i} \left| M_i^{-1} \right|_{m_i} a_i \right|_M , \qquad (1)$$

where $M_i = M / m_i$ and $\left| M_i^{-1} \right|_{m_i}$ - multiplicative inverse of M_i modulo m_i.

If we divide (1) by constant M, then we will get the approximate value

$$\frac{A}{M} = \left| \sum_{i=1}^{L} \frac{\left| M_i^{-1} \right|_{m_i}}{m_i} a_i \right|_1 = \left| \sum_{i=1}^{L} k_i a_i \right|_1 , \qquad (2)$$

where $k_i = \dfrac{\left| M_i^{-1} \right|_{m_i}}{m_i}$ - constants of the chosen system and a_i - remainders of number A represented in RNS, thus value of expression (2) will be in an interval $[0,1)$. The end result of the amount is computed after summing and discarding of an integer part of number with saving a fractional part of the amount. The fractional part can be also written as $X \bmod 1$, because $X = \lfloor X \rfloor + X \bmod 1$.

Follows from a formula (2) that the RNS to positional notation conversion is made by a formula:

$$A = M \left| \sum_{i=1}^{L} k_i a_i \right|_1 \qquad (3)$$

III. THE REVIEW OF WORKS OF MODULAR MULTIPLICATION COMPUTATION IN RNS

Algorithms of modular multiplication computation can be divided into two classes: the ones, which use an operation of finding the remainder of division by the fixed module of a product and the others, which use the operations of finding residual during multiplication computation process. We will consider the algorithms which allow executing modular multiplication without use of operation of finding the remainder from division in general but require precomputation and storage of constants.

The Montgomery algorithm for modular multiplication without division is proposed in work [9]. The effective systolic realization of the Montgomery algorithm is proposed in work [2] and is presented below by the algorithm:

Algorithm 1. MMM (A_R, B_R, p)

1. If $(b_0 = 1)$ then $B_R = B_R - 1$; $T^{(0)} = A_R$;
2. For $i = 0$ to $n+1$
2.1. For $j = 0$ to $n+2$
2.1.1. $t' = (t_{i,j} \oplus C0_{i,j}) \oplus (a_i \wedge b_j)$;
2.1.2. $C0_{i,j+1} = ((t_{i,j} \oplus C0_{i,j}) \wedge (a_i \wedge b_j)) \vee (t_{i,j} \wedge C0_{i,j})$;
2.1.3. $t_{i+1,j+1} = t' \oplus ((t_{i,0} \wedge n_j) \oplus (D0_{i,j} \vee D1_{i,j}))$;
2.1.4. $D0_{i,j+1} = t' \wedge ((t_{i,0} \wedge n_j) \oplus (D0_{i,j} \vee D1_{i,j}))$;
2.1.5. $D1_{i,j+1} = (t_{i,0} \wedge n_j) \wedge (D0_{i,j} \vee D1_{i,j})$;

where $p - n$-bit odd module, $R = 2^{n+2}$, $A_R = A \cdot R \bmod p$, $B_R = B \cdot R \bmod p$ and the result $T = [t_{n+2,n}, ..., t_{n+2,0}]$ satisfies a condition $A_R, B_R, T \in [0, 2p)$; in beginning of cycle $T^{(0)}$, $C0$, $D0$ and $D1$ are zero. In work [3] it is said that critical way of this algorithm delay is $3T_{XOR}$, where T_{XOR} delay of two input element XOR.

The modular multiplication algorithm of Montgomery in two fields and generalization of set of modules conversion algorithm for two fields is shown in work [10]. The multiplication algorithm where $\oplus$ multiplication/subtraction operation in two fields and $\otimes$ - multiplication operation in two fields is set as:

Algorithm 2. RMM $(A_\tau, B_\tau, (-p^{-1})_\beta, Q_\alpha^{-1}, p_\alpha)$

1. $s_\tau = A_\tau \otimes B_\tau$;
2. $c_\beta = s_\beta \otimes (-p^{-1})_\beta$;
3. $c_\alpha = c_\beta$ (set of modules conversion);
4. $u_\alpha = c_\alpha \otimes p_\alpha$;
5. $v_\alpha = s_\alpha \oplus u_\alpha$;

6. $T_\alpha = v_\alpha \otimes Q_\alpha^{-1}$;
7. $T_\beta = T_\alpha$ (set of modules conversion).

In this algorithm sets of modules are $\alpha = (p_1, p_2, ..., p_L)$ and $\beta = (q_1, q_2, ..., q_L)$ such that $\gcd(p_i, q_j) = 1$, $\forall i, j \in [1, L]$. Input are numbers A and B represented by two sets of RNS modules, i.e. A_τ and B_τ, constant $(-p^{-1})_\beta$ in RNS β, constants Q_α^{-1} and p_α in RNS α, where $A, B < 2p$, $Q = \prod_{i=1}^{L} q_i$. The output of this algorithm is T_τ, where $T < 2p$ and $T \equiv A \cdot B \cdot Q^{-1} \bmod p$. During execution of multiplication it is necessary to transfer between systems of the bases α and β twice.

Important aspect of the given algorithm is that it comes down to simple accumulative multiplication where the word length is equal to module length. It allows to construct the device with completely parallel architecture where each module corresponds to one modules of the RNS bases system.

IV. EFFECTIVE IMPLEMENTATION OF A REMAINDER OF DIVISION COMPUTATION IN RNS

We will consider approach when computation of modular multiplication comes down to two stages: to find two numbers product $C = A \times B$ and to find residue of number modulo p, i.e. $C \bmod p$.

Effective implementation of finding number C remainder of division modulo p in RNS can be achieved with the formula (2):

$$\frac{C}{M} = \left| p \sum_{i=1}^{L} \frac{\left| M_i^{-1} \right|_{m_i}}{p \cdot m_i} c_i \right|_1 = \left| p \sum_{i=1}^{L} \overline{\overline{k_i}} c_i \right|_1$$

$$= \left| \sum_{i=1}^{L} k_i c_i \right|_1 = p \sum_{i=1}^{L} \overline{\overline{k_i}} c_i - \left[\sum_{i=1}^{L} k_i c_i \right], \qquad (4)$$

where $\overline{\overline{k_i}} = \dfrac{\left| M_i^{-1} \right|_{m_i}}{p \cdot m_i}$ and $[x]$ – denotes integer part of number x. From (4) follows that C can be represented:

$$C = \left(p \sum_{i=1}^{L} \overline{\overline{k_i}} c_i - \left[\sum_{i=1}^{L} k_i c_i \right] \right) \cdot M \qquad (5)$$

With the formula (5) we calculate value C / p:

$$\frac{C}{p} = \left(\sum_{i=1}^{L} \overline{\overline{k_i}} c_i - \frac{1}{p} \cdot \left[\sum_{i=1}^{L} k_i c_i \right] \right) \cdot M \qquad (6)$$

Therefore, value $C \bmod p$ can be calculated by a formula:

$$C \bmod p = C - \left\lfloor \frac{C}{p} \right\rfloor \cdot M =$$

$$= C - \left\lfloor \left(\sum_{i=1}^{L} \overline{\overline{k}}_i c_i - \frac{1}{p} \cdot \left\lceil \sum_{i=1}^{L} k_i c_i \right\rceil \right) \cdot M \right\rfloor \cdot p \quad (7)$$

As there is no need to make computation with integer parts of real numbers it is possible to make transition from computation with fractional parts to integer calculations. It can be made as follows:

- to multiply each real constant by 2^N, where N - the number of binary digits of the fractional part providing the necessary level of accuracy of computation;
- to ceil each received number;
- to make all computation in residue class ring over the module 2^N.

Using an assessment of N from work [9], we will receive that $N = \left\lceil \log_2 \left(M \cdot \sum_{i=1}^{L} (m_i - 1) \right) \right\rceil$. Considering the fact that in FPGA operation with real numbers is expensive, we will transfer from real numbers to integer having multiplied $\overline{\overline{k}}_i$ and k_i by 2^N, then the formula (7) will assume:

$$C \bmod p = C_{RNS} - K \cdot p_{RNS}, \quad (8)$$

where $K = \left\lfloor \left(\sum_{i=1}^{L} \widetilde{k}_i c_i - \mu \cdot \left\lfloor \sum_{i=1}^{L} \overline{\overline{k}}_i c_i / 2^N \right\rfloor \right) \cdot \frac{M}{2^N} \right\rfloor$,

$\widetilde{k}_i = \left\lfloor 2^N \cdot \overline{\overline{k}}_i \right\rfloor$, $\overline{\overline{k}}_i = \left\lceil 2^N k_i \right\rceil$, $\mu = \left\lfloor 2^N / p \right\rfloor$ and

$N = \left\lceil \log_2 \left(M \cdot \sum_{i=1}^{L} (m_i - 1) \right) \right\rceil$.

As a result of the computation of $T = C \bmod p$ by the formula (8) algorithm work, a result satisfying a condition: $0 \le T < 2p$ will be received, analogically to Montgomery algorithm from works ([1]-[3], [9], [10], [11]).

Simulation is made on board Kintex7 XC7K70T.
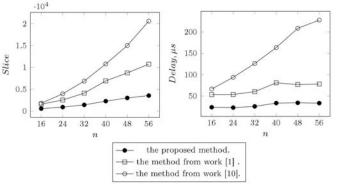
Fig. 1 Technical characteristics of FPGA modular multiplication architectures

From Fig. 1 it is obvious that the the offered method allows to win in time on average for 75%, and in the area on average for 80% relatively to modified method from work [1].

V. Conclusions

In the paper a new method of modular multiplication computation, based on finding by the approximate method a residue from division of a multiplication by the given module in RNS is proposed. Use of the approximate method for finding a remainder of division doesn't require expensive modular operations which are replaced with fast bit right shift operations and taking low bits. The carried-out simulation on Kintex7 XC7K70T board showed that the offered method allows to win in time on average for 75%, and in the area on average for 80% relatively to modified method from work [1] that makes it more applicable for the hardware implementation of the cryptography primitives constructed over a simple finite field.

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Is it Possible to Improve the University Education with Social Networks: the Opinion of Students and Teachers

Marina S. Chvanova
Department of Information Systems
Moscow State University of Technologies and Management
named after K.G.   Razumovskiy
Moscow, Russia
tmbtsu@gmail.com

Alexander E. Hramov
Department of Automation, Management, Mechatronics
Yuri Gagarin State Technical University of Saratov
Saratov, Russia
hramovae@gmail.com

Marina V. Khramova, Elena N. Pitsik
Department of Information Systems and Educational
Technologies
Saratov State University
Saratov, Russia
mhramova@gmail.com, pitsikelena@gmail.com

Abstract—**The article considers the roles of social networks in education, and also an image of the teacher on a social network. It is offered to consider the following questions in this article: where is "framework" in communication between students and teachers? What is the impact of social network in the educational process? What is inappropriate to discuss with the teacher in a network?**

Results were analysed and illustrated in the form of histograms.

Keywords— social networking; educational opportunities; the impact on the education system; teacher; student; teacher communication quality

I.   INTRODUCTION

As the practice shows, 61.5 million people visits Internet monthly in Russia and this index is increasing with time [1], [2]. According to the survey of 2011 [3], 81% of respondents use social networks. Now more than 90% of Internet users visit social networks, both Russian and foreign [4]. Users of social networks give them more and more time, regardless of age and social status .

Researchers [5] concluded that the interaction of the Internet carries out social and educational impact on a person. Netizens gain social experience through the assimilation of norms, values and attitudes of virtual community.

Today, the use of social networks as a tool for learning communication is an integral part of the university information space [6], [7]. Communication issues have been raised many times in the open education and distance learning [8], [9], both as a specialised communication in distance education systems [10], [11] and as a problem of communication in the social network in the teacher-student system [12], [13].

It is obvious that social networks provide additional opportunities in the educational process and allow you to implement additional functions. With the appearing of social networks appear different values [14], due to the development of the information age. Actualizes the need to study the phenomenon of social networks from the perspective of identifying and addressing new educational problems.

However, it is important to take into account the opinion of the participants of the educational process of the wish to use social networks for this purpose and a wish to communicate with teachers and understand their advantages and disadvantages - it is important for improving the quality of the educational process in the situation of the active use of information technologies. It is dedicated to research.

II.   RESEARCH

Survey was chosen as a research method. It was conducted in September when all the participants of the educational process was involved in the work. The survey involved 1,269 respondents: bachelor students, masters students, graduate students, teachers, employees (Fig. 1).
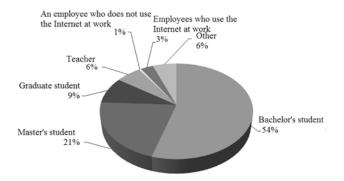
Fig. 1   The social statuses of the respondents.

When it was asked about the time spent on the Internet, the respondents gave answers, presented in Fig. 2.

It was revealed that there is a lot of the respondents residing in the network using gadgets for all age categories. A quarter conducts in the network of 3-6 hours per day, slightly smaller - from 15% to 30% — more than six hours a day. Very few respondents spend 1-2 hours a day on the Internet, or as little go online at all.
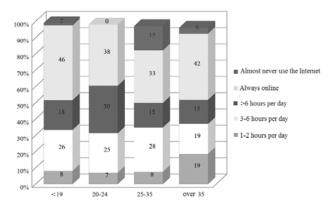
Fig. 2 How much time do you spend on the Internet?

The results, in general, are quite logical: the Internet has become something daily, turning fron a tool of developers and fans in a basic human right.

Figure 3 presents the results of answers to the question about the direction of Internet use.
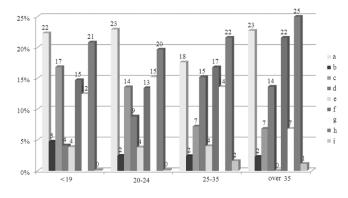
Fig. 3 The results of answers to the question: "Why do you use the Internet? a – communication with relatives, friends, acquaintances (social networks); b – meet new people; c "– just a lot of fun, for entertainment; d – work online; e – online games; f – news; g – download multimedia files (movies, music, etc...); h – for education (distance learning, information retrieval, electronic textbooks, etc...); i – other

Obviously, the use of the Internet for communication is high — about one fifth of the respondents of all ages are using the World Wide Web to communicate with relatives, friends and acquaintances, including social networks. Roughly the same popular answer is "for educational purposes".

We compare these results with the results of the survey of 2008 and 2013, when in the course of the study the respondents were asked the same question (Fig. 4). Here we also see a clear tendency of Internet users to network education (including distance learning) and communication (including a communication in social networks). Also the

situation has changed for the use of the Internet in professional work.
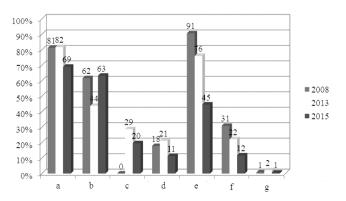
Fig 4 The results of the survey in different years about the purpose of the Internet use: a – for communication; b – for educational purposes; c – work on the network; d – online games; e – news; f – to meet new people; g – other.

Then we found out what social networks use respondents (Fig. 5). The first place took social network Vkontakte in all age categories. Among the representatives of the "over 35" age there are many Facebook and "Odnoklassniki" users. It may be noted the popularity of "Instagram" among junior high school age - 19% of people in this age group use this network.
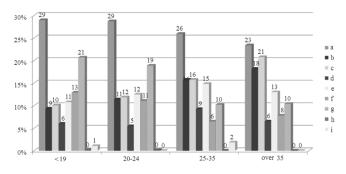
Fig. 5 Results of answer to the question: "What social networks do you use? a – Vkontakte; b – Odnoklassniki; c – Facebook; d – My World (MoiMir); e – Google+; f – Twitter; g – Instagram "

The popularity of Facebook network among the older gener- ation can be explained whith the fact that it is the first social network, introduced in 2004 — when the representatives of other age groups did not use the Internet because of their age. Appeared later social network "Vkontakte" is not gained popularity among Facebook users.

Then we specified the purposes of the social networks use (Fig. 6). The most common response — communication and information in groups and / or communities of interest category. Communication is the most popular motivation for the use of social media - the survey results have shown that this is true for all ages. You can also note that many of the students — this age category "19" and "20-24" — use social networking sites for viewing multimedia.
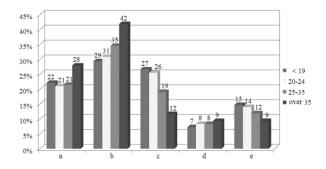
Fig. 6 Results of the answer to the question: "For what purposes do you use social networks in which an account? a – communication / relationships; b – f communication and information in groups and / or communities of interest issues; c – multimedia; d – self-expression; e – entertainment "

Since our research is much about the topic of social networking in education, we decided to ask respondents how they evaluate the impact of social networks on the education or work. The results are shown in Fig. 7.
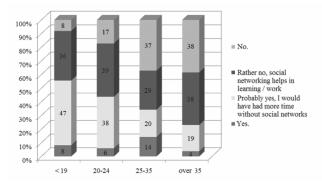
Fig. 7 The results of answers to the question: "Do you think that social networks have a negative impact on your performance / work?"

Here you can trace the explicit dependence of the results on the age of the respondents: the older the respondent, the more he controls the time spended on social networks.

Option "No" was chosen by 38% of respondents older than 35 years and only 8% - students up to 19 years, while the option "yes" chose almost half of the young respondents. An equally large number of people who believe that the social network more help in learning / working.

Thus, young people are more likely to mention the negative impact of social networks on their lives. This can be explained by the fact that the older generation is occupied by building "adulthood": work, family, the related liability. It was founded that the level of responsibility among users of social networks depends on the time which the user spends on social networks: the higher the first indicator, the lower the second. Social networks can be seen as an opportunity for unscrupulous people to move away from their responsibilities and indulge in procrastination, which is a pretty common problem among students. Largely results of this survey help to explain the results of the following: "How much time do you spend social networking" (Figure 8)?
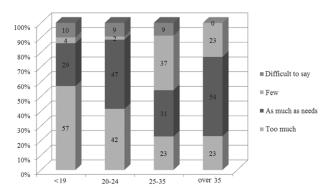
Fig. 8.Results of the answer to the question: "How much time do you spend social networking?"

Among the students of junior high school age, more than half believe they are paying too much time to social networking. It is noticeable that the number of respondents who chose this option decreases with increasing age — in categories from 25 years only 23% of respondents believe that they spend on the internet too much time. Unexpectedly large numbers of people in the "25-35" category, chose the answer "not enough". This can be explained by the fact that at this age, most people are busy careers.

The place of social networks in our lives as well allow us to judge the answers to the following question: How do   you assess the dynamics of your activity on social networks (Figure 9)?
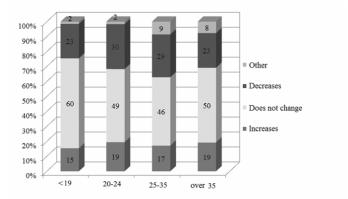
Fig. 9 Results of the answer to the question: "How do you assess the dynamics of your activity on social networks?"

Generally, the results for all ages look about the same. Only answer of representatives of junior high school age is different: 60% believe that their activity does not change with time, 23% reported a decrease in activity, and only 15% confirmed that their activity increases with time.

For other age groups, this figure is higher — from 17%   to 19%. Thus 46-50% still believe that their activity remains unchanged.

The survey also clarified how users evaluate the possibility of using social media in education (Fig. 10). The number of respondents who believe that social networks are not suitable for the education is slightly for all ages. As a rule, the

respondents believe that social networks are a suitable platform for the educational process. Percentage answered positively great for junior high school age, and for people over 35 years, including a large number of already experienced teachers.
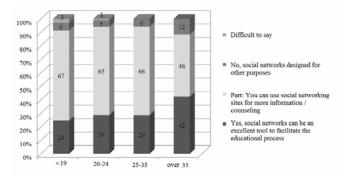
Fig. 10 Results of the answer to the question: "Do you think it is advisable to use social networks in education?"

It can be measured about the interaction between teachers and students in social networks by a survey of students (Fig. 11), and teachers (Fig. 12), what will they do if they will found each other accounts in social networks. It is seen that students are not so much disposed to dialogue, as teachers, but both of them will show the activity one way or another.
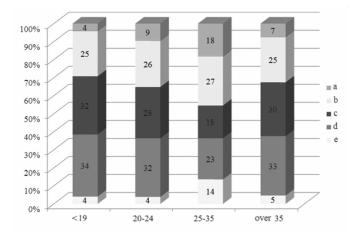
Fig. 11 The results of the survey of students: "... a - add to my friends / subscribe, start a dialogue; b - Add to my friends / subscribe, without dialogue; c — will not add to friends / subscribe, but will regularly review; d - ignore account; e — other»

According to the survey, about one-third of students of all ages will not show any activity, but many will regularly review teacher's account; 25-27% will subscribe to an account or add to the "friends" without a dialogue, and only 4-18% will come into active correspondence. Also, some respondents chose the option "Other", noting that their choice in a given situation depends on the personality of the teacher and how the teacher presents itself in a social network.
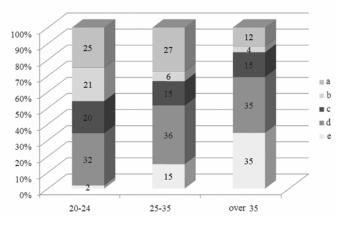
Fig. 12 Results of the survey of teachers: "... a – add to my friends / subscribe, start a dialogue; b – Add to my friends / subscribe, without dialogue; c – will not add to friends / subscribe, but will regularly review; d – ignore account; e – other

The same question was asked to teachers (Fig. 12): 32-36% of the respondents will ignore the accounts of their students / pupils, 15-20% will view accounts without signing or adding to "friends", 4-21% will add to "friends "or subscribe, without entering into a dialogue, and 12-25% will correspond. It is noticeable that among teachers is much more ready for active communication in social networks. Also, some respondents chose "Other", often explaining: ready to communicate in social networks, if a student show initiative.

To the question: "Do you look for information about your student / teacher on the network?" (Fig. 13). Minority does not consider it necessary to do it at all — 11-26% for all age categories. Most respondents still will show some activity in relation to information about their student / teacher network. The only question is, what kind of activity is it about.
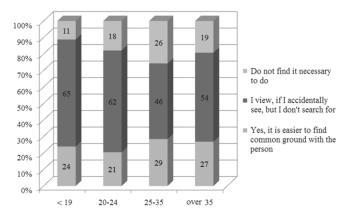
Fig. 13 Results of answer to the question: "Do you look for information about your student / teacher on the network?"

It may be noted that more than half of students - 65% up to 19 years and 62% of 20-25 - prefer "passive" interest. They will not specifically look for information, but they will view it if it gets in the eyes. This option is the most popular for the other age categories. Also there is a great number of those who purposefully looking for information, assuming that it is easier to find common language with people.

The next question was: what will you do if you will figure out that your students/teachers are browsing your social network account (Fig. 14)? The result is about the same for all age categories, ie the majority of respondents would not take any action. It may be noted that the students up to 19, and 20-24 will clean the page of content, while respondents older prefer to restrict access to the page.
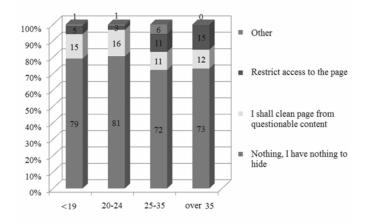
Fig. 14 Results of the answer to the question: "What will you do if you will figure out that your students/teachers are browsing your social network account?"

Let's see the other side of this issue. How will you react if your student / teacher will suddenly hide his page from you (Fig. 15)? Almost half of the respondents under 19 years — 48% — will slightly upset. Recalling the previous questions, we can conclude that a certain interest among the younger age to university teachers activity in the social network is present, but respondents are not ready to take the initiative to communicate. The number of respondents that chosed this answer is large among the other age groups-from 27% to 38%. Despite the fact that the majority of respondents chose "will not respond", we can assume that many people of different ages still attach certain importance to communicate in social networks.
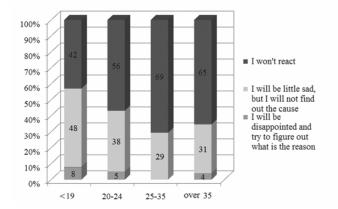
Fig. 15 Results of the answer to the question: "How would you react if your teacher / student will hide his page from you?"

Respondents were asked: "Do you imagine your life without social networks?" Opinion has divided (Fig. 16): approximately the same number of respondents chose the

answer "no" and "yes." Nearly half — 45% — of the respondents in the age group of 25-35 easily imagine their life without social networks, while other respondents, this percentage is slightly lower.
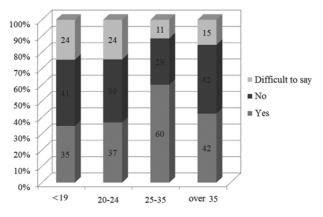
Fig. 16 Results of the answer to the question: "Do you imagine your life without social networking?"

As you know, universities have active pages on social networks, where there are a discussion about the news of the student's life and communication between students. We asked whether respondents discuss university affairs in social networks (Fig. 18). Half of the respondents older than 25 years have answered "no", while the students of junior and senior high school age discussed student life in personal messages. There is not so great number of those who is an active member of the university community — 17-23%.
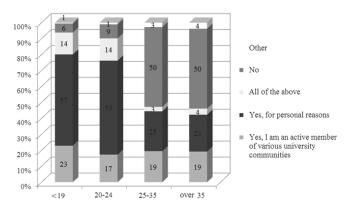
Fig. 17. Results of the answer to the question: "Do you discuss in social networks university affairs?"

III. CONCLUSIONS

A significant proportion of respondents (especially students) attach great importance to their pages on social networks, as well as their filling: in fact, we know that most of the students prefer to hide some content from their teacher. You can draw a parallel with real life, in which there is a distinction between social circle. In real life, a student will not communicate with the teacher as well as he communicates with his peers, and prefer to hide away some aspects of his life. Page on the social network has become something

important enough to attend it's appearance.

Communication is a leading way of social networks use, with it has always been - the previous studies have shown similar results. Also the majority of respondents positively assess the prospects of the use of social networking in education. Now social networks is an informal platform, and in contrast to educational resources there is not regulated any framework for communication and other activities.

Heads of educational process in high school pay attention to the activities of their wards in the network, many students actively use it. According to polls, more than half of the respondents under the age of 25 years, not only to discuss university affairs in social networks, but they are also active participants in the various university communities. And in the latter category are the same and teachers.

The vast majority of respondents, one way or another, with the appearance of such an opportunity, interested in content on a page of their teacher / student. There are those who are specifically looking for information on the net about the teacher or student, believing that it will help to find a common language with a person. This result can be attributed to the fact that the communication network blurred constraining limitations that exist in real life, making people more open and accessible in terms of communication.

The older the respondent, the better he allocates his time. Data on the activity of users of social networks, as well as their impact on the study and the work showed that many students spend too much time on the net, noting their negative impact on their education. With age, this figure is reduced. The survey data in common with performance increasing importance of social networks. If social networks are a comfortable platform for representatives of high school age, it is possible to transfer some functions in it to improve the educational process.

The survey allowed to conclude that the respondents oppose the use of social networking in education is very small. However, not all are willing to communicate with their teachers or students in the network. Perhaps this is due to some caution related to information security.

Currently, both among universities and among large companies, it is not in common to monitor the accounts of students or employees in social networks, but often there are cases of dismissal due to the employee publication inappropriate content. If we look at this aspect in the context of the study

subjects, the question arises: whether to impose restrictions on the activities of teachers and students in the network? Obviously, it is necessary. How strict should be the limit? Users are accustomed to perceive social networks as an opportunity of unlimited freedom of expression. Any restrictions on the freedom of the Internet in society are perceived negatively. However, the involvement of social networks in the educational process itself imposes restrictions on Internet users. If social networks eventually will enter the university infrastructure, and the students and teachers, one way or another, will have to monitor their activity.

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Organization of Virtual Environment for Interaction of University and High-Tech Sector of the Economy

Marina S. Chvanova
Department of Information Systems
Moscow State University of Technologies and Management
named after K.G. Razumovskiy
Moscow, Russia
tmbtsu@gmail.com

Alexander E. Hramov
Department of Automation, Management, Mechatronics
Yuri Gagarin State Technical University of Saratov
Saratov, Russia
hramovae@gmail.com

Marina V. Khramova, Elena N. Pitsik
Department of Information Systems and Educational
Technologies
Saratov State University
Saratov, Russia
mhramova@gmail.com, pitsikelena@gmail.com

Abstract— The aim of this article is to examine the problems of the organization of virtual interaction between the university and the high-tech sector of the economy. One of such possible tools is information system realized with WEB-technologies services. It lets meet the innovative infrastructure, potential of the university, specific innovation and human resources in the innovation field, conduct preliminary analysis of mutually beneficial issues and identify the right contacts to interact.

However, it is important to prepare the youth to activities in innovative projects. For these purposes, the use of expert systems to support innovative design activity of students is considered. It lets to students choose the best project leader of the student group of classmates and provides consulting support of innovative project activities.

Another component of the expert system implemented using fuzzy logic device, will help students to evaluate the project. Thus, a virtual environment allows to remove some routine burden of the organizers from the beginning to the completion of the project.

Keywords— cluster approach: high-tech clusters; cluster interaction with universities; virtual environment; economy and education; Internet technology; expert system; project activity; University portal

I. INTRODUCTION

Increasingly, universities become members of high-tech clusters. Most active are research universities, who are specifically working on creating and promotion innovation technologies and services. But most universities are still learning logic of interaction with high-tech sector of the real economy. Universities are trying to find their niche in the cluster. For optimization and harmonization of interaction and removing routine loads they need "virtual assistants" created on base of real practice.

Different universities solves this problem in different ways: as the professionally-oriented expert networks, information databases, sites, or united databases. These "virtual assistants" basically are an information systems with the interactive components of existing and potential partners' interaction. Based on literature review, we can conclude that there are separate solutions, that fragmentarily realized by universities for different purposes. However, there is a need in systematic presentation of the different areas of cooperation that are basically reflected the environment of all university's innovation activity and are caused by harmonization of types of university's innovative activity and high-tech production.

Today cluster systems are large scientific and technological centers created on a base of private-government partnership. The cluster approach allows to optimize and increase the integrated resources of all stakeholders to achieve common goals, to harmonize interaction of government and trade association and research and educational institution and private sector. At the same time at the universities it is already possible to identify specific functions in cluster interaction. To detect them let's analyze development of world clusters.

In Russia, the cluster strategies has not yet received wide development. They belong to the innovation structures of new economy, such as industrial districts and special technical innovation economic zones, federal industrial technoparks and technopark of high-tech. In Russia it is considered that metallurgical, machine-building, agriculture, construction, forestry and tourism clusters are formed. [1, 2].

Oriented on a cluster approach, economy develops in direction of competitiveness and investment attractiveness [3, 4]. Different models of high-tech cluster formations cooperate with universities as with centers of specialist training, generators innovative-educational programs, scientific and innovative design, information and resource centers and

centers of social-oriented innovations for maintain a comfort living environment in cluster formations.

For success in high-tech cluster activity it is important to computerize the interaction processes.

– need for technology exchange for their standardization, unification and harmonization;

– presence of cross-cluster commodity-money relations;

– existence of property relations between clusters;

– need for implement social and budget functions by members of cluster.

Optimal information interaction between members of cluster promotes significant decrease of unproductive distribution costs and optimizes processes of planning and decisionmaking and control. Computerization of external relations promotes optimization of making effective decisions of interaction between cluster and representatives of the external environment. For example, creating of integration system of marketing information allows [5]: to ensure the coherence of actions; to minimize functional disunity in cluster; optimize the information streams service; to use common databases, that promotes decrease of operating personnel number and development costs, eliminate the appearance of a chain of random errors, fast updating of information.

The list of informational resources may include:

– science and technical information about problems of cluster's development;

– information about high-tech development of profiled clusters;

– scientific information about clustering models and information support of clusters;

– government regulatory documents;

– information about target indicator and international priorities of innovative activity;

– national priorities of science and technical development, lists of national critical technologies and connected with them cluster projects;

– information about science and technical competitions and investment tender;

– information about mechanisms of administrative support of innovative projects;

– commercial information;

– information of marketing and advertising character and other information, that optimizes innovative interaction between members of cluster and univesity.

II. RESEARCH

A. Creating of virtual environment of cluster interaction between university and subjects of high-tech sector with help of WEB-portal.

In practice of Russian universities work innovative interaction allows to come to the creation of a virtual environment model, on a base of it's analysis. Let's consider how it realizes in a classical state university. Virtual environment "penetrates kinds of activities of different

innovative structures: through the option "innovations" university's information portal, through organization of common innovative project work of students in the environment of the international professional community (through the system of distance learning of high-tech specialties) and others "points of entering".

Let's see the contents of basic information and interactive components of "innovation" option of universities' portal, that perform several functions simultaneously: motivation and motivation and stimulating for potential members of competition of students' and teachers' innovations, consulting and informative for authors of innovative projects, coordinate for small innovative enterprises as part of the university cluster, and logistic-informative to track the logic of interaction with partners of innovative interaction.

An overview of components for the Tambov State University named after Derzhavin G.R. is presented in Tables 1-3. In the tables also are presented the elements: "Specialized magazines" - represents a list of names, addresses, and a brief description of the most respected publications in regions, "It's fun" - scientific and popular publications and resources, "Contacts" - social networks, including specialized and "Web resources." - addresses of the scientific foundations, funders, etc. Similarly, it can be submitted for any institution with a developed innovation infrastructure and active position aimed at interaction with the high-tech manufacturing.

TABLE 1 THE CONTENT OF THE ELEMENT"INNOVATION INFRASTRUCTURE"

	Features of innovative state policy in relation to the university	Strategy of Innovation Development of the Russian Federation for the period till 2020	Government documents
Legal framework	Regulatory base of implementation of innovation policy with in relation to universities	Recommendations for data collection and analysis on innovation (Oslo Guidelines) Russian Federation Government Resolution dated April 15, 2014 № 316 about the approval of the state program "Economic development and innovative economy"	Documents of international level and government documents, documents of departments
	Network interaction	Concept of Networking University	Interuniversity document agreement about network interaction
Innovati	Department of development of social and business innovative business	- Functions; - Employees; - Contacts	
	The objects of the University of	Innovation centers and laboratories	- Center for eco-faunal studies;

on innfrastructure	innovation infrastructure		- Laboratory of linguistics and intercultural communication; - Computer Security Center and other
		Centers of collective use	- Nanocenter; - Centre of Ecology and Nanochemistry
		Training and Production Center of youth innovation	- Student Design Bureau; - Students' Scientific Society; - Student and community initiatives in the field of professional activity
		Small innovative companies	- LLC "Nanodiagnostics"; - LLC "IT Meredian"; - LLC "Air"; - LLC "Nanobio-Tech"; - LLC "Legal Standard" and other

TABLE 2 THE CONTENT OF THE ELEMENT"INNOVATIVE CONTESTS AND PROJECTS"

	U.M.N.I.K.	The purpose of the program. The amount of financing. Period. Participants in the program. Main directions. The structure of applications for the contest. Selection criteria. Recommendations for the presentation of the project. Past winners.
Competitions	START	The purpose of the program. The main provisions of the program. Information about competitions. Focus themes. Conclusion of the contract. Reporting
	"Seliger"	Website Youth Educational Forum "Territory of meanings"
	International competition	The site of the scientific and socio-educational journal "XXI Century Initiative"
	"Skolkovo"	"Skolkovo" Website. Under the project established five clusters, developing innovative projects: informational, biomedical, energy efficiency, nuclear and space technologies.
	Support of the small innovative enterprises	The site of the development of industry and enterprise. Fund website of facilitating the development of small enterprises in the scientific and technical sphere.
	Student innovative university projects	The site of the development of industry and enterprise. Fund website of facilitating the development of small enterprises in the scientific and technical sphere.
	Innovative ideas and developing of students and pupils	Regulations on the competition. Rules of registration and submission of the application. The winners of previous years
University in	Development of software and technological complex for automated designing and implementation of intelligent expert systems based on neural network knowledge base constructor,	1. Institute 2. The Project Manager 3. Phone 4. Description of the project 4.1. Name 4.2. goal 4.3. Relevance 4.4. Brief description of the project - Scientific and technical problem to be addressed; - The rationale for the project; 4.5. Expected results 4.6. Project readiness

novative projects e	using parallel computing and remote access system.	5. Information about the originality of technical solutions underlying the development 6. Copyright certificates 7. The volume of investments 8. Payback period
	Local history multimedia resources	Same
	Development of technology of the creation of nanostructured fertilizer with prolonged action	Same
	Development of technology for the creation of energy efficiency and fuel blends with improved environmental characteristics on the basis of bioethanol using ultrasonic treatment	Same
	Equipment for the diagnosis of physical and mechanical properties of functional and structural materials, and other projects.	Same

TABLE 3 THE CONTENT OF THE ELEMENT "INTELLECTUAL PROPERTY"

The legal framework for intellectual property	University policy about intellectual property	University documents and materials that define the direction and rules of operation
	Terms of remuneration for service inventions, service useful models, service industrial designs	External regulatory documents and specifying university documents
Registered objects of intellectual property	Patents	- Object name; - Object type; - The date of priority; - The country, the period of validity; - № of the document; - The date of the certificate, patent
	Know-How	Same
	Databases	Same
	Computer programs	Same

The one who interested in partnership with the university, can get acquainted with the innovation activities: from innovative projects and infrastructure of the University to its capabilities in investment competitions and staffing of innovative projects.

B. Organization of project activity of students high-tech areas

The next virtual environment interaction component is the organization of the project activities of students high-tech areas. It comprises two components intertwined. The main component is creative, it is not subject to formalization. Decision-making in the creative process of the project belongs to the person, and at this stage it is not possible to automate it.

The second component contains a set of traditional worked ideas about the structure and logic of the project activities, its phased implementation and management of the potential risks and how to find investment support. This component can be partially structured and implemented as a set of expert systems to support processes such processes as selection of a project manager from a project group students, evaluation of innovative project on formal grounds, and others [5].

Let us discuss some aspects of created by us system of virtualization of innovative project management with help of its tracking system through expert subsystems. This system includes a variety of assistants - expert systems, each of which solves a specific task to advise the students.

For example, as a support distance learning high-tech specialties students it is proposed prototype of an expert system, which are included as modules in distance learning, and allows you to get advice on the problematic areas of knowledge such as "Project activity", "Business" Communication ". There is an opportunity to ask the expert and choose from the issues presented in the sections of the system. A prototype of an expert system for distance learning (DL) that is embedded in the system of distance learning «MOODLE», developed on the basis of precise knowledge representation model using a scripting language PHP environment Moodle development [6].

One of the important tasks in the preparation of high-tech professionals in the specialties to the system is to help the student in the selection of the project and evaluate its effectiveness. To solve this problem was chosen the apparatus of fuzzy set theory. In general, most of the data processed in modern information systems, are clear and numeric. However in queries to relational databases, formulated by a person, often presents uncertainties. Therefore, fuzzy database queries is a promising trend in modern information processing systems. Application of the apparatus of fuzzy systems theory in information retrieval tasks currently experiencing a period of rapid development. This tool makes it possible to formulate queries in natural language, for example, in our study, you can create a list of all projects with high profitability, the presentation level and patent and licensing studying, which is impossible with using a standard query mechanism.

Thus, the support environment of the project activities was created, namely assistance in choosing of the project, help in choosing the head of the project team, assist in evaluating the effectiveness of the project, its promoting and find financing for the project. Such a system allows the flexibility to manage the technology of design activity at a distance, if necessary - to go to brainstorm of the project goals. This system gives a reason to develop and structure the interaction between the participants of the cluster. This is only the first steps, that in their development can be a very effective way to attract innovative activities of young people, which is "socialized in the network space."

III. CONCLUSIONS

The main directions of university activity in the high-tech cluster is the establishment of communication between its participants: research institutes, governments, companies. Technological universities of the country fit perfectly in the training of high level specialists for these clusters. Despite the different models of high-tech cluster formations, they interact with universities as a training centers, the generators of innovative educational programs, scientific and innovative develops, as an information and resource centers and centers of socio-oriented innovations to support the liveability in cluster formations.

Universities are trying to find their niche. In order to optimize and harmonize the interaction, removal of the routine load they need various "Virtual Assistants: information systems, portals, expert systems" based on actual practice. The primary interaction of the University with high technology enterprise can contribute the profiled portal of the University, namely the content of the basic information and interactive components of the option "innovation" of the university portal. They simultaneously perform several functions: motivation and stimulating for potential participants of innovation competitions of students and teachers, consulting and informative for innovative projects authors, coordinating for small innovative enterprises as part of the university cluster, logistic-informative to track the logic of interaction between partners of innovative interaction.

Created portal can acquaint with all the attributes of innovation activities: from innovative projects and university innovation infrastructure to its potential in investment competitions and staffing of innovative projects. The portal invites you to take part in joint competitions, see the perspective developments of the university and human potential. There is a need of creating an integrative Internet resource of Russian universities. The issue will enable fast track the development of innovation, human resources and infrastructure features of a particular university to combine resources in the cluster interaction.

Another interaction helper is the technology of virtual

tracking project activities of students. It is experimentally tested in a distance learning system, and represents a collection of expert systems for the organization of the project activities, the project manager chosing and evaluation of the project activity, counseling to promote the project.

These aspects contribute to the development of cooperation with university knowledge-intensive production, including using different virtual components implemented in Internet technologies.

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Approaches for IT Infrastructure Modeling of Electronic University

Alena O. Graule, Zinaida N. Erochina, Valery P.Maiboroda, Maria A. Mizginova

Chair of Quality Management; Institute of Track, Construction and Structures
Moscow State University of Railway Engineering "MIIT"
Moscow, Russia

Abstract— **The article touches upon issues pertaining to the domain of IT infrastructure modeling in electronic university. It describes the approach of IT infrastructure modeling based on system and process principals, and decomposition method. The functional modeling of business processes of providing e-learning services and designing IT infrastructure has been performed. Supporting ITIL/ITSM processes with recommendations on the IT departments formation have been considered.**

Keywords— electronic university; IT infrastructure; process approach; ITIL/ITSM; Deming cycle; business process; IT service

I. INTRODUCTION

Currently the integration of information technologies (IT), especially services, is aimed primarily at improving of the work in the business context. Information technologies play a significant role in modern education, contributing to the transformation of classical universities into electronic ones. The activities of any university that offers distance learning opportunity are the automation of academic, administrative and other interrelated processes. These processes require high-speed large data streams processing, using cloud storage and other component benefits offered by IT. Combining different IT components represents the IT infrastructure of the university. Besides, the considerable importance is attached to the efficiency of IT services provision by the university and forming the departments that support them. However, there are some difficulties in the process of practical implementation of IT service management systems, for this reason, a large part of investments in real projects does not pay off.

The implementation of IT infrastructure in electronic university (e-university) based on a clear organization of interrelated departments and IT services leads to the fact that for efficiency and optimization of business processes, occurring within the IT services and departments, it is needful to provide automation of all managerial and organisational processes. To achieve this goal it is necessary to rely not only on a theoretical base, which is grounded on modern approaches and methods of IT service management, but also to consider the detailed decomposition of all processes for the further development of recommendations for the IT infrastructure implementation of the e-university, taking into account the existing structure.

II. APPLICATION OF PROCESS APPROACH FOR IT INFRASTRUCTURE MODELING IN ELECTRONIC UNIVERSITY

E-learning is an IT service provided by university, and it requires IT infrastructure. This educational format involves implementation systems for course preparation and design, support and conduction of e-learning. In addition, there should be the centres for creating videos, including the development department with the essential software and hardware, as well as shooting equipment and also the centre of distance learning. In the simplest configuration such centre is any computer with a stable Internet access. All systems and equipment which mentioned systems are supported by (servers, databases, etc.) are part of the IT infrastructure of the university. In general, aforesaid combination of components of different levels is architecture. This fundamental structure of the system represents its components, interactions between them, and the operating conditions with the principles underlying design and development of the system [1]. The electronic university and its infrastructure in particular can be considered as the example of such system. For instance, the Open University [2] uses a set of services to provide e-learning, as shown in Table.

TABLE   SERVICES OF THE OPEN UNIVERSITY UK

Comparative Characteristic	The Open University UK
Departments	8 departments (colleges, institutes)
Teaching and learning	application of credit system learning via web-sites of courses/modules feedback with tutors is performed via e-mail, phone, etc.
Available services for e-learning, social activities and collaboration among universities	OU Library Service OpenLearn iTunes U Open Research Online Student network

The university architecture includes a set of different levels of architectures (services, applications, data, IT, etc.). For example, the IT architecture is a combination of technical and technological solutions for ensuring the effective functioning of business processes. It describes basic functionality of the systems, their intercorrelations, and includes their development, improvement and support principals [3]. In turn,

ITIL concepts of IT infrastructure and IT architecture have the same meaning to a certain extent. For this reason, in this article the IT infrastructure is considered as a part of the university architecture.

The proposed approach to model IT infrastructure of the e-university is represented in the sequence form of certain steps based on the analysis of the overall university architecture. The approach will be grounded on system and process principles described in ISO 9000. Thus, all activities of the electronic university, including implementation, operation and improvement of IT infrastructure, are managed as a system of coherent processes. Systematic identification, management and especially interactions of processes used by university are considered as a "process approach" [4]. This approach provides a comprehensive and clear solution to the problems associated with the modeling of the IT infrastructure in e-university.

According to the process approach, firstly, it is necessary to define the business processes occurring directly in the electronic university. "Business process is a set of interrelated or interacting activities that transforms "inputs" into "outputs" and represents value to the consumer" [5]. Subsequently, the processes associated with the IT infrastructure of e-university are extracted from the previous ones and could be described and modeled.

Modeling of business processes is used to improve the quality of processes in the organisation and includes a description of the relationships between all elements of the processes. IDEF0 methodology is applied during modeling processes. The methodology helps to build models oriented for functions (called functional models). Advantages of functional modeling include a sufficient degree of detail of the processes and their interrelations. IDEF0 model consists of functional blocks and connections among them.

After the description of business processes, the next step is functional decomposition, where the process on the context diagram is divided into subprocesses. The diagrams of decompositions are modeled for this purpose. Then each subprocess is divided into smaller ones, and so on until reaching the desired degree of detail. The collected and associated diagrams represent the final model (hierarchically organized set of diagrams).

Described approach of modeling IT infrastructure has been applied on the example of provision of e-learning. The first step was the extraction of the business processes in the e-university: monitoring, preparation of teaching materials, course creation, conduction and support of learning (Fig. 1).
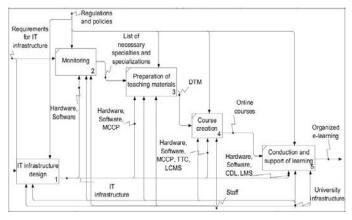
Fig. 1 Provision of e-learning

The next step was to define the necessary IT infrastructure based on dedicated processes, which was depicted on the diagram as the process of IT infrastructure design. According to the diagram, the output of the design process is formed IT infrastructure, which in turn is a resource (mechanism) for processes related to the provision of e-learning. The regulations and policies of the university are taken as the control actions. These processes have been considered thoroughly:

1. Monitoring

Monitoring includes the analysis of required categories of specialists and their educational level, necessary specialties and specializations, personnel training and retraining. The process also involves the assessment of the capabilities for delivering educational content from Moscow and other Russian regions to the distance learning centre with modern means of telecommunication technologies. The structure of the essential IT infrastructure for monitoring consists of hardware and software (computers, networks, servers, databases, applications for monitoring etc.).

2. Preparation of teaching materials

The process of preparation of teaching materials contains the development of teaching materials (DTM), including educational curriculum, learning materials, scripts of online courses and methods for their monitoring. Specialized staff involves course administrators, lecturers, managers of educational programs. In addition to the basic components of IT infrastructure (hardware and software), this process involves methodical centre of course preparation (MCCP) as a resource. The centre contains infrastructure components aimed to assist the development of teaching materials.

3. Course creation

The course creation process involves course and content development: video materials, tests, laboratory works, web-based tasks. The issues of storage delivery and providing access for courses to the user are solved at this stage. Course creation requires different specialists such as engineers, programmers, system administrators and tutors. Resources also include methodical centre of course preparation with IT

infrastructure, but in this case the application software is used directly for courses creation. Learning content management system (LCMS) pursues this goal. It represents content as a set of reusable learning objects with specific context for different categories of students. The majority of LCMS systems have a significant amount of common components. Main components are:

− learning object repository as a database where courses grounded on learning objects and metadata are stored;

− application for quickly creating learning objects and courses that provides opportunity to develop new learning objects and place them in a storage. The application should have necessary tools and templates for rapid course creation;

− dynamic display interface is used to deliver content, support custom pages, feedback from the author of the course if the course, or learning object is changed;

− applications for administration that allow to add some functions of LMS, for instance, user registration, managing learning progress, etc.

The television technical centre (TTC) is formed for shooting videos. It involves shooting rooms and equipment, hardware installation, station of nonlinear editing, Internet broadcasting complex, video communication centre. This centre may be used to conduct online classes (live) in the future.

4. Conduction and support of learning

Process of the conduction and support of learning includes course studies in the centre of distance learning (CDL). The centre provides the necessary software and hardware for automation of educational activities. It is possible to use learning management system, known as LMS. This system is a high-level strategic solution for planning, conduction and management for all learning activities, encompassing administration, virtual classes and courses, maintenance of electronic gradebooks and documents, etc. Thus, the main purpose of LMS in e-learning is the continuous support of the ongoing courses, educational assistance and proctoring. The staff includes tutors, engineers and administrators. Despite the automatic assignments any course requires support from the educational assistant who is able to understand student problems. At least one assistant should be assigned for each course to respond to the comments and questions, and to redirect the questions and error messages that do not pertain to his competence, to the senior tutors or the course developers.

After the description of the processes associated with activities of the e-university, the stages of IT infrastructure design process have been considered. This process is presented in the form of the Deming cycle (Fig. 2).
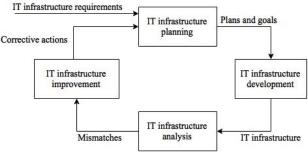
Fig. 2 IT infrastructure design

Such form of a closed loop gives the opportunity for continually IT infrastructure improvement of the e-university. The cycle can be formed separately for each centre or structural unit. Planning is based on requirements for IT infrastructure, encountered during making requests for organization of e-learning. The IT infrastructure creation and its use by members of other related processes occur at the development stage. The analysis reveals failed requirements for IT infrastructure. These mismatches can be obtained while performing other processes (e.g., in the form of reported incidents or problems by support service). Then, corrective actions focused on resolving problems and preventing further incidents are applied. The implementation of corrective actions, which takes place in the new plans, goals and strategies, is aimed at improving IT infrastructure.

Thus, common elements of the IT infrastructure have been selected according to the process modeling approach for each described process of providing e-learning services. The process of IT infrastructure design has been presented in terms of PDCA cycle.

III. MODELING OF IT INFRASTRUCTURE SUPPORT PROCESSES

By the present the development of IT service management methods has resulted in the establishment of standards, sets of recommendations and models such as ISO 20000, COBIT, ITIL/ITSM, CMM, etc. In general, this tendency is formulated as a "best practice means following best practices". The "best practices" are reflected in continuously developing standards. This process is accompanied by a revision of objective evaluation methods of organisational compliance with their requirements [6].

Improving and supporting the management of IT infrastructure requires IT departments (services), which are formed in accordance with the proceeding processes in the departments (Fig. 3).

Organisational structure (ITSM)	
Organisational department	**Basic goals**
Customer relationship management	To analyse demands and develop the relations with IT service users
Budget management and accounting	To carry out budgeting and accounting to provide IT services
Service level management	To define, coordinate and manage services levels
Capacity management	To monitor the conformity of IT capacity to current and future requiremets
Continuity and availability management of IT services	To ensure the coordinated levels of availability and continuity of IT service provision
Release management	To plan, implement and monitor the introduction of new or changed software and hardware
Change management	To ensure the assessment, coordination and implementation of changes within established methods and procedures
Configuration management	To define and control the components of services and infrastructure, maintain the integrity and relevance of information about configurations
Report management	To report about IT services reliably
Information security management	To manage information security effectively within the framework of the service provision
Service Desk	To provide a single point of contact to support users of IT services
Inicident management	To restore the normal functioning of IT services quickly, to minimize the negative impact of incidents
Problem management	To identify and resolve root causes of incidents proactively
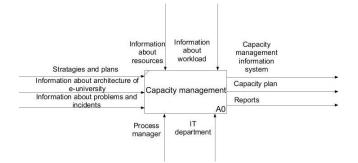
Fig. 3. Organisational structure of departments

The processes have been chosen according to the basic 10 processes described in ITSM and recommendations contained in ITIL to solve the problems of modeling IT infrastructure of e-university. Each IT service management process implemented in the IT infrastructure of the organization properly and effectively represents a coordinated management system. The following processes require modeling [6]:

 − capacity management;
 − service level management;
 − continuity and availability management of the services;
 − information security management;
 − budget management and accounting;
 − change management;
 − incident management;
 − problem management;
 − report management;
 − release and deployment management;
 − contractor management;
 − customer relationship management.

The IDEF0 has also been applied for modeling processes that support the operation of the e-university. Each process has been represented as a separate system in the form of "black box". Modeling of the processes performed within each department assists to coordinate the work of the e-university

and to determine the additional IT infrastructure that was missed in the previous stages of modeling the university activities.

In this article, the following processes have modeled: capacity management (Fig. 4), service level management (Fig. 5), release and deployment management (Fig. 6), referring to the e-university. Owners of processes are the heads of IT departments. All departments have installed hardware and software to support selected processes.

Fig. 4 Capacity management process
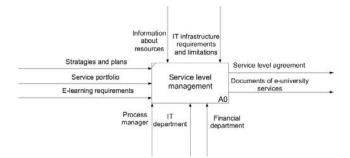
Fig. 5 Service level management process
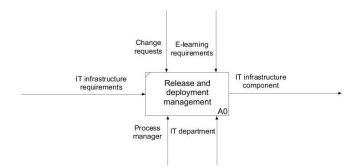
Fig. 6 Release and deployment management process

A coherent organizational structure that allows to use effectively IT services by combining them into a single mechanism is formed as the result of practical application of support and improving processes to manage IT infrastructure of e-university. A possible representation of this organizational structure is reflected at Fig. 7 [6].
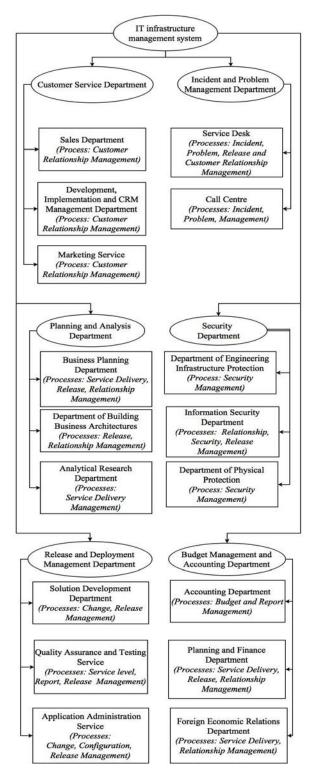
Fig. 7 IT infrastructure management system

This scheme facilitates the IT infrastructure design process. Depending on the size of the e-university IT infrastructure management system can undergo changes.

IV. CONCLUSIONS

In this article the approach of IT infrastructure modeling in e-university has been discussed. Basically, it is grounded on process and systematic approaches, decomposition principle and analysis of general university structure. This approach involves the selection and modeling of business processes of e-university and IT infrastructure design, support processes according to ITIL/ITSM and subsequent forming of IT departments.

Having modeled all e-university processes it is possible to visualize the necessary IT infrastructure. The further decomposition enables to identify application software and hardware for each engaged component. In addition, IT departments assist to manage designed IT infrastructure.

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Approaches to the Development of a Mediacontent Delivery Network Based on the Infrastructure of Existing Saas and Iaas Providers

Denis Korolev, Anastasiya Gorokhova-Alekseyeva

Moscow Institute of Electronics and Mathematics

National Research University "Higher School of Economics" (HSE)

Moscow, Russian Federation

dkorolev@hse.ru

Abstract --Video broadcasts on the Internet have become a commonplace and increasingly find their audience, supported by popular video services and social networks. But there are tasks, that require content delivery network (CDN), which lead to extra expences, and moreover, does not give sufficient flexibility and limits personalization of the broadcasts. This paper presents the principles of creating a flexible and scalable streaming content delivery network, created automatically for each individual broadcast over existing infrastructure of the cloud virtual machine hosting providers.

The report originates from a commercial project dedicated to creation of media-content delivery network, currently being at development stage.

Keywords — Cloud technologies, virtual machine, CDN, video streaming, hosting, broadcasting, SaaS, IaaS, bandwidth

I. INTRODUCTION

Over the years of live streaming in Internet, much has changed in the capabilities of computers and networks, but the architecture of Internet remains unchanged. Babbitt hardly distinguishes video program as seen on TV from the same video program shown through a streaming service, but in practice the difference is huge, and it is rooted in the principle of delivering information to subscribers on the Internet: TV sends a signal "to all who is tuned to", but Internet in general does not distribute such messages and the sender has to deliver streams to each subscriber separately. This means that the stream, downloaded from the broadcast server has proportional bandwidth to the number of viewers. For broadcasts with a large spectator audience Content Delivery Networks (CDN) [1] are used. These are special services with wide and stable channels and data centers located "closer to viewers". As a rule, the cost of services of such networks significantly burdens the budget of a broadcast.

At the same time, there are commercial services that have the similar infrastructure, but not aim themselves for such a narrow dedicated purpose — the delivery of streaming media content. They are known as virtual machine (VM) hosting service providers [2]. There is a significant number of companies offering such services, many of them have their own networks of data centers over the world. Normally, creation and configuration of server software can be automated via programming interface (API). Servers can be allocated on a permanent basis (monthly payment), and on an hourly basis. Thus, traffic limits are usually the same for monthly and hourly plans, and for short-term hourly-paid servers apply to virtual machine lifetime. These conditions allow us to move from the problem of scaling broadcasts to a large audience to a project for creation of a CDN over existing VM-hosting infrastructure.

II. METHODS FOR DELIVERY OF VIDEO STREAMS

As it is known from the basics of computer networks, TCP/IP networks have different ways of delivering packages: unicast, multicast, broadcast, anycast [3]. Terrestrial TV could be compared to multicast [4]: packet will be received by all nodes that have tuned to accept it, though it will not be re-sent in case if someone have missed them. Also, transmitter does not know how many nodes accept its packets and sends each packet just once. But Internet uses unicast [5] — an individual packet delivery method, and mostly TCP protocol, which requires establishing a connection with each recipient before sending packets, giving a guarantee of delivery. It perfectly suites for e-mail or documents, but not effective for real-time appliances, such mass distribution of video streams.

To deliver the video streams in their own networks IP-TV operators normally use multicast, which greatly relieves the communications channels avoiding duplication of streams [6]. Thus, the transmitter sends stream to a multicast-address and everyone "listen" it at this location. At the same time, the number of spectators will not affect the outgoing traffic from the server. This delivery method is not applicable to the open Internet [7], but inside the service provider network, this approach can be very convenient (if supported).

III. NETWORK INFRASTRUCTURE

For commercial VM hosting services the simplest case of a CDN is a cloud of virtual machines that runs "on demand" within the data center of the provider (a new virtual machine runs as load grows and currently working machines approach

to their limits). We can point these important characteristics of the infrastructure provided by cloud services:

1. **Hourly plans.** In fact, the CDN is built separately for each broadcast, so servers are deployed and started only for the time of a broadcast. Even for clockwise broadcasting varying number of viewers will require different bandwidth and, to avoid paying for idle resources, servers will need to be added or removed from this "on-demand" CDN.

2. **Traffic** metering: volume of traffic included to the paid time of the server's life. There are different ways of billing, ranging from complex component price-lists (Amazon EC2) to flat-rate hourly plans with fixed traffic volume (DigitalOcean, Linode, VScale, etc). There are services with unlimited traffic (Rootwelt), but often "unlimited" offers are limited by some of their characteristics, e.g. bandwidth.

3. **Bandwidth of virtual machines.** This parameter determines how many machines will be required, and what will be the depth of the "tree" for a given number of audience flow given bitrate.

4. **Billing for internal traffic in the provider's cloud.** There is a significant traffic exchange between the virtual machines, the CDN consists of. Exclusion of this traffic from the prepaid limit affects the calculation of the limits for the end user. For example, in DigitalOcean there is internal private network between servers in the provider's cloud, where the traffic is not taken into account, but this can be only unicast traffic.

5. **Support for multicast traffic within the cloud.** As we shall see later, the use of multicast / UDP can significantly simplify the structure of the network, making it "flat", distributing the traffic from one "source" VM on the input of the CDN to all the "output" VMs streaming to the viewers.

6. **Application Programming Interface (API)** for automated server management.

7. **Server deployment speed and server technologies supported.** As server deployment is initiated by real-time demand in new resources, deployment time should be the less the better. The less time is taken to add a new server to CDN, the less likely a denial of service or delay in connection to the end viewer will happen. And the less servers will stand by in reserve to reduce the risks of these unwanted events. Server deployment time consists of two main parts: a) deployment of the system and b) deployment of applications and their start. Typical server installation is a time consuming operation, but there is a technology that allows to run a pre-configured software bundle on any operating system and any equipment where it is supported — Docker. In this case, after the launch of a new clean virtual machine just one file is being copied and run, and the machine is ready for use.

Some of the listed characteristics are not mentioned in tariff plans or descriptions of hosting providers, so the choice of the

provider is a more tricky task than it may appear at first sight. The availability of the API does not guarantee decent tools for automatic server deployment, and promised high-speed characteristics may be unreachable. To be sure a particular VM provider fits to be used for cloud CDN deployment goals, thorough testing is required. Real-life tests can be run after an version, adopted to provider's API is ready. In this report, we consider only the common approaches to the construction of such a service, and will not go in to details of the implementation of features in the networks of different providers.

IV. Stream Delivery Over a Cloud of Virtual Machines

To deliver video streams to end users, CDN needs to create as many copies of the input stream, as the number of concurrent viewers (recipient nodes). In simple case it means that for one input stream of N Mbit/s, the output for the X subscribers requires bandwidth $X*N$ Mbit/sec. Here we assume that the input stream is equal to each of the output streams.

Normally, CDNs use multibitrate [8] feature to deliver high bandwidth streams to viewers with narrow or unstable channels, such as 3G networks or office networks with limited traffic. Multibitrate lowers output bandwidth requirements, so the formula above shows the maximim evaluation.

For example, a 4 Mbit/s stream (typical bandwidth for 1080p H.264 encoded broadcast) distributed from the virtual machines with 100 Mbit/s network bandwidth limit will serve maximum:

$$N_{max} = B_{channel} / B_{stream}$$

where N_{max} is the maximum number of viewers that a given virtual machine is able to serve, and Bis the corresponding bitrate. If we are distributing streams directly from the input virtual machine, in the best case for a fixed bitrate stream we can serve up to 100/4 = 25 subscribers. This does not allow us to use this method for real-life broadcasts, where the number of viewers counts in hundreds and thousands, rarely — in tens of thousands.

There are two evident ways to overcome this limit:

1. **Use virtual machines with wider channels** (there are VM-providers offering 1 and even 10 Gbit/s per each VM, having 40 Gbit/s channel in each data center),

2. **Build a tree of virtual machines** to distribute the input stream first to the intermediate layer (or several layers — depending on the desired size of the audience) and then — to the subscribers

In the first case, the calculation of the maximum broadcast audience for a fixed bitrate (e.g. 4 Mbit/s) remains the same simple: for VMs with 1Gbit/s bandwidth it will serve 250 subscribers.

If we create a tree of virtual machines, there should be created at least one "layer" of *intermediate* VMs behind the *input* VM.

If the input VM is capable to distribute up to 25 streams, there can be run up to 25 intermediate VMs serving up to 25 streams each (225 subscribers). For a larger audience, more intermediate layers should be started and in general this CDN will serve 25^n, where n is the number of layers including the input VM (so, n is not less than 1).

The minimum number of VMs to start at the beginning of a broadcast is equal to the number of layers plus one input VM.

This approach can be implemented to VMs on wider channels, so real-life cases will operate times higher audiences. Nevertheless, this looks straightforward. More elegant solution can be achieved using multicast streaming within the provider's network. In this case there is no need to create multiple intermediate layers as the input VM distributes a single stream to all distributing VMs. The stream is transmitted to a multicast address, the distributing machines "listen" to it and transmit to the subscribers (the same 25 subscribers on one machine in the example above), as we cannot use multicast in internet environment.

The minimum number of VMs to start is two:

- Input machine, that makes a multicast broadcast,

- The first distribution VM for the first subscribers connecting to the CDN.

To implement this approach, multicast traffic must be enabled in the provider's internal network. Also, it is important to exclude this internal traffic from billing limit.

V. OTHER CDN FEATURES

Popular CDNs provide a range of other services, besides the delivery of real-time streams. One of the main tasks of content delivery networks is providing access to frequently requested information — records of media content, and even sites. In this case CDN acts as cache for static content servers. There are ways to do this job using an alternative way (different from described in this paper, but also using existing cloud infrastructure and services), but they are out of this article's topic. There are other tasks for CDNs, relating to the delivery of streams:

1. **Multibitrate.** The service must be able to convert the input stream into several smaller bitrates and, in some cases, convert the input format or protocol.

2. **Access control.** Password protection, IP address filtering or a group-managed access for registered users.

3. **User related data** collection from the player and browser's environment.

Since the streams are distributed individually to each subscriber, the implementation of these, and more, features

becomes possible. It is an opportunity to target, tune or substitute the content of the broadcast, depending on the captured user data such as geotargeting defined by IP address or user's locale (system language) detection to choose the language of the stream and captions.

VI. ALTERNATIVES TO BUILDING AN OWN CDN

Automatic deployment of an own CDN is complicated and depends on many external factors, requires experience in this area. Meanwhile, there are certain services, such as Youtube, Facebook, Twitch, LiveStream, etc., offering live broadcasts. These services are capable to maintain really high loads [9], have a well-developed robust infrastructure and can be used for stream delivery purposes. For example, Youtube's player, placed on any wesite will display broadcast directly on the page and will not take traffic from the website's hosting. The opposite side of using these services as CDNs is the lack of control over stream distribution and poor user data, available from their statistics. It is impossible to use any targeting, monetization is only available according the network's rules and rates. Free accounts embed their advertising pre-rolls and banners (this can be solved by obtaining corporate domain subscription or private accounts using intermediate services such as Unlim.us). Anyway, this alternative to using or building a CDN gains a growing popularity. There are services for simultaneous re-broadcasting to several networks that enlarges the audience. For example, Facebook live broadcast supplements Youtube, that is good as the main CDN and is represented by a player on the event's website. There are services for re-streaming to multiple networks, such as On-Air.Pro.

VII. CONCLUSIONS

Currently there is a suitable infrastructure for the creation of flexible and cost-effective solutions in the delivery of media content to the subscribers of live broadcasts. It can be based on the commercial virtual machine hosting services. This infrastructure corresponds to the level of software technology, that allows to create rapidly deployable virtual servers, easily portable between different providers. At the same time, the differences in terms of hosting services of virtual machines require practical experience and stress testing of each VM provider before making a decision on placing own live stream CDN there.

Depending on the objectives of the project that requires live broadcasts, additional services of live stream delivery can be claimed, which would require the use of a commercial CDN or create an own network, as described in this paper. At the same time, many common broadcast tasks can be completed using existing streaming services and bulk-management services above them.

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Automation of Planning of Medical-Economic Drug Prescription Control

Artem A. Koshkarov[#1], Aleksan A. Khalafyan[#], Ekaterina U. Dolzhkova[#], Artem B. Semenov[#]

[#]Faculty of Computer Technology and Applied mathematics; Department of Applied Mathematics

Federal State Budgetary Educational Institution of Higher Education «Kuban State University»

Krasnodar, Russia

[1]koshkarov17@ya.ru

Abstract— **The problem of the automated data processing, visualizing and up-to-date informing about preferential medicinal maintenance arrangements is in priority for the federal program participants of state social assistance to the population of Russia. This paper describes the developed system of medical-economic control (MEC). The object-oriented approach and relational logic model for database building are used to design the information system. The "entity-relationship" model is chosen as a concept model. The business process reengineering and decomposition have been made to develop the MEC system problem-oriented software. Consequently the system tasks have been divided into two modules: a complex of tasks of expertise results accounting automatization and MEC planning and ABC / VEN-analysis subsystem as a standalone application. The MEC information system is developed to apply for the public health of Krasnodar Region.**

Keywords— information technologies in medicine; preferential medicinal maintenance;medical-economic control

I. INTRODUCTION

Such a particular attention to the process of public health informatization in Russia is caused by: (1) the development of scientific disciplines, directions and activity types, related to the healthcare and complementing the medical knowledge system, (2) the importance growth of medical-economic and medical-legal information, and (3) the need for monitoring of medical and demographic processes, public health level and the quality of medical care, sanitary and epidemiological welfare, and other society state strategic parameters. To embed the program-technical environment in health service it is advantageous to use cloud computing, which is thriving now and extensively used in combination with the conventional medical information systems [1], [2].

There is a number of services in the USA [3], [4], [5], [6] that allow to compare the system abilities of different developers and various function directions in advance. However, being typical for another finance organizational model, the represented products are not relevant for Russian healthcare organizations, thus they can't be applied to the needs of Russian healthcare properly.

A wide employment of information technologies in Russian healthcare made the automated systems an integral part of the daily work of medical organizations.

The significant progress in the use of information technology in medicine is associated with the modernization program carried out by the Russian Federation Government in 2011-2013, the confirmation of the concept of creating a unique state information system in the health sphere in 2011 [7] and its development "Road map" for 2015-2018 [8].

However, despite the progress made, the issuing and servicing systems of preferential recipes and prescriptions for controlled drugs, which are assigned to regional transactional systems in the Concept 2011, have not reached the necessary level of development yet.

Considering that the system of medical care, based on common to the whole territory of the Russian Federation modern standards, is exceptionally innovative and that the amount of the medical care, provided to the population is traditionally large, automation of planning of medical-economic control (MEC) of drugs prescription validity is a relevant direction in the development of information technologies in medicine.

The object of the research is represented by the methodical aspects and algorithms of medical organizations business processes and the MEC criteria for drugs prescription validity.

The subject of the research is the information system of medical-economic drugs prescription control (MEC-system).

A. Research Aims and Objectives

The aim of the research is to develop methods and MEC algorithms of drugs prescription validity for practical implementation of planning and accounting system.

The objectives are:

1) To explore MEC as a medicinal maintenance management system from the positions of system analysis; to analyze the existing types of preferential recipes and information security methods; to classify the information systems of healthcare institutions (HCI);

2) To justify the choice and the application of the design and development methods, to analyze and synthesize the modules of the produced MEC information system; to develop the mathematical MEC planning models [9];

3) To automate the organization and performance MEC processes; to implement a standalone ABC / VEN-analysis application; to use the integration concept of issuing and servicing systems of preferential recipes;

4) To design and develop a unique database in preferential medicinal maintenance (PMM) sphere in Krasnodar Region; to apply the depersonalization methods to the data to be put into the cloud; to identify the current threats to the information security; to describe the content and the structure of the developed MEC information system.

B. Research Methods

The applied methods include: the system analysis, the business-process reengineering, data depersonalization techniques, identification (ID insertion technique), the modelling methods of information security threats, cloud computing technologies, integration system methods, methods of functional and informative modelling, methods of software development and database designing, the pharmaco-economical analysis techniques.

1) Scientific novelty of the research consists in the development of methodology and software of the modern MEC technology and includes the following new scientific results:

2) The technique of automated MEC planning of drugs prescription validity;the image used in each figure is clear;

3) The development of a special algorithmic support of drugs prescription MEC information system;

4) The technique of receiving, analyzing and processing of the results of medical care quality examination;

5) The development of an algorithmic support for pharmaco-economical ABC-analysis;

6) The technique of the unique automated database building; the database may be located both in the protected private cloud and the public one, with its information being available from the work places on the Net.

The practical significance of the paper lies in the development of the new technology of automated planning of medical and economic drugs prescription validity control (MEC) and its implementation in the form of a software package, the use of which allows us:

1) To perform the reengineering of business processes of the compulsory health insurance, the necessary medicines provision (NMP), the examination of medical care quality; the image used in each figure is clear,

2) To structure the MEC criteria selection, to implement the solving algorithm for the game MEC model;

3) To evaluate the efficiency of information technologies embedded in different NMP organization levels;

4) To identify the priority areas and the foreground tasks of information technologies application to the NMP practice;

5) To automate the MEC performance scheduling;

6) To provide an automated detection of preferential recipes with potential violations in the drugs prescription process;

7) To improve the application efficiency of the NMP costs structure estimation method (ABC-analysis).

Among the creation principles of information systems in healthcare, affecting the system architecture substantially, we can highlight the following [10]:
- interoperability insurance of different medical information systems;
- the creation of applied information systems on the "software as a service" model (SaaS);,
- the decision on modernization of inherited and the development of new components of information systems in healthcare, considering the maximum possible preservation of existing software and hardware, basing on the total cost of ownership analysis.

II. INFORMATION SYSTEM DEVELOPMENT

The systematic approach to the problem of information system creation allowed us to present it as a combination of two subsystems, each of which is considered as a separate system, being examined individually (Fig.1):
- The MEC Software complex of drugs prescriptions,
- The ABC / VEN-analysis subsystem as a standalone application.
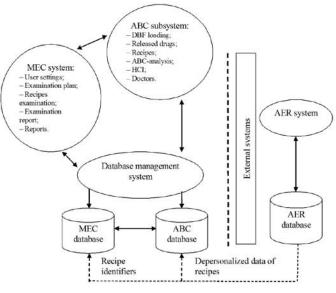
Fig. 1 The functional model of information system

Having passed the automated examination, the recipes identifiers are sent to MEC information system database from the database of the system for automated examination of

recipes (AER). The ABC-analysis subsystem database uses the same data formats as AER program complex, except for personal data of beneficiaries.

The Interaction between the MEC system and ABC-analysis subsystem is provided by the recipes identifiers. The functional model of drugs prescription MEC information system involves the interaction and functioning as an organic whole of two databases: preferential recipes and recipes examinations.

The algorithm of program processing consists of five steps (Fig.2):

Step1. Running of the software package;

Step2. Users Authorization and delineation of their access rights to the software package in accordance with an individual username and the password;

Step3. Accounting of detected violations in recipes by selecting the MEC plan, based on particular criteria; by selecting of healthcare institutions (HCI) from the list, according to the MEC plan; by the recipe selection from the register, formed, according to HCI; by inclusion of identified errors of the current recipe in the database;

Step4. Automated creation of an electronic version of MEC report, based on the information, put into the database;

Step5. Export of MEC report to the electronic document such as XLS / XLSX.
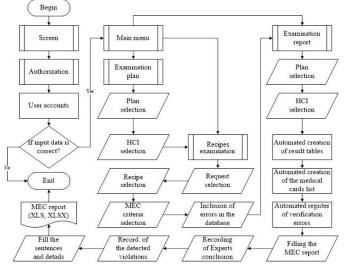
Fig. 2 The flowchart of the program work algorithm.

A. Information System Structure

MEC drugs prescription system as an automated integrated system consists of the MEC program complex (PC) and the ABC / VEN-analysis subsystem, implemented as a standalone application (Fig.3). Data communication is performed in compliance with the common formats of preferential recipes. Database applications Interaction is accomplished by making queries of Microsoft SQL Server database management

system by keeping the unique format of information exchange by the recipe identifiers.
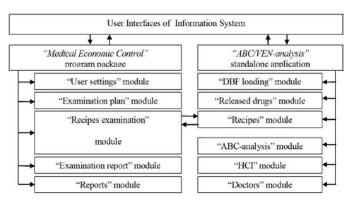
Fig. 3 The structure chart of PC and of stand-alone application

Functional modules are integrated into the MEC information system, which is implemented as a software system, consisting of five modules:

1) The "User settings" module for information processing of program complex users (login, full name, position end etc.) and for performing the operations on user accounts: delete, add, password change;

2) The "Examination Plan" module performs the analysis and grouping of automated examination results, the recipes selection for MEC in medical organizations;

3) The "Recipes examination" module for making notes on MEC results in medical organizations;

4) The "Examination report" module automates the MEC report generation and file export to Excel;

5) The "Reports" module generates and allows viewing of the reports forms.

The ABC / VEN-analysis subsystem, implemented as a standalone application, consists of six modules:

1) The "Recipes" module, containing the list of all the preferential recipes, served in pharmacies over the time period studied;

2) The "Doctors" module, representing the directory of Krasnodar Region medical workers, authorized to prescribe drugs to beneficiaries;

3) The "Released drugs" module reflects the information on all the drugs, released on prescription over the time period studied, including the details on each of them in relation to the amounts consumed by each of the beneficiaries, personalized by SNILS, beneficiary category and the price per released drug unit;

4) The "HCI" module provides all the necessary information about the healthcare institutions involved in the NMP program in the Krasnodar Region;

5) The "ABC-analysis" module distributes the drugs in the share of costs for each drug in the total cost of the most expensive to the least expensive in the three classes (A, B and C), depending on their consumption volumes over the time period studied;

6) The "DBF Loading" module imports the raw data files in DBF format into the application.

B. Information System Features

The transition to the cloud platform will allow us to solve the requirement problem of continuous development of service quality (including medical services) and cost optimization for information technologies [11]. At the same time, the work in the cloud is associated with the risk of compromising or data loss, unauthorized access and possible errors while information being transferred.

Considering the nature of cloud technology architecture and the information security threats [12], about 575,436 positions of personal data in the database has been developed impersonal. Thus, we excluded from the database all the personal data of people, eligible for state social assistance.

The Impersonal database can be placed both in the private secure cloud and in the public one, including the possibility of access to information in the workplace through the "Internet" network using any Web-browser (Internet Explorer, Mozilla Firefox, Opera, Google Chrome and etc.). Depersonalization of designed database information makes a significant difference from the existing solutions in PMM sphere of the Krasnodar Region, which are focused on the implementation of other important tasks – personified accounting of rendered medical services.

In fact, users are given an access to the data store, including the ability to create exclusively the data selection queries that will allow using a smaller amount of server infrastructure resources, as opposed to the standard or specialized systems, offering a full range of information.

The Reporting Services – the Server Reporting Platform is used as an application service, which makes working with reports from a variety of data sources more comfortable [13]. Reporting Services include a complete set of tools, allowing us to create, to manage and to deliver the reports; they also contain the API-interfaces that allow developers to make the integration or empower the data and the reports processing in users applications. Reporting Services tools work in Microsoft Visual Studio and are fully integrated with the environment tools and components of SQL Server.

The decision support systems (DSS) are defined as human-machine systems, allowing managers to use their knowledge, experience and interests, objective and subjective models and assessments as well as data for decision-making computer methods implementation [14], [15], and the MEC information system is developed as DSS, allowing you to store, organize and provide analytical information to make effective management decisions. Thus, the MEC information system of drug prescription is designed considering the system analysis methodology for medical decision support system and in accordance with the current level of information analytical technological process control systems development [16], [17], [18].

III. CONCLUSIONS

The technique of automated MEC planning of drugs prescription validity for each medical organization for the planned period of the year by months is first proposed in this paper. The ABC-analysis is used as an additional criterion for the recipes selection.

The approach and the methodology of the design and economic essence definition of problem complex is developed, using the methods of functional and information modeling. The problem complex involves partitioning into functional MEC system modules, implemented in the form of the software package, and the ABC-analysis subsystem, implemented as a standalone application.

A technique of the unique automated database designing is offered to solve the problem of automated processing, visualization of data and up-to-date informing on preferential medicinal maintenance (PMM) arrangements [19].

The developed information system of drugs prescription medical-economic control provides running the automated examination analysis, carrying out of the farmacoeconomic analysis and creating of checks plans. [20], [21], [22], [23].

Being the main functional advantage of the developed system, the possibility of placing the database with impersonal data in the cloud increases the speed of complex queries execution and provides access to experts and decision-makers.

The interactive, tabular, graphical reports, and free-form reports from relational, multidimensional, and XML-data sources are created using the Reporting Services. The reports are published and accessed upon request. The reports can be exported to other applications. They can be observed as part of the Microsoft Windows application or the SharePoint site or using a web connection.

The Developed information system is adapted to the organizational and financial healthcare model of Krasnodar Region.

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Methodology of Educational Process Organization Using Training Simulator

Dmitrii V. Mardashov
Department of Oil and Gas Fields Development
Saint-Petersburg Mining University
Saint-Petersburg, Russia
dmitry_mardashov@mail.ru

Bogdan U. Vasiliev
Department of Electric Energy and Electromechanical
Saint-Petersburg Mining University
Saint-Petersburg, Russia
vasilev.bu@yandex.ru

Abstract—**The quality of technical education in training of specialists for fuel and energy complex is affected by many factors. To a greater extent, education is determined by the level of technical equipment of laboratories and by methodology of the educational process. This paper is dedicated to the professor's and lecturer's experience of modern educational technology's implementation and training methods in the Bologna system within St. Petersburg mining university. The principle of laboratories acquisition and methodology of training is explained. The article reveals the content of learning session. The existing experience of training is analyzed.**

Keywords— education; training simulator; methodology; game.

I. INTRODUCTION

The educational process in technical universities which are training specialists for fuel and energy complex, in modern conditions has number of features. In particular [1-10]:

– complexity of the courses provided for students;

– requirement to learn not only the manifestation of physical phenomena, but also to understand their physical basis;

– invisibility of the current technological processes, which need to be managed;

– high complexity of training simulator;

– reducing the number of classes, etc.

To draw students in the educational process and manifestation of desire to master complex technical disciplines requires the use of modern laboratory and research equipment. In addition to the technological aspects of the educational process methodological support is crucial. The presence of high-tech simulators and interesting for students training methods makes education effective. This paper is dedicated to the professor's and lecturer's experience of modern educational technology's implementation and training methods in the Bologna system within St. Petersburg mining university. As an example, the article describes laboratory and methodology of teaching the discipline "Well remedial work and workover",

which is taught at the department "Development and operation of oil and gas fields" of the St. Petersburg mining university.

II. USE HIGH-TECH SIMULATORS IN THE EDUCATIONAL PROCESS

The department "Development and operation of oil and gas fields" of the Mining university has a number of classrooms equipped with up-to-date training and research facilities. One of these complexes is "Training class for well remedial work and workover" with a workover simulator AMT-401.

An important part of teaching the course "Well remedial work and workover" is a laboratory workshop. The purpose of which is theoretical and practical study of the basic operations of the workover in conditions as close to field. To achieve this goal the simulator AMT-401 of workover is used, which consists of two main facilities:

1. Hardware-software complex consists of consoles and control station facilities for workover operations (Fig. 1).

2. Software network complex consists of 15 workplaces and one instructor operation station (Fig. 2).

Workover simulator AMT-401 allows carrying out laboratory classes on the following topics: well killing, round-trip operations, well completion by a swabbing and compressor method, acid treatment, well cementing, hydraulic fracturing, abrasive jet perforation, drilling out of cement plug, the elimination of gas, oil and water shows during the well drilling. Each subject is given on average about 6 academic hours.

The complex of educational and methical instructions was developed for implementation of this laboratory workshop for students. It provides a summary of the theory, calculation formulas, design and the sequence of actions corresponding to operations of the well remedial work and workover in the simulator. Students can obtain more detailed information on the theory from textbooks and the lecture course "Well remedial work and workover".

Fig. 1. Hardware-software complex

Fig. 2. Software network complex

III. PREPARE YOUR PAPER BEFORE STYLING

A. Carrying out laboratory classes on hardware-software simulator system.

First, the instructor shows the process of performing the laboratory workshop on the simulator, giving examples of possible emergency situations and how to resolve them. Then the instructor divides the group of students, consisting generally of 12-15 people, in sub-groups of 3-4. To create student's interest in performing its tasks the instructor gives to the class competitive nature, in particular, the aim for each

team is performing laboratory workshop in the shortest possible time with minimal penalty time. The instructor at the same time has the opportunity to diversify preset the progress of assignments by simulating a variety of emergency situations and complications.

B. Carrying out of laboratory classes on software-network complex.

In the beginning the instructor demonstrates process of carrying out the laboratory workshop on an interactive multimedia board, describing possible ways of controlling and

displaying the main technological parameters of the simulated operation. Then each student is given practical guidelines for relevant laboratory workshop and an individual option (user name) under which the student logs in the simulator program. The goal of this class is the individual performance by each student one of the well remedial work and workover operations. Instructor while sitting at his working place, by using the program "Supervisor" monitors the actions of each student. Advice of the instructor and his help in managing the actions of any student is carried out through a network connection. The result of this class is the implementation of each student laboratory work with minimal errors (no more than one). The quality of the work performed and the number of errors the instructor checks in the workplace on the student's variant number (Fig. 3).
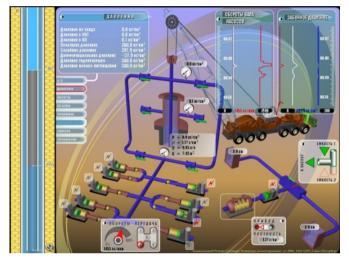
Fig. 3. Software-network complex of the training simulator

C. Test classes in a topic of laboratory work

According to the results of performed laboratory work on hardware-software and software-network simulator AMT-401, each student prepares a report. The requirements for which are set out in the educational-methodical instructions. After making the report, the student defends it to the instructor and answers questions related to the topic of a laboratory work. As a result of the work performed and the knowledge the instructor allots the mark for a student.

ACKNOWLEDGMENT

The implemented methodology on the department "Development and operation of oil and gas fields" of bachelor in "Oil and Gas Business" is innovative, since it is modern and advanced technology equipment of domestic production in the educational process, and also takes into account the interest of the students to the solution of complex engineering tasks in conditions as close to field.

Eastern wisdom says: "One man may lead a horse to watering but even a hundred cannot make him drink the water." The student can be made to sit in the classroom, but you cannot force something to teach and to develop his abilities. Horse drinks water when thirsty, and the student learns when he wants to learn.

The student wants and will learn the discipline only if it is interesting and attractive for him. He needs motives for cognitive activities. Students of high schools get much more khowledge about their chosen profession from an internship, carrying out laboratory works.

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Quality Improvement Information Technology for Mineral Water Field's Control

Alexander A. Martirosyan[1], Karina V. Martirosyan[2]

North-Caucasus Federal University, branch in Pyatigorsk,

Pyatigorsk, Russia

[1]martalex11@mail.ru; [2]kv1961@live.ru

Abstract— **In this work the technology of mineral water field's control is given. Mineral water field as a control object is described with mathematical model, based on partial differential equations. Also a new approach of hydrogeological object modelling is given. Using of the proposed approach the possibility of more accurate modelling is given. The results of a successful implementation of this approach are shown. Thus, the new technology of mineral water fields' control is introduced.**

Index Terms— **automatic control, geofiltration models, overflow coefficient, control quality improvement.**

I INTRODACTION

One of the most important steps in the synthesis of a control system is the object's mathematical model development. Mathematical model should clearly reflect both the object and the nature of the processes occurring in the object or affecting it. The main problem is the development of that mathematical model, what will show the optimal ratio accuracy of the object's description and complexity of the mathematical apparatus [2]. Since the simulation object often has a complex structure, it is necessary to resort to certain assumptions, which in turn reduces the accuracy of simulation [3,4,8]. This article is invited to consider an advanced process modeling hydrogeological object. A model of mineral water field has a large number of parameters that are accepted conditionally constant (coefficient of filtration, the formation compressibility factor, overflow coefficient, etc.). [2,7] Taking account of the possibility of spatial nonuniformility of these factors will lead to a significant complication of calculation [6]. However, it is proposed to amend the classical approach to the formulation of the hydrogeological object's controller synthesis problem. It is proposed to explore the possibility of obtaining a more accurate simulation results by providing spillover factor in the form of data that reflects the spatial variation of the value of this coefficient.

II MODELING PARAMETERS

It is proposed to consider the set of parameters for hydrogeological modeling object. It includes:
- the geometric dimensions of the object;
- seam thickness;
- formation compressibility factor;
- type of soil formation;
- filtration coefficient;
- overflow coefficient between horizons.

Selection of the geometric dimensions of an object depends on the set of modeling tasks. In the simulation process geofiltration choice for large deposits of segment length it does not make sense, because the process is slow. The average speed of the fluid in the aquifer is from 1 to 10 meters per day, therefore, if you specify a large object sizes, the system response to the operation input in the production well is very poorly reflected in the observation wells [3]. In turn, the large size of the object selection is warranted for solving the problem of mass transfer, since the chemical processes in the field and with a low rate, making it necessary to review at a sufficiently large time interval. Since in this paper we propose to consider only the process geofiltration as a simulation object square field segment will be selected with a side of 1000 m.

The next parameter is the seam thickness (m), which represents the distance from the reservoir trough to a static liquid level therein for pressureless reservoir. For a confined aquifer, this parameter is the distance from the sole to the formation of the roof. This parameter is defined in the course of exploration work.

Compressibility coefficient (η) is the change of fluid volume per unit volume of rock by the pressure measuring unit. The dimension of the coefficient m^{-1}. Depending on the breed, this ratio can range from 10^{-5} to 10^{-3} m^{-1}.

Also in the course of geological exploration of the formation is determined by the type of soil, which is closely associated with the filtration coefficient. Coefficient of filtration k plays an important role in mathematical model, since it quantifies the permeability rocks. It depends on the geometry of pore space and the filtered fluid hydrodynamic properties (density and viscosity). Filtration coefficient has the dimensions and expressed in meters per day (m/d) [1].

The greatest attention in this paper we propose a pay coefficient of overflow between layers b, which will be discussed in more detail below. The dimension of the coefficient is day⁻¹. This factor is applied to the boundary conditions that determine the intensity of spillover between adjacent aquifers through poorly permeable layers (Darcy conditions). The definition of this ratio is expedient when the lithology formations suggests the possibility of overflowing (the presence of thin layers, cracks in rocks solidified) [7].

Determination of these parameters will provide hydrogeological object model that best describes the place in it hydrogeological processes.

III MATHEMATICAL MODEL OF CONTROL OBJECT

As a control object selected Nagutskaya mineral waters. The peculiarity of this field is a complex structure. Therefore, the problem most accurate reproduction hydrogeological field structure [5] has been put in the development of a mathematical model. The mathematical model of Nagutskaya mineral water field is as follows:

$$
\begin{cases}
\dfrac{\partial S_1}{\partial t} = \dfrac{1}{\eta_1 *}\left(\dfrac{\partial(k_{x1}\cdot\partial S_1)}{\partial x^2}+\dfrac{\partial(k_{y1}\cdot\partial S_1)}{\partial y^2}+\dfrac{\partial(k_{z1}\cdot\partial S_1)}{\partial z^2}\right); \\[2mm]
\dfrac{\partial S_2}{\partial t} = \dfrac{1}{\eta_2 *}\left(\dfrac{\partial(k_{x2}\cdot\partial S_2)}{\partial x^2}+\dfrac{\partial(k_{y2}\cdot\partial S_2)}{\partial y^2}+\dfrac{\partial(k_{z2}\cdot\partial S_2)}{\partial z^2}\right)- \\[1mm]
\quad -F_{x2}\cdot\dfrac{\partial S_2}{\partial x}; \\[2mm]
\dfrac{\partial S_3}{\partial t} = \dfrac{1}{\eta_3 *}\left(\dfrac{\partial(k_{x3}\cdot\partial S_3)}{\partial x^2}+\dfrac{\partial(k_{y3}\cdot\partial S_3)}{\partial y^2}+\dfrac{\partial(k_{z1}\cdot\partial S_3)}{\partial z^2}\right)- \\[1mm]
\quad -F_{x3}\cdot\dfrac{\partial S_3}{\partial x}-\hat{S}(t)\cdot\delta(x_i,y_i,z_i); \\[2mm]
\dfrac{\partial S_4}{\partial t} = \dfrac{1}{\eta_4 *}\left(\dfrac{\partial(k_{x4}\cdot\partial S_4)}{\partial x^2}+\dfrac{\partial(k_{y4}\cdot\partial S_4)}{\partial y^2}+\dfrac{\partial(k_{z4}\cdot\partial S_4)}{\partial z^2}\right); \\[2mm]
\dfrac{\partial S_5}{\partial t} = \dfrac{1}{\eta_5 *}\left(\dfrac{\partial(k_{x5}\cdot\partial S_5)}{\partial x^2}+\dfrac{\partial(k_{y5}\cdot\partial S_5)}{\partial y^2}+\dfrac{\partial(k_{z5}\cdot\partial S_5)}{\partial z^2}\right)- \\[1mm]
\quad -F_{x5}\cdot\dfrac{\partial S_5}{\partial x}; \\[2mm]
\dfrac{\partial S_6}{\partial t} = \dfrac{1}{\eta_6 *}\left(\dfrac{\partial(k_{x6}\cdot\partial S_2)}{\partial x^2}+\dfrac{\partial(k_{y6}\cdot\partial S_2)}{\partial y^2}+\dfrac{\partial(k_{z6}\cdot\partial S_2)}{\partial z^2}\right); \\[2mm]
\dfrac{\partial S_7}{\partial t} = \dfrac{1}{\eta_7 *}\left(\dfrac{\partial(k_{x7}\cdot\partial S_7)}{\partial x^2}+\dfrac{\partial(k_{y7}\cdot\partial S_7)}{\partial y^2}+\dfrac{\partial(k_{z7}\cdot\partial S_7)}{\partial z^2}\right)- \\[1mm]
\quad -F_{x7}\cdot\dfrac{\partial S_7}{\partial x}; \\[2mm]
\dfrac{\partial S_8}{\partial t} = \dfrac{1}{\eta_8 *}\left(\dfrac{\partial(k_{x8}\cdot\partial S_8)}{\partial x^2}+\dfrac{\partial(k_{y8}\cdot\partial S_8)}{\partial y^2}+\dfrac{\partial(k_{z8}\cdot\partial S_8)}{\partial z^2}\right); \\[2mm]
\dfrac{\partial S_9}{\partial t} = \dfrac{1}{\eta_9 *}\left(\dfrac{\partial(k_{x9}\cdot\partial S_9)}{\partial x^2}+\dfrac{\partial(k_{y9}\cdot\partial S_9)}{\partial y^2}+\dfrac{\partial(k_{z9}\cdot\partial S_9)}{\partial z^2}\right)- \\[1mm]
\quad -F_{x9}\cdot\dfrac{\partial S_9}{\partial x}; \\[2mm]
\dfrac{\partial S_{10}}{\partial t} = \dfrac{1}{\eta_{10} *}\left(\begin{array}{l}\dfrac{\partial(k_{x10}\cdot\partial S_{10})}{\partial x^2}+\dfrac{\partial(k_{y10}\cdot\partial S_{10})}{\partial y^2}+\\[2mm]+\dfrac{\partial(k_{z10}\cdot\partial S_{10})}{\partial z^2}\end{array}\right);
\end{cases}
$$

$$0<x<L_x, 0<y<L_y, 0<z<L_z, \tag{1}$$

where S_j – level lowering, m;

j – layer number;

k_x, k_y, k_z – filtration coefficients along the corresponding axis, m/d;

η_j* - compressibility coefficient, m^2/d .

In some equations of the system 1 flow rate (F) is omitted. The flow rate of the first equation is omitted, since it describes the layer of groundwater, which is powered by precipitation, rather than a constant flow of water. In other cases, the flow rate is lowered so considered watertight layers made and the flow in them is assumed to be 0.

Initial conditions are defined as:

$$
\begin{aligned}
&S_j(x,y,z,0)=0; \\
&(j=1...10),
\end{aligned}
$$

where j – layer number.

The boundary conditions within the facility are given as:

$$
\begin{aligned}
&\frac{\partial S_j(L_x,y,z,\tau)}{\partial x}=0; \\
&S_j(0,y,z,\tau)=0; \\
&\frac{\partial S_j(x,0,z,\tau)}{\partial y}=\frac{\partial S_j(x,L_y,z,\tau)}{\partial y}=0; \\
&(j=1...10).
\end{aligned}
$$

The boundary conditions on the boundaries of the reservoir are presented as:

$$
\begin{aligned}
&k_{zj}\frac{\partial S_j(x,y,L_{z_i},\tau)}{\partial z}=k_{zj+1}\frac{\partial S_{j+1}(x,y,Z_{j+1},\tau)}{\partial z}; \\
&\frac{\partial S_1(x,y,z=L_{z_1},\tau)}{\partial z}=0, \frac{\partial S_{10}(x,y,z=L_{z_{10}},\tau)}{\partial z}=0; \\
&0<x<L_x, \quad 0<y<L_y.
\end{aligned}
$$

Communication between the layers I and II is presented in the following form:

$$
\begin{aligned}
&S_1(x,y,L_{z_1},\tau)=S_1(x,y,L_{z_1},\tau)+ \\
&+b_1\cdot(S_2(x,y,0,\tau)-S_1(x,y,L_{z_1},\tau)),
\end{aligned}
$$

$$
\begin{aligned}
&S_2(x,y,0,\tau)=S_2(x,y,0,\tau)- \\
&-b_1\cdot(S_2(x,y,0,\tau)-S_1(x,y,L_{z_1},\tau)).
\end{aligned}
$$

Communication between the layers II and III is presented in the following form:

$$
\begin{aligned}
&S_2(x,y,L_{z_2},\tau)=S_1(x,y,L_{z_2},\tau)+ \\
&+b_2(x,y)\cdot(S_3(x,y,0,\tau)-S_2(x,y,L_{z_2},\tau)),
\end{aligned}
$$

$$S_3(x,y,0,\tau) = S_3(x,y,0,\tau)$$
$$--b_2(x,y) \cdot (S_3(x,y,0,\tau) - S_2(x,y,L_{z_3},\tau))$$

Communication between the layers III and IV is presented in the following form:

$$S_3(x,y,L_{z_3},\tau) = S_3(x,y,L_{z_3},\tau) +$$
$$+ b_3(x,y) \cdot (S_4(x,y,0,\tau) - S_3(x,y,L_{z_3},\tau)),$$

$$S_4(x,y,0,\tau) = S_4(x,y,0,\tau) -$$
$$- b_3(x,y) \cdot (S_4(x,y,0,\tau) - S_3(x,y,L_{z_3},\tau)).$$

Communication between the layers IV and V is presented in the following form:

$$S_4(x,y,L_{z_4},\tau) = S_4(x,y,L_{z_{4;}},\tau) + +$$
$$b_4 \cdot (S_5(x,y,0,\tau) - S_4(x,y,L_{z_4},\tau)),$$

$$S_5(x,y,0,\tau) = S_5(x,y,0,\tau) -$$
$$- b_4 \cdot (S_5(x,y,0,\tau) - S_4(x,y,L_{z_4},\tau)).$$

Communication between the layers V and VI is presented in the following form:

$$S_5(x,y,L_{z_5},\tau) = S_5(x,y,L_{z_5},\tau) +$$
$$+ b_5(x,y) \cdot (S_6(x,y,0,\tau) - S_5(x,y,L_{z_5},\tau)),$$

$$S_6(x,y,0,\tau) = S_6(x,y,0,\tau) -$$
$$- b_5(x,y) \cdot (S_6(x,y,0,\tau) - S_5(x,y,L_{z_5},\tau)).$$

Communication between the layers VI and VII is presented in the following form:

$$S_6(x,y,L_{z_6},\tau) = S_6(x,y,L_{z_6},\tau) +$$
$$+ b_6 \cdot (S_7(x,y,0,\tau) - S_6(x,y,L_{z_6},\tau)),$$

$$S_7(x,y,0,\tau) = S_7(x,y,0,\tau) -$$
$$- b_6 \cdot (S_7(x,y,0,\tau) - S_6(x,y,L_{z_6},\tau)).$$

Communication between the layers VII and VIII is presented in the following form:

$$S_7(x,y,L_{z_7},\tau) = S_7(x,y,L_{z_7},\tau) +$$
$$+ b_7(x,y) \cdot (S_8(x,y,0,\tau) - S_7(x,y,L_{z_7},\tau)),$$

$$S_8(x,y,0,\tau) = S_8(x,y,0,\tau) -$$
$$- b_7(x,y) \cdot (S_8(x,y,0,\tau) - S_7(x,y,L_{z_7},\tau)).$$

Communication between the layers VIII and IX is presented in the following form:

$$S_8(x,y,L_{z_8},\tau) = S_8(x,y,L_{z_8},\tau) +$$
$$+ b_8 \cdot (S_9(x,y,0,\tau) - S_8(x,y,L_{z_8},\tau)),$$

$$S_9(x,y,0,\tau) = S_9(x,y,0,\tau) -$$
$$- b_8 \cdot (S_9(x,y,0,\tau) - S_8(x,y,L_{z_3},\tau)).$$

Communication between the layers IX and X is presented in the following form:

$$S_9(x,y,L_{z_9},\tau) = S_9(x,y,L_{z_9},\tau) +$$
$$+ b_9(x,y) \cdot (S_{10}(x,y,0,\tau) - S_9(x,y,L_{z_9},\tau)),$$

$$S_{10}(x,y,0,\tau) = S_{10}(x,y,0,\tau) -$$
$$- b_9(x,y) \cdot (S_{10}(x,y,0,\tau) - S_9(x,y,L_{z_9},\tau)).$$

The boundary conditions at the lower boundary of the lower layer are presented in the following form:

$$\frac{\partial S_{10}(x,y,L_{z_{10}},\tau)}{\partial z} = 0 .$$

The boundary conditions on the lateral faces of the modeled area are presented in the following form:

$$S_j(x,0,z,\tau) = S_j(x,L_y,z,\tau) = S_j(0,y,z,\tau), \ (j = 1...10).$$

After determining the type of mathematical model proposed to go to determine the dynamic characteristics of the control object.

IV OVERFLOW COEFFICIENT DETERMINETION

For the simulation model it is necessary to determine the coefficient of overflow. In the standard formulation of the problem spillover coefficient is set separately for each stratum. Thus, previously used in calculating the average value of the coefficient of overflow, overflow spatial variation coefficient neglected to simplify the model.

This approach is acceptable if the layer has no significant expansion or cracking. If the field has a complex hydrogeological structure, the structure and integrity of the reservoir is required. Therefore, the decision was made in this work to present overflow coefficient at each sampling. To do this, overflow coefficient was presented as an array of values, allowing to simulate hydrodynamic processes in the field, taking into account changes in the size and integrity of the aquifer.

The values of this ratio are presented in the form of an array:

$$b = \begin{cases} 0.01 & 0.012 & 0.015 & 0.016 & 0.018 & 0.012 & 0.01 \\ 0.01 & 0.013 & 0.017 & 0.019 & 0.017 & 0.015 & 0.01 \\ 0.01 & 0.013 & 0.019 & 0.024 & 0.022 & 0.012 & 0.01 \\ 0.01 & 0.014 & 0.018 & 0.03 & 0.019 & 0.025 & 0.01 \\ 0.01 & 0.014 & 0.02 & 0.023 & 0.021 & 0.024 & 0.01 \\ 0.01 & 0.014 & 0.019 & 0.02 & 0.016 & 0.023 & 0.01 \\ 0.01 & 0.013 & 0.015 & 0.016 & 0.018 & 0.017 & 0.01 \end{cases}$$

For a greater clarity, we are invited to consider the spatial distribution of the coefficient values b (Figure 1). This spatial distribution corresponds to the actual physical picture of the changes overflow coefficient, depending on the origin.

Fig. 1. Spatial distribution ratio of b values
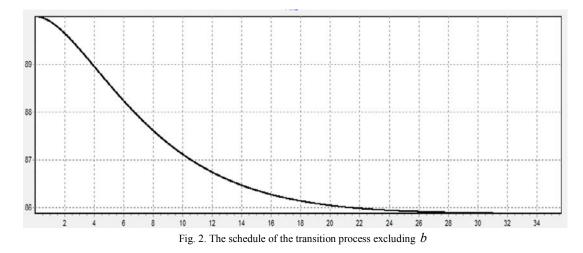
Presented below describes the distribution of the values of the coefficient of overflow changes depending on the structural changes in the formation. At the edges of the reservoir on the x-axis coefficient adopted minimum (conditions of flow continuity).
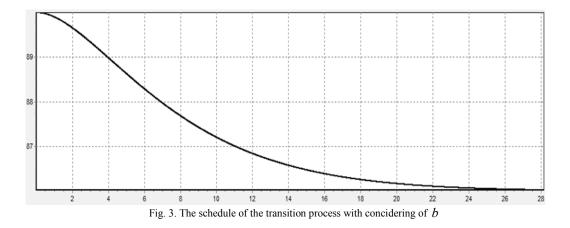
It is further proposed to consider the impact of such a representation factor in the simulation results geofiltration process.

V MODELING RESULTS

The simulation results presented in Figures 2 and 3. Figure 2 shows a plots of transients on the first and second modes of the input exposure with a standard way to account for overflow ratio.

Figure 3 is a graph of the transition process, taking into account the dynamic of b coefficient overflow.

Fig. 2. The schedule of the transition process excluding b

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Fig. 3. The schedule of the transition process with concidering of b

To validate the model the simulation results and performance data were compared. For a given volume of pumping real deviation was 9.4 m. The standard deviation of the simulation was 11.3 m., at a time when considering the dynamic coefficient of overflow deviation was 11 m.

If we compare the results, the modeling error is the standard approach is 20.21%, and with a new approach 17.02%, which proves the feasibility of the proposed changes.

Further, the regulator has been synthesized for the mine management system. For the synthesis of the regulator frequency synthesis method was applied, which was successfully used to solve problems in this domain. stability analysis was conducted using the open loop Nyquist stability criterion.

According to the received results, it can be said that both the systems meet the stability criteria. However, the system stability margin obtained based on the updated model larger by 3.6% higher.

VI CONCLUSIONS

This paper presents a detailed analysis of the mathematical model of Nagutskaya mineral water field, including description of the main model's parameters, the system of partial differential equations that describe the geofiltration processes of the field, as well as the initial boundary conditions and overflow conditions. In the work an analysis overflow coefficient spatial nonunifomility was done, which made the simulation results more accurate than those obtained with the standard approach, as well as to increase the margin of stability control systems. In the standard formulation of hydrogeological object's overflow ratio modeling problem is defined separately for each layer [5]. Thus, previously used in calculating the average value of the coefficient of overflow. This means that the spatial variation coefficient overflow neglected to simplify the model. This study shows that the use of the proposed submission rate increases simulation accuracy and stability of the system, which confirms the feasibility of the solutions.

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International Activity of Russian Universities. Case Study of St.-Petersburg Electrotechnical University "LETI"

Olga Shvetsova

School of Industrial management

Korean University of Technology and Education (KOREATECH)
Cheonan, Chungnam,Republic of Korea

shvetsova@koreatech.ac.kr

Abstract— In the conditions of internationalization of the higher school increase of competitiveness of higher education institution is impossible without creation of a strong brand. One of the factors influencing this process is the inclusiveness of university in the international activity. Traditionally international activity of higher education institution is carried out in the directions: the organization of educational process with involvement of teachers from abroad; organization of the international conferences, symposiums, seminars, forums; participation in grant programs. In recent years actively the academic mobility, export of educational services, and programs of double certification develop. In article, it is said about how these directions are realized in one of structural divisions of the Saint-Petersburg Electrotechnical University "LETI" at faculty of management and economics. Ways of further improvement of the international activity of higher education institution are offered.

Index Terms— competitiveness of higher education institution; international activity; interaction of Russian higher education institute and Global education process

I. INTRODUCTION

Powerful integration processes the spheres of public life, which are more and more taking everything, demand adequate answers from the higher education, strengthening of the international component in the organization of training of the modern expert, assume internationalization not only producers and products, but also the higher education and science. In documents of the first world conference on the higher education it is emphasized that "the higher education should be considered as the general property and that the international cooperation and exchanges are the main ways of development of the higher education around the world" [3, p. 23].

Calls of time, feature of the international life generate new tendencies in the higher education. One of the major tendencies - the increase in scales of the higher education caused by increase of a role of science in production and society. The higher education more and more to become mass, there is a prompt proliferation of students of higher education institutions. If in 1960 the number of students in the world

according to UNESCO made 13 million, then in the present it has increased almost up to 100 million [4] B arrival of graduates of high schools developed the countries level in higher educational institutions has made nearly 60%, and in the USA and Canada more than 80%. Now in the world more than 14 thousand higher educational institutions [5, p. 12].

Other important tendency developing especially dynamically from the second half of the 20th century is diversification of the higher education in institutional forms, levels and contents. The third, the tendency which is promptly gaining strength is the internationalization of the higher education gaining recently more and more real character. In the sphere of the higher education "the closest rapprochement if not a community, problems, tendencies, tasks and the purposes, forcing to forget about national and regional distinctions and specifics" [6, p. 2] is observed.

Requirements to experts, first of all to mobility of graduates, quality of their professional knowledge, foreign language skills, new information technologies increase. On statistical data, the number of the students who are getting higher education outside the country from 920 thousand people in 1980 has grown to 1 million 550 thousand people in 1996 and now makes according to some information about 2 million. In prepared by the International Association of rectors of universities (IAUP) the report on strategy of internationalization it is noted by International Association of University President: "We resolutely insist on that all institutions of system of the higher education actively promoted process of internationalization of the educational institutions".

Various reasons of internationalization of the higher education [3, p. 31] are specified, as the most essential it is possible to allocate the following:
1. Political – democratization of the world community, development of integration processes in political and social spheres;

2. Economic – globalization of economy and technologies, requirements world and regional labor markets;

3. Cultural and ideological – growth of the international openness and the developing dialogue of national cultures;

4. Academic – international nature of scientific knowledge, a universal basis of education and research activity, formation of the international quality standards;

5. Information - new information technologies, global networks.

However at realization of the main directions of development of the international activity of Saint-Petersburg State Electrotechnical University (further – LETI), as well as many other Russian universities, faces a number of vital issues. The main problems constraining development of the international activity of university.

1. Personnel. The most part of teachers and staff of university have no sufficient language training; we aren't familiar with legal Regulations of Admission of official delegations; we are insufficiently familiar with normative documents of the Russian Federation and the Ministry of Economics of the Russian Federation (foreign sending financing; reception of official delegations).

2. Weak strategic planning of the international activity at the level of faculty, department.

3. The problems connected with a set of foreign citizens for study (there are no regional models of export of educational services; there is no close cooperation between higher education institutions of the region concerning export of educational services; potential education markets are poorly studied).

4. Low level of social conditions of accommodation of foreign citizens.

5. Insufficient level of development of the academic and student's mobility (weak language training of professorial and student's structure; lack of financing; weak ability of preparation of application materials on a grant).

6. Low popularity of scientific works of staff of university abroad (a lack of financing on foreign patenting and publications in the known foreign publishing houses) that prevents entry into world scientific and educational space.

7. Lack of experience of commercialization of science projects (inability of research associates to create the final product of science projects, best-selling in the internal and vernal markets).

8. Absence at university of well-prepared project-managers, i.e. specialists in preparation of application materials for participation in joint international projects, for example, TACIS/TEMPUS, INTAS etc.

For the solution of these and many other problems interfering successful development of the international cooperation of university the International service LETI which is a factor of strengthening of scientific and educational capacity of university just is also created.

II. RESEARCH BASIS

A. Selecting a concept

In February, 2002 at university the decision on creation within the International service LETI of the Center of the International Education (CIE) was made. Its parts were the preparatory office (foreign part); department of work with foreign pupils and the regional center of testing of citizens of foreign countries for Russian. At the same time the uniform control system (the vice rector for international relations) and through control of all process of a set, training, social and cultural and educational work with foreign pupils has been created.

The main areas of work of the Center of the international education are the following:

Promotional and informational - the activity connected with involvement of foreign citizens for training at our university (development and release of brochures and booklets in foreign languages, including Mongolian, Chinese, Turkish etc.; participation in the international exhibitions and fairs; work with foreign agencies on recruiting of students for training abroad; information support of the specialized Websites, etc.).

Educational and methodical - the organization of educational process for programs of prehigh school preparation before revenues to a basis cycle of training (a bachelor degree, engineering training, a magistracy); the organization of training in Russian for various forms and terms of preparation (from 1 month to 3 years), including the included training and training in Russian at the main faculties of university; language training; summer language schools; interaction with the general education and special departments training foreign students and also with the regional center of testing.

Cultural and educational - the organization of cultural and mass and educational work: cooperation with associations of foreign pupils; help in welfare adaptation; organization of Days of first-year students; traditional spring Festivals of friendship; celebration of national public holidays; organization of excursions, visits of theatres, museums, etc.

Organizational - order taking for training; correspondence with candidates and their selection; registration of necessary documents for entry into the Russian Federation; organization of meetings of foreigners; moving of pupils in hostels; control of their accommodation and timeliness of payment for training; registration of newcomers of pupils; registration of vacation and exit visas; registration of diplomas; development of material and technical resources (including equipment of hostels) etc.

B. Research.

The international service closely coordinates the work with the offices of the international educational organizations and

the centers existing at university: Information center of the British Council; DAAD Information center; regional representative office of Institute of Goethe; the regional center of fund Niksdorf - the Industry; North-West center of the international cooperation in automation. At close cooperation and interest of foreign partners of university opening at university of the new centers is planned soon: American Studies, Korean Studies, China Studies, European Studies. The last center will be open within the TEMPUS "Development of the Siberian Network of the European Studies Centers" project which the university among other partner participants has won in 2003 (fig. 1).
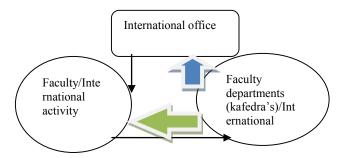
Fig. 1. Structure of communication (international activity) at the Russian Universities

Regulatory base of the International service are the Charter, orders of the Ministry of Education of the Russian Federation and orders on higher education institution; the approved Provision on activity of division and the Provision on distribution of the means arriving for training and accommodation of foreign citizens.

The provision on activity of division contains the main activities, functions of employees, an order of financing, education and distribution of the income. The provision on distribution of the means arriving for training and accommodation of foreign citizens contains structure of distribution of the means which have arrived for:

- training of foreigners at a stage of pre-university preparation, at faculties, in postgraduate study and doctoral studies;
- for training in Russian in programs of various duration;
- for passing of training at departments of university;
- for services in paperwork to foreigners (registration of entrance documents in the Russian Federation; registration of diplomas of bachelors, masters and experts);
- for accommodation in the hostel of the Center of the international education.
-

In structure of distributions the main articles are selected: fund of development of university; fund of payment of the faculty; fund of development of material and technical resources of faculties; fund of development of department of

Russian; fund of development of the International service (including the off-budget salary fund of employees).

In the International service also the package of the normative documents for internal use regulating processes is developed:

- foreign sending of teachers, employees and students;
- reception of foreign delegations;
- Organizations and carrying out the international symposiums, conferences, seminars.

Personnel structure of the International service:
the number of employees - 14;
middle age - 38 years;
the higher education - 100%;
computer skills - 100%;
foreign language skills (English, German, French, Italian, Korean, Chinese, Japanese) - 95%.

Each employee of the International service fulfils functional duties according to the approved Provision on activity and supervises the separate direction (for example, France, Germany, Korea, China etc.) and also he personally is responsible for execution of the separate project according to the approved annual Plan of the international actions. At the same time at execution of projects direct link is carried out: the employee of the International service - the responsible representative of department/faculty.

The general coordination and responsibility for execution of the projects and actions approved by the Academic council of university and administration is assigned to the vice rector for international relations. Annually the report on the work done by the International service is heard at a meeting of the Academ-ic council of LETI. Through meetings, meetings and publications in university editions (newspaper "ELECTRIC") the straight line and feedback of the International service with teachers, employees and students of university is carried out. Also International service has close connection with mass media of the city and the region and will regularly organize the press conferences accompanying each international action that also promotes formation of positive image of our university.

The international service LETI is open for active partner cooperation with the international services of all higher education institutions of the region both on exchange of experience and professional development, and on joint implementation of the international projects. Elaboration of regional strategy and association of efforts are necessary for us for successful activity in the world market of educational services (see figure 2).

	2013	2014	2015	2016
EU	45	48	49	49
number of agreements between LETI and foreign University				
USA	12	15	13	12
China/Korea/Japanese	8	8	25	28
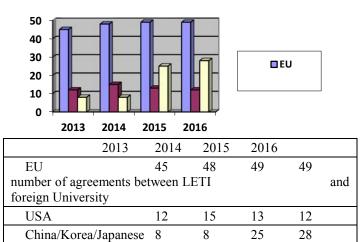
Fig. 2. Dynamics of cooperation agreements between LETI and foreign Universities (partners).

So, for example, one of the important and perspective tasks on the near future demanding association of efforts of regional higher education institutions is opening of Representative Offices of higher education institutions abroad, in the countries, perspective in respect of a set of students.

III. CONCLUSIONS

Certainly that one higher education institution, even the most powerful, won't be able to solve this problem. Only initial investments make about 300 000 US dollars. And will be much more perspective if such Representation renders abroad a wide range of educational services in various disciplines.

Saint-Petersburg state Electrotechnical University ("LETI") carries already out a preparatory work on opening united Representative offices of higher education institutions abroad. It is important that in this preparatory work to our university there is an opportunity to rely on partners.

ACKNOWLEDGMENT

The international service LETI solves the following priorities constraining development of the international cooperation:

1. Insufficient language training of the most part of research associates, teachers and students of university. This problem is solved due to expansion of a network of offices of the foreign educational organizations and centers located in the territory of university and creation of the language centers organized by various legal entities on a competitive basis.

2. Insufficient knowledge of legal aspects of reception of foreign guests of university and the normative documents concerning financial side of reception of foreign delegations and foreign sending of employees and students of LETI.

3. Increase of level of strategic planning of the international activity at faculties and departments.

4. Decrease in level of a set of foreign students.

5. Insufficient level of the social sphere of accommodation of foreign students, trainees, the invited teachers etc. Decides due to development and improvement of living conditions of accommodation in the hostel of hotel type for foreign pupils.

6. Insufficient financing of the academic and student's mobility. The practician with foreign partners of LETI decides due to purposeful search and selection of various foreign programs, grants and grants financing mobility development and also due to development of exchange student's programs also.

7. Low popularity of results of scientific researches of employees of LETI abroad.

8. Low level of commercialization of science projects. Decides due to creation joint with Korea and China of the Centers of high technologies, creations in LETI of the distributed Science and technology park and department of commercialization of science projects.

9. Certainly what development of the international activity of higher education institution demands not only new thinking, new approaches, new skills, but also considerable financing? University, understanding importance of development of the international cooperation for strengthening of the scientific and educational potential, consistently solves these problems constraining his international activity..

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Research of the Academic Web Space in the Russian Federation

Yu.M. Solomentsev[1], S.A.Sheptunov[1], T.V. Karlova[1], A.L Barashkova, I.V.Vorobjev[1], A.N. Zapolskaya[1],
R.S. Nakhushev[1], Yu.M.Yakhutlov[1], A.S. Sannikov[1]
[1]IDTI RAS, Institute of Design & Technological Informatics
Moscow, Russia
ship@ikti.ru[1,2]; karlova-t@yandex.ru[3]; asa271006@inbox.ru[4]; jsparrow@mail.ru[5]; zap-ann@yandex.ru[6];
electronics_rn@mail.ru[7,8,9]

Abstract — **A number of communications in the work of the informative sites of leading scientific organizations of the Russian Federation, including in the structure of the Russian Academy of Sciences and Federal Agency of Scientific Organizations is researched.**

Keywords - scientific journalism; scientific edition; press-centers; online media; popularization of scientific knowledge; academic web space; communications in the scientific media; monitoring.

I. INTRODUCTION

In one of his latest interviews Sergey Petrovich Kapitza, a Russian physicist, a master of scientific journalism and an author of a famous TV programme ''Ochevidnoye-Neveroyatnoye'', noticed that nowadays the Internet ''demonstrates a gigantic gap between technology and content.''* The scientist characterized the Internet as ''a tribune used for broadcasting whatever one likes'' and claimed that periodicals along with television and web journalism still remained in more advantageous position.

However, a rapid development of information technologies has radically changed the rules at the global information market. For a modern society the Internet network is one of the most available and operative sources of information. Scientific journalism is not an exception. Electronic resources of scientific themes are gradually filling information web space up and getting a status of electronic media.

According to the research data of Public Opinion Foundation ''Internet in Russia. Dynamics of penetration. Winter 2015-2016.''**, the indicator of penetration of the Internet network in this period of time among adult population of Russia is 69% that is 80,5 million people. Precisely a year ago it was 63% that is 73,8 million people. The authors of the branch report on the results of the nineteenth Russian Internet forum RIF+KIB 2016 ''Internet in Russia. Status, tendencies and perspectives for the development.'' **mark that the level of the Internet penetration in Russia nowadays is the highest in the Commonwealth of Independent States and BRICS2, but it is lower than in other countries of The Group of Eight and in the Baltics. Citizens most often use the global network for the search of the necessary information, a large number of which is in the Internet edition and on the platforms of social networks. It is highly important that in the report the most active user of the Internet is called the student youth which is the target audience for the programs of the popularization of science in the Russian Federation.

Russian web platforms directly in the field of science can be divided into three main categories, such as network projects, electronic versions of popular science periodicals and official representatives of Russian research institutes and scientific centers in the Internet. In this article I would like to consider the third category in particular. I dare to claim that its potential in the context of popularization of scientific knowledge has not been fully disclosed.

The relevance of the studied issue involves both growing attention to the popularization of scientific knowledge in our country in general and expending the boundaries of information web space in the field of science and education. The information web space has already created a certain amount of scientific and educational resources. These are mainly electronic versions of scientific media and autonomous thematic web sites. They have both advantages and disadvantages. However, the information sites of leading scientific institutions of Russia could compete with traditional electronic media about science. Data of the research below confirm that on these platforms a user can find reliable and well-presented information in an interesting and clear way. But for the success in this case a cooperative work of researchers and a private press service in each separate scientific institution are needed.

II. EASE OF USE

Monitoring of information web space of the Russian Academy of Sciences

The research that I would like to tell about is a monitoring of the information web space of the Russian Academy of Sciences (RAS) that was made by a group of Russian scientists together with the press service of RAS. 405 web sites of the scientific institutions, which are the part of the structure of RAS and the Federal Agency of Scientific Organizations, as well as their official representatives in social networks, were an empirical base of this research. During the year, from April 2014 to April 2015, the web sites of 405 scientific institutions in the structure of RAS of 44 Russian regions were studied.

The following criteria were used as the indicator of a positive or negative assessment of each resource. They are the availability of official data of an institution on a web site (visiting card), the presence of the news section and the regularity of its updates, a clear navigation of the resource and its interface, the access to contacts, the availability of the English version. The presence of the institution at pages of Russian and international social network platforms was marked separately. Moreover, the presence of the press services themselves or the staff responsible for media relations in RAS institutes were clarified with the use of the electronic contacts, listed on the websites of the institutions.

The results of the monitoring of the sites of the scientific institutions of RAS happened to be ambiguous. Superficial research of the official Internet representatives of the scientific institutions of RAS showed a rare update of the resources and their uselessness. In fact, everything was not so bad.

As it has become clear, first of all, Internet users are frightened off with a rather uninteresting interface of websites created with minimal means and being out of date for a long time. Unattractive website design has been observed in 223 scientific institutions of RAS. A significant part of users immediately leave such electronic platforms due to their unattractive interface.

Further, the main criteria in selecting the source of information by the representatives of media were considered. What is of first priority for a journalist in searching for information on a particular recourse? I dare to assume that we are talking about news section (that is relevant at present) and access to contacts of the institution staff, ranging from the management to the researchers of laboratories. If a journalist has already got the information, he or she, as a rule, needs the confirmation of these data and expert points of view of specialists.

Monitoring of electronic resources of the scientific institutions of RAS showed that at the time of the study contact details were available on the websites of 287 scientific institutions of the Russian Federation, that is much more than a half of the studied resources in the paper. Section ''Contacts'' on these web sites is not limited to dating actual and legal addresses of the institution, a public phone number and email address. Contacts of five or more employees of the institution, including the Director and the scientific secretary, are noted with personal service data emails for remaining in contact. A significant part of the institutes has contact details of all the institution employees on their web sites. At the same time, the percentage of the institutes showing the contacts of press services on their web sites is low enough.

Not everything is bad with the indicators of news updates. Websites of 319 institutions have special news sections which date from two or more messages for the first half of 2015. The very fact of news section updates proves that in the institution there is the staff responsible for providing information on the activities of the research center. There were no news sections on 13 websites. News sections were formed on 73 electronic platforms, but there was no news of 2015 in them. Perhaps, the information presented in the news sections, was far from the style of the language of scientific journalism

(news are written in a pure scientific, barren style). However, a journalist always has an opportunity to get comments on the interested questions from the experts – employees of the institute. Their contact details, as written above, are mostly in public access.

The sadder is the situation with the navigation of the examined electronic resources. A clear vivid navigation, enabling a rapid search for the necessary information, was presented only on 159 sites of the scientific institutions of RAS. The rest part is characterized with illogical transitions and links, overabundance of graphic elements and banners with hyperlinks. Studying the home page of a website, many users even have no idea about its extensive informative content. It is very often impossible to become familiar with the very same page ''Contacts''because of illogical navigation.

Other criteria are not so critical. 250 electronic platforms have English versions of sites. 71 resources do not have a visiting card of a scientific institution at home page. Even if there is information on a site, it is fragmented and the parts are placed at different pages, such as ''History'', ''Stages of formation'' and ''Research areas''. It turns out that the search for the most important information to start exploring, such as what the institute is, where it is and what it does, is difficult in this case.

Noting the results of the monitoring, authors of the research gave a general description for each resource, using as a basis the presence of two most important criteria for journalists, that is a regular update of a site and/or the access to contact database. The navigation and availability of a visiting card were also taken into account. Summing up the research, it can be argued that in 2015 91 sites of the scientific institutions of RAS were not available for the representatives of media to work with, 32 of them belong to Moscow research institutes.

The best indicators were recorded on 36 sites of institutes and scientific centers, including Institute of Higher Nervous Activity and Neurophysiology of RAS, Institute of History - Siberian Branch of RAS, Institute For the Study of Science of RAS, Geological institute of RAS, Institute of Economics - The Ural Branch of RAS, V.E. Zuev Institute Of Atmospheric Optics - Siberian Branch of RAS, A.M .Obukhov Institute of Atmospheric Physics – RAS.

Cardinal modernization, according to the results of the research, is necessary for 15 electronic resources of the scientific institutions of RAS.

It should be also noticed that, despite a number of uncertainties in the navigation and functionality of some electronic resources, in the structure of these sites there are services focused on more active interaction with users and greater openness.

For example, the home page of the website of the Institute of World Economy and International Relations of RAS (Moscow) is provided with the section ''Current comment''. Reviews of the leading members of the Institute on the most important events taken place in the field of international relations today, and on economic situation in the world are published in it. The website of Kurnakov Institute of General and Inorganic Chemistry of RAS (Moscow) has a number of

interviews with Russian specialists in the field of chemistry. 'The section 'Blogs" provokes interest on the website of the Institute of Sociology of RAS. As it has turned out more than 30 scientists of this institution really keep blogs, including video blogs, on the website.

There is its own expert network on the website of the Institute for Economic Strategies of RAS (Moscow). It includes both Russian scientists and foreign partners of the Institute. In the section specially designed for the expert network there is a database with the information about each expert with the reference to its scope of activities, scientific specialization and publications.

An illustrative example of the interaction of a scientific center with the public can be observed on the website of the Institute of Natural Resources, Ecology and Cryology of Siberian Branch of RAS (Chita region). It is an online service of the popular science section ''Ask a scientist''. Anyone can address a question to the specialists of this institution, for that you need to fill an online form and send a message.

Informative sections and useful services on some electronic resources have a special role in the popularization of scientific knowledge. On the website of the Botanical Garden of Ural Branch of RAS (Sverdlovsk region) there are links to thematic sites of the Garden. On the site of the Institute of Petroleum Chemistry of the Siberian Branch of RAS (Tomsk region) there is a list of granted patents. On the website of the Institute of Ethnological Studies of R.G.Kuzeev of Ufa Scientific Center of RAS (Republic of Bashkortostan) you can explore online a 3D-model of a headdress called hushpu. A remarkable detail is that the symbol of the age limit ''12+''was seen on the site of the Institute of Mechanics and engineering of Kazan Science Center of RAS (IME KazSC RAS).

Monitoring of the academic web space has proved the relevance of using digital media technologies in promoting scientific knowledge. Video players or official representatives on the website of video hosting ''YouTube'' are on the websites of such institutes as, The Polar-Alpine Botanical Garden-Institute of N.A. Avrorin of Scientific Center of RAS (Murmansk region), V.I.Il`ichev Pacific Oceanological Institute of the Far-Eastern Branch of RAS (Primorye), Institute of Applied Mathematics of the Far-Eastern Branch RAS (Primorye), Peter the Great Museum of Anthropology and Ethnography of RAS (Kunstkamera) (Saint Petersburg), Prokhorov General Physics Institute of RAS (Moscow), Solomenko Institute of Transport Problems of RAS (Saint Petersburg).

Finishing the review of the results for the research of the academic web space, it is necessary to mention one very important detail. Contrary to popular opinion that Russian media is indifferent to the success and problems of national science, regularly updated sections ''Press about us'', ''Media'', ''Media about the institute'' are on more than 130 sites of the academic institutes of RAS.

Acknowledgment

Monitoring of the academic web space carried out by the authors of this article allows to compare traditional electronic media in the scientific field with a fundamentally new kind of media, namely, with the electronic resources of the research institutes and scientific centers in the Russian Federation. It is clear that some of them doing secret researches will never give details of their work to the public. However, in Russia, as well as all over the world, there are enough institutes leading public activities and interacting with media. Electronic resources of these organizations are very informative and the navigation is easy to use. Some of them also have full-fledged representatives on the platforms of Russian and international social networks. Both representatives of press service of the scientific institutions and other staff are involved in the formation of the content for filling and updating these resources. And with the elimination of some uncertainties a number of electronic resources of the scientific institutions has a chance to become the new media about science and make its contribution in the popularization of scientific knowledge.

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Popularization of Science in Online Media: Theory and Practice

Yu.M. Solomentsev[*1], S.A. Sheptunov[*2], T.V. Karlova[1]; A.L. Barashkova[3], I.V. Vorobjev[*4], A.N.Zapolskaya[*5], R.S. Nakhushev[*6], Yu.M. Yakhutlov[*7], R.M. Glashev[*8]

* IDTI RAS, Institute of Design & Technological Informatics

Moscow, Russia

ship@ikti.ru[1,2]; karlova-t@yandex.ru[3] ; asa271006@inbox.ru[4]; jsparrow@mail.ru[5]; zap-ann@yandex.ru[6]; electronics_rn@mail.ru[7,8,9]

Abstract - **The study of communications in scientific media in Russia.**

Keywords - communications in the scientific media; scientific journalism; science press-centers; science online media; popularization of scientific knowledge; science web space; scientific edition

I. INTRODUCTION

In view of the importance of the science popularization objective of the Federal Targeted Programme for 'Research and Development of Priority Areas of Russian Scientific and Technology Complex in 2014-2020', authors of this article investigate segment of the Russian e-media in the field of science. The importance of scientific online journalism is proved by numerous social researches. For example, in September 2014 Russian Academy of Science (RAS), Federal Agency for Scientific Organizations and 'Skolkovo' Innovation Center jointly organized in Moscow the interdisciplinary science conference Moscow Science Week (MSW 2014). One of the conference programs was dedicated to the study 'Means of Communication in Russian Academic Area: Best Practices, Challenges and Opportunities' presented within the framework of the event by SPN Communications Agency. It reveals data collected by 250 research institutes from published sources, mass media, expert and telephone polls. The main objective of the investigation was to answer the question: what is the percentage of publications about science in the Russian mass media?

Let's observe the poll results. According to the research data, between April 1, 2013 and April 30, 2014, 459, 529 works on science and education were published in the mass media registered in the Russian Federation (44 % of them being rewritten). The amount seems to be impressive, but it is worth mentioning straight away that the study was initiated at the same time as RAS reorganization which drew attention of both Russian and foreign mass media in 2013. As a result, 40% of the total number of publications was dedicated to science itself, while 58 % - to political aspects with reference to the Russian Government, Russian State Duma, Ministry of Education and Science of the Russian Federation, and RAS. According to the study, 'setting aside the publications dedicated to humanitarian subjects, final amount of publications on science and scientific innovations totaled 6 %

of the overall volume of academic information in mass media'. Total amount of publications includes materials of e-media (63%), news agencies (17%), print media (17%), and TV and radio broadcasters (3%). As far as I can see, resources of Russian information web space are leading. That is no surprise as both representatives of miscellaneous print media and key Russian TV and radio broadcasters have their websites in Global network. I will try to classify online platforms using the Russian language to cover activities of Russian scientists and development of science in Russia as a whole.

Basing on the analysis of the information web space in the field of science I can single out the following categories of that:

- newsfeeds of the news agencies covering development of science and education
- online versions of Russian popular science mass media (this category includes specialized mass media, as well as those mass media whose list of headings contains 'Science' section)
- autonomous online projects developed by scientific sector (this category includes specialized web sites and resources whose list of headings contains 'Science' section)

Let's review each category in detail.

II. NEWS & INFORMATION AGENCIES

According to data as of 2015, more than 15 news agencies are registered in Russia. Only three of them have 'Science' news feeds, namely, International News Agency 'Rossiya Segodnya' (INA 'Russia Today'), TASS (Telegraph Agency of the Soviet Union), and Regnum News Agency. It goes without saying that other agencies publish news about science in their news feeds as well, but more often in the sections 'Society', 'Interviews' or 'Conferences'. Besides, in October 2013 mass media announced the launch of a new, unrivaled in Russia and abroad, news agency for popularization of science – Information Bureau 'Russian Science'. The agreement for organization of a new media company was signed in Saint Petersburg between RAS representatives, All-Russia Public Organization Obshchestvo 'Znaniye' Rossii, National Research Center 'Kurchatov Institute', News Agencies RIA Novosti (Russian Information Agency Novosti), and ITAR-

TASS (Information Telegraph Agency of Russia - Telegraph Agency of the Soviet Union). The new information agency was meant to be an educational project about country's advances in space, atomics and other knowledge-intensive areas. Unfortunately, little is known today about further progress of this new media organization. And project 'RIANAUKA' on INA 'Russia Today' website is developing in the most effective way. It was launched as a part of 'Science and Ecology News' news feed in Science section of then not yet closed down RIA-Novosti agency. Its authors outlined that the competent journalists of the only Russian media editorial board 'Nauka-Sobstvennyi Kontinent' participated in the project. For them, partners of the project, such as scientific organizations and research institutes of Russia, are the primary sources of information.

Challenging tasks, such as developing a new specialized portal with reliable data on science and technology, launching products and E-tools (analytical database, digests, expert advice) designated for experts in the field of science and education and achieving dominant position among other scientific e-media, were set in the course of the new media organization. From 7 to 25 pieces of scientific news are published daily by project 'RIANAUKA' on portal INA 'Russia Today'. Space is the most demanding sphere with the following most frequently quoted in 2015 (as well as in 2014, in fact) speakers: Deputy Prime Minister of the Russian Federation, Dmitriy Rogozin, and heads of the Federal Space Agency Roskosmos. Apart from the development of the information digital resource, interactive projects focused on popularization of Russian science are created and launched in the framework of this project. In the first place they target young people. Such projects are usually carried out in multimedia press center of INA Russia Today. Scientific talk show 'Fizika Budushchego' ('Physics of the Future') with the direct involvement of officials and professors of National Research Nuclear University 'Moscow Engineering Physics Institute' ('MEPhI') can be mentioned as an example.

Scientific news feed of ITAR-TASS New Agency is updated daily. From one to seven news articles with illustrations and at times with video content are published every day. Members of the Presidium of RAS are often invited to speak on scientific issues. Comments on the news are disabled, but it is possible to share the news on your pages in social networks.

III. Electronic Versions of Scientific and Educational Periodicals

Each and all major mass media, including those covering scientific news, have their representatives in the Global network. Reputable scientific and popular science media have their own E-platforms on the Web. These are, first of all, magazines 'Nauka i Zhizn', 'Znaniye-Sila', 'V Mire Nauki' (Russian version of 'Scientific American magazine'), 'Populyarnaya Mekhanika', 'KVANT' (since 2011 it has been issued only in electronic format), and newspapers of academic communities 'Poisk' and 'Troitskiy Variant'. However, these media compete with scientific sections of weekly newspapers 'Rossiyskaya Gazeta', 'Izvestiya', 'Vechernyaya Moskva', and 'Nezavisimaya Gazeta' in terms of efficiency of data

transmission and update. It happens that epubs of materials are often issued in corresponding sections of these mass media on their e-platforms ahead their versions in print. As a rule, columnists of science columns/sections draw information from digests of Russian and foreign news agencies, as well as use their personal contacts with scientists and authorities in the field of science. At least once every 2 weeks these mass media publish interviews with experts in various areas of science and with RAS academicians in particular. Below you will find general characteristics of scientific sections of e-media:

- timely coverage of scientific activities in the Russian Federation, in the first place, in the spheres of cosmonautics, nuclear power engineering, nanotechnology and medical science
- availability of both news and analytical publications
- coverage of RAS activity and its cooperation of public authorities
- quality graphic design in most cases
- availability of feedback option, such as opportunity to comment on the published materials
- probability of factual errors or mere misprints in the released materials and, unfortunately, not prompt enough correction of them.

Back to specialized scientific and popular science media, it is worth mentioning that their authors deal with a bit different tasks since a considerable part of their manuscript backlog is formed with analytical rather than purely news materials. Newsworthy topics are suggested by scientists themselves in the course of the personal communication with magazine editors. And it is them who often play role of authors of the publications and form editorial board of the media. Take notice: the above mentioned publications and newspapers are most commonly issued once a month, except for the weekly newspaper 'Poisk'. Promptness of publications in this case is not the matter of primary concern in their work. However, in recent years, taking into account update of their digital resources, 'Nauka i Zhizn', 'Znanie-Sila' and 'Populyarnaya Mekhanika' magazines have come to update their websites more frequently and timely. Below you will find general characteristics of these resources:

- everpresent availability of a news section
- limited access to the main analytical content
- availability of buying materials with limited access in the online shop of the editorial board
- availability of the calendar of upcoming events in the scientific world, including banner advertisements
- availability of the magazines on popular social media networks, such as Facebook, Twitter, vKontakte (VK)
- feedback option with a reader, such as opportunity to comment on the published materials
- availability of interactive sections, video content and photo galleries on media websites
- availability of mobile applications of publications for modern gadgets
- advertising of subscription to print versions.

IV. AUTONOMOUS ONLINE PROJECTS DEVELOPED BY SCIENTIFIC SECTOR

Autonomous scientific online projects can also be subdivided into two subgroups, such as specialized websites and general information resources, whose list of headings contains Science section. The letter includes popular science sections of such e-media as 'Gazeta.Ru', 'Lenta.Ru', 'Utro.Ru', and 'Pravda.Ru'. Specialized page of 'Russkiy Reporter' mass media dedicated to science is, perhaps, worth adding into this group as well. This magazine belongs to the category of the print media, but its Internet version is not updated as promptly as daily E-newspapers. Nevertheless, 'Science' web page of 'Russkiy Reporter' contains a great number of publications, both of news and analytical nature, and deserves attention of the potential audience.

'Gazeta.Ru' provides extensive coverage of RAS activities on its web site. It is worth mentioning vivid style and clear statement of information from the materials written at meetings of RAS Presidiums. It is really interesting to read them. 'Gazeta.Ru' has own subsections in its scientific newsfeed, such as 'Science and Authorities', 'History', 'Biology', 'Space', 'Social Sciences', 'Physics and Mathematics', 'Lectures', and 'Obscurantism'.

Let's consider online projects about science that are web sites fully dedicated to the field of science. There are plenty of them in the Global network of which many were launched long ago, and overall number of such websites keeps on growing year by year. Unfortunately, quantity of such resources often dominates over their quality. Let's analyze two successfully launched and developed projects.

E-media 'NAUKA I TEKHNOLOGII ROSSII – STRF.RU' was launched in 2005 with the assistance of the Federal Agency for Science and Innovations and the Ministry of Education and Science of Russia. Today this website is one of the most frequently visited by Russian Internet users websites about science. Journalistic materials and information graphics are published on the daily updated website in the following sections, 'Organization of Science', 'Science and Technology', 'Innovations', 'Information Science', Foresight, 'Technological Platforms', and 'Student Forum/HEI-2020'. The site is also available in English version. Below you will find characteristic features of the project:

- e-media content is written by journalists themselves. More than 50 authors, mainly young experts in the sphere of Mass media or other scientific subject, are engaged to work in the project.
- availability of an extensive, up-to-date database of contacts with Russian scientific institutions, including with those in the regions.
- daily monitoring of regional mass media for events occurring in the field of science and education.
- a portion of the content is dedicated to cooperation of scientific community with the authorities, predominantly with the Ministry of Science and Education of the Russian Federation.
- availability of feedback with the potential audience. Readers can comment materials and rate their quality on a 5-point scale. Webpage of 'NAUKA I

TEKHNOLOGII ROSSII – STRF.RUis present in all popular social networks, including Facebook, Twitter, vKontakte, LiveJournla, and Instagram.

E-media 'NAUKA I TEKHNOLOGII ROSSII – STRF.RU' no doubt is a good example of expert popularization of scientific knowledge. In 2010 this media won the All-Russian Contest 'PRO-Education 2010'. It identifies itself as 'the best Internet mass media about science, education and innovations'. It is also worth noting that Russian physicist, RAS Academician, Vice-Chancellor of 'Lomonosov Moscow State University', Aleksei Khokhlov, is one of the authors of this mass media.

Another popular scientific resource Rosnauka.ru was launched only in February, 2015 with the assistance of Technological Platform 'Innovative Polymeric Composite Materials and Technology' and Association of State Research Centers 'Nauka'. This portal is updated almost daily. Apart from standard columns like 'News', 'Publications', 'Events', and 'Videos', it also contains such sections as 'Book Review' and 'Polls'. While navigating the site, the user is offered to answer several questions about the development of science in Russia, for example, 'How necessary is funding of nanotechnology in Russia?', or 'Is Literature science or art?'. 5 of such polls were taken within 3.5 months of work of Rosnauka.ru portal. The results are available online and a user can familiarize himself/herself with them right upon the participation in the poll.

The Book Review section is to introduce readers to popular scientific books which members of the editorial board considered interesting for them. The unified format of book presentation is not yet developed: one publication is accompanied with a too short review, while another ones with detailed reviews of the Russian scientists and scans of their pages. One more drawback is a lack of book year of publication in the reviews.

Just like 'NAUKA I TEKHNOLOGII ROSSII – STRF.RU' website, Internet project Rosnauka.ru is presented in social networks, such as Facebook, Twitter, vKontakte, and Google+. Content of Rosnauka.ru pages in the social networks is identical to that of its main website.

Portal Rosnauka.ru says that 'online editorial board and the best authors work on the site content'. It is worth noting that authors of the project pay a lot of attention to the accessibility of information published on their website to general public. Such headings as Important Discoveries of Russian Chemists Uncovered in mass media, From Plywood Glider to the Stars, 'Laws of Physics in Simple Experiments', 'How to Mine Gold from Litter?', 'Brief Facts. What is New in the World of Russian Medicine?' will be interesting not only to experts in some scientific field, but also to people without specialized education.

Anyhow, Rosnauka.ru project solves high-priority tasks of creation and development of favourable image of the Russian science. Everyday people learn about interesting scientific discoveries, familiarize themselves with Russian scientists, discover new books, and even personally participate in the establishment of scientific trends (here it is implied acquisition

of statistic data and presentation of results). Easily understandable style without excess of scientific terminology, timely updates of the resource, online polls, small number of publications about cooperation between scientists and authorities (in other words – absence of officialism) and focus of user's attention on the science itself. All these factors allow more effective popularization of knowledge among potential audience. Time will show how this portal will develop in future.

Conclusion

So we have considered specific examples of information categories existing in web space in the field of science, such as newsfeeds of the news agencies covering development of science and education, electronic versions of Russian popular scientific mass media and autonomous online projects developed by scientific sector. As one can see, analysis of activities of the resources under investigation proves that in the Global network there is a great deal of projects in the Russian language dealing with popularization of science in Russia. We focused our attention only on the brightest, being in the most demand and fastest growing ones.

However, discussions on promotion of scientific knowledge in the society are going on. Oddly enough, no one is satisfied. Science is little spoken about, modern young people are not interested in technical specialties, science journalism is not revitalized – society has already got accustomed to hear such comments from government officials, scientists, and mass media. And if not the popularization of science then what function do print and online media and resources, such as 'Nauka i Zhizn', 'RIANAUKA', 'Rosnauka.ru', 'NAUKA I TEKHNOLOGII ROSSII – STRF.RU', perform? What do they currently lack for more visible advancement and attraction of more attention from young audience? All the opportunities are clearly visible: swift development of IT-technology, availability of contacts in the area of science, abundance of human resources and even a bit of state funding. Let's say whatever needed, both expertise and monetary assets, are enough. At that the listed media are few. While other popular scientific mass media on the Internet have obvious problems.

These are electronic resources which are to the fullest extent filled with incorrect information. The stories of scientific discoveries may be nicely written and reveal a number of interesting facts, but essentially remain too far from the truth. Such inaccuracies as misspelled names and surnames of the scientists, as well as scientific terms, omission of importance details and incorrect explanation of scientific phenomena are quite often met in the works of authors. Why does it primarily concern online media? There are several factors of applied nature which matter in this case.

It should be taken into account that preparation of the materials for print media, especially in the area of science, requires quite a lot of time. Unlike online resources where speed of data submission, high volume of content and its timely update are extremely important, an article for magazine 'Nauka i Zhizn' can't be written within one hour to be urgently issued in print. Consequently, raw materials written in hustle often forwarded for publishing. The second factor is

an opportunity to promptly negotiate content of the article with a scientist which is essentially non-existent. And finally, such a simple condition as availability of the professional science editors and proofreaders in the staff of the e-media which is as a rule not fulfilled nowadays. All these factors result in a flow of unreliable information and loss of credibility to such mass media among those who have at least a little understanding of some scientific phenomenon. The range of contacts in the scientific world gets shortened as well, since no scientists want to cooperate with the incompetent media.

In the conclusion of our research, with reference to all the areas of online journalism investigated in this article, I would like to summarize the key aspects of further popularization of Russian science in e-media.

- Scientific journalism falls beyond the general outline of immediate acquisition of information. The concepts of instantaneity and speed race do not apply in this case. Any scientific information requires analysis, absorption, assessment of own knowledge and presented data. In this context, staff composition of editorial boards of the news agency scientific departments is especially crucial. The scientific news flows should be handled by highly experienced and intelligent professionals.
- Due to the increasing amount of pseudoscientific knowledge in mass media, it is absolutely important for academic institutions, depending on their scientific specialization, to make official denials of the incorrect facts in the area of science. These documents shall be necessarily published on the websites of the scientific institutions and forwarded in writing to mass media.
- Today both government institutions and entrepreneurs are engaged in science promotion. Unfortunately, it is no more a rare case when popularization is used merely to achieve financial goals in the area of science and innovations. In such cases, only vested interests are promoted, facts are distorted, while expert opinions are absent.
- Popularization of science in the modern context has great opportunities. New communicative technologies and visual aids, options of online search, and emergence of various gadgets boosted development of knowledge promotion. For better cooperation both journalists and scientists should know how to use them, at least at basic level. The requests entered into the web search engines alone determine (and at times even distort) the process of scientific knowledge promotion.
- There is no point in searching a unified formula for scientific knowledge promotion. Science popularization should be target-focused taking into account age and social background of users of information.

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Implementation of New Educational Technologies to Improve Student's Learning Efficiency

Dmitry S. Tananykhin[1], Liliya A. Shangaraeva[2]

Department of Development and Exploitation of Oil and Gas Fields

St.-Petersburg Mining University

St.Petersburg, Russia

[1]dmitryspmi@mail.ru; [2]l.shangaraeva@mail.ru

Abstract — **Nowadays training of students is associated with a decrease in hours of classroom hours, therefore increasing the number of questions on special subjects remains on extracurricular study. The way out of this situation is the implementation of the research-training and project-based training technologies, and Internet technologies. The article analyses the experience of using these technologies, and describes the prospects of their further application.**

Keywords — research-training method; project-based training technology; Internet-technology

> *Bad teacher teaches the truth,*
> *good one – teaches how to find it.*
> *A. Diesterweg*

I. Introduction

Training of specialists in modern conditions, even at full-time education, is associated with an increase of self-study and a decrease of classroom hours. Therefore a lecture can present only the basics of the studied discipline and its key provisions, and during practice only methods of solution for some types of tasks. Independent student's preparation at the Department of Development and exploitation of oil and gas fields of professional disciplines requires working with up-to-date educational literature of oil and gas profile, much of which is scattered across a journal articles. Unfortunately, they often have to deal with a situation when students are not able to orient by themself in the variety of articles and find required and relevant information.

The above factors require implementation of modern technologies into educational process to come out of this specified stalemate, when a student cannot obtain a sufficiently high level of knowledge and skills. These technologies are associated with carrying out together with the students of design and research activities, the implementation of Internet-technologies, enabling experimentation with remote access, as well as writing manuals in electronic form [1].

II. Application of educational technologies at the department

Department of Development and exploitation of oil and gas fields is not the first year engaged in the development of this issue. Currently completed in electronic format (textbooks, course material is in the form of presentations, workshops and e-tests) most courses on special subjects. Assistant professors are 20 students who, on their own initiative, participate in research and project activities.

At the Department of development and exploitation of oil and gas fields are trained undergraduate students of "Oil and gas Business" profiles – "Operation and maintenance of oil facilities", "Operation and maintenance of gas, gas condensate and underground gas storage facilities", "Development of hydrocarbon shelf deposits". The scientific potential of the department aims at development, testing of new approaches to train students. The material base of the department includes the research laboratories.

The main experimental facilities concentrated in the laboratory complex of the department of Development and exploitation of oil and gas fields includes: "Integrated laboratory of enhanced oil recovery", which by itself includes 6 laboratories: preparation of coresamples and reservoir fluids; rheological studies; physics of oil and gas formation; studies of processes of a filtration reservoir fluids; studies of oil disperse systems; studies of the processes of corrosion and salt, paraffin-deposits; "Laboratory simulation of oil and gas development" (class 3D visualization software for modeling oil and gas deposits and software for geological and hydrodynamic modeling of oil and gas fields supplied by company "ROXAR"); "Laboratory of the exploitation of oil and gas wells (with laboratory training stands for the study of wells and a reservoir).

As part of the integration process in 2008 at the training base "Sablino" (Mining University) were commissioned scientific training polygon "Neftyanik" with modern drilling, oilfield and research equipment (automated geophysical, hydrodynamic and other complexes) for curricular field studies training of students; apprenticeship of oil and gas areas; research in the field of drilling, operation and wells workover.

Within a teaching of special disciplines active learning methods stands at the forefront, which assume self-mastery of the knowledge in the process of cognitive activity and continuous monitoring of learning process. For these purposes, "Training class for well remedial work and workover"

(Complete with workover simulator) is used. Widely used in the educational process virtual labs provide opportunities for the development and improvement of professional skill and intuition, as well as developing creativity. The process of laboratory workshop is identical to the works in the real world. Working with a virtual lab allows no large material costs to complete any decisions and to select the optimal way of solution, and then implement it. Virtual labs allow students to consolidate the theoretical knowledge by laboratory work as close as possible to natural conditions, as they are held in electronic analogues of real equipment, involving animation (figure 1).

Fig. 1. A fragment of the virtual laboratory work on discipline " Petrophysics"

Virtual simulators are a highly efficient method of learning, because of their low level of abstraction contained in their training material, in other words, a virtual learning environment in multimedia educational-scientific laboratories maximally mimics real-world conditions.

Visual comparison of various techniques of teaching, including simulation of real activities, gives Professor of the state University of Ohio – Edgar Dale's "Cone of learning" (1900-1985), which is presented in figure 2.
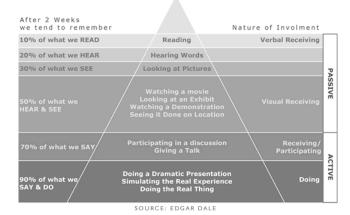
Fig. 2. Edgar Dale's cone of learning

Further improvement of the educational technology is to develop a software system for the implementation of a remote experiment, as well as expanding the range of research. It is also planned to attract students to work on the 3D modelling of oil and gas fields, including the construction of simulation models.

III. ANALYSES OF UP-TO-DATE EDUCATIONAL TECHNOLOGIES

Design and research activities of students - work on conducting their own research involves the allocation of the goals and objectives, allocation principles of methods selection, planning studies course, the definition of the expected results of the study, the definition of the necessary resources. The main result of the research activity is an intellectual product that establishes a particular truth as a result of the research procedures and presented in standard form [2]. The basic idea of the introduction of educational technology is to stimulate students' interest in certain problems, the solution of these problems, the ability to apply practically this knowledge. The analysis of design and research activities conducted at the Department of Development and exploitation of oil and gas fields together with the students allows to distinguish the following main stages:

- information (discussion with the student general issues of interest field of activity, setting goals and objectives of the project, the formation of motivation to implement the project;
- planning (preparation of short-term / long-term research plan);
- search (search and analysis of relevant information on the study subject);
- generalizing (structuring information, data systematization, construction of logical systems, conclusions).
- stage of the presentation and defense (defense, presentation, result).
- Positive aspects of this educational technology are:
- formation of interdisciplinary relations;
- development of the student's self-view of the solution to the problem;
- student's acquisition of knowledge and skills in the planning and execution of the work;
- the experience gained in the course of the project activity, based on the interest and initiative of the students.
- Disadvantages of the technology:
- unequal load on the different stages of activity;
- increase of emotional stress on the scientific supervisor and the student.

IV. CONCLUSIONS

It should be noted that the development of Internet-technologies associated with significant cost and technology itself is quite time-consuming because of the need to create: the quality of electronic versions of training courses, virtual laboratories, allowing conduct laboratory work in real time on

a computer analogy of real systems [3]. In view of the above, we believe that the integration of higher education institutions, research institutes and industrial enterprises is need in the implementation of work in this direction.

The best result of the introduction of educational technology is a new generation of students - internally free, loving and able to creatively apply to reality, to others, can not only solve the old, but also put a new problem, that can make informed choices and independent decisions.

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To the Problems of Engineering Education in Modern Russia

Khazhismel G. Tkhagapsoyev[1], Martin M. Yakhutlov[2]

Kabardino-Balkarian state University (KBSU)

Nalchik, Russia

[1]gapsara@rambler.ru, [2]martin_yah@mail.ru

Abstract— **The situation in the engineering education in the Russian regions is estimated as stagnation (with some recovery and development in megacities) and a prolonged adaptation of the post-Soviet realities. This situation is fueled by a number of adverse factors, including: lack of a national strategy for the development of engineering education in modern conditions; significant differences in the level of development of regions; a low level of R & D (Research and Development) needs and innovation in small and medium business in the regions. A series of measures to overcome the aforesaid situation and the development of domestic engineering education is proposed, including: correction of vocational education development strategy; the transition to a more flexible formats of Federal State Educational Standard; active use of corporate resources in universities; empowerment of universities and profile faculties involved in preparation of engineers.**

Keywords— engineering education; environmental factors in engineering education; stagnation; adaptation; competencies; competency approach; type of knowledge production

Engineering education in our country, unlike many areas of education, as yet adapted to the realities of the post-Soviet [1]. However, the analytic situation is such that all of the extensive problems of Russian engineering education in active discussions focus is only 3-4 its "mainstream" aspects - competence approach [2,3]; a two-level organization of engineering education [4]; innovative economy as a challenge to engineering education [5]; the specificity of the training of engineers in the national research centers, and for the defense industry [6]. It is clear that the marked thematic circle is a "anterior Front" of development of engineering education. But engineering education in the Russian regions, to put it mildly, not avant-garde. Nevertheless, whatever the sphere of engineering affecting in our discourses, appealing to the very broad context of his being: the globalization of the world, the emergence of a knowledge society, to the hypothetical future technologies - regardless of the particular realities in the country.

Discourses on the problems of engineering education has another feature - the assessment on his condition in our country are very different, sometimes - polar. Thus, the authors [7] claim that today "the best Russian technical universities are at the leading engineering centers in the world". At the same time the authors [8, 9] are convinced that our engineering education - in a deep crisis and to overcome it is not enough efforts of the sphere of education, requires specific measures of the strategic plan.

Of course differences in the positions and assessments are inevitable in any discourse. However, "inconsistencies" and contradictions in this case is something more than the usual discourse element. They reflect the complexities and contradictions of the Russian engineering education, still remaining on the stage of adaptation to the post-Soviet economic, scientific and technological realities.

The fact that the Soviet industrial system, which sought for obvious reasons to "technological self-sufficiency", created in Russia large-scale and successful in many areas of engineering education, which in the 90s was "excessive" and already a number of decades existed in stagnation mode, survival and difficult to adapt to the post-Soviet realities. The situation in this regard is particularly difficult in regions that until a proper discussion can not find a common discursive arena of the country - there is clearly dominated by the voice and the "vision of the situation" a narrow range of technical colleges, who managed to "find a place" in the defense industries, which are on the rise in recent years. The result is as follows: in the discourse on the domestic engineering education is still no consensus on the main issues - the nature, range and scale of problem our engineering education and real ways to overcome it. In addition, often overlooked the circumstance that the situation ("degree of stagnation") in various fields of engineering varies considerably. Because, there are many areas of engineering and for this reason the levels of their development, as well as the degree of problematical, differ significantly. So, if the world's production leaders of sophisticated technology (corporation "Boeing", for example) can not do without Russian technology titanium metallurgy and molding processing, and US and Europe astronauts, going to the International Space Station, choose our domestic rocket, the success of engineering and engineering education in these areas (in the directions associated with them) is available. At the same time, the share of machinery, equipment and technology in the structure of Russian exports is less than 5% [8].

Given these circumstances, it is obvious that in the approach to the analysis of engineering education turn is required - from the "global-mainstream view of the situation" and search for "universal methods" to solve them, that now

prevails, to a detailed analysis of the situation in each area of the fatherland engineering.

Clearly, the global context (economic, informational) influences the practice of engineering and engineering education. However, unlike, say, the economic and financial activity, globalization of the world affect the engineering and engineering education in the country only indirectly - through the economic and technological environment in the country. Moreover for engineering education of this "local" (Russia, the regional - provincial, territorial) environmental factors has a determinative significance far greater - because at him directly absorbed the preparatory process engineer. In this sense, it is the difference (sometimes - very large) in the levels of economic and technological development of the Russian regions and generate those problems of engineering education, which currently have the most acute character and require system solutions. And solutions must be sought not only to "the forefront of progress" of the world Engineering Education (to which the whole strategy of the Russian professional education today is reduced), but in the "internal reserves" - in the development strategies of regions or the use of corporate resources of the country's university community. However, the emphasis is on the mechanical reception of "best international practices", although it is obvious that the success of such a strategy is not clear.

Let's start with the Bologna process, which has already been a lot said and written. Undoubtedly, he is working on increase of academic and professional mobility of the future engineer, which importance is hard to deny. However, demand attention and consideration the arguments of those who believe that the Bologna scheme virtually incompatible with the traditions of Russian engineering school, provided in due time output of the first man in space, and so far only lead to a decrease in the level of competence of the younger generation of Russian engineers [11]. A compromise approaches here clearly suggest themselves - for example, giving the university the right to choose their own scheme of engineering education.

Seems unreasonable and actively asserted in discourses the idea of an absolutely dominant (determining) the role of the innovation economy addressed to engineering education. After all, the essence and guise of the innovation economy is far interpreted ambiguously. In some interpretations of the innovation sees only "knowledge society" economy, based on microelectronics technology, genetic engineering, the production of new types of energy, nanotechnology and nanosystem technology; converged on the "nano-bio-info-cognitive (NBIC)" technologies [12]. But the fact that their share of no more than 25-30% of the world economy, in Russia even lower - not higher than 10% [13]. Can the strategy of training of engineers in the country to be guided only on the 10% sector of most developed part of the economy or be constructed only in his interest? Activities of engineer - this is the reproduction of all of the existing production and technical potential of nations and countries of the world.

Of course no one is not calling for conservatism - is disastrous for engineering education. The question is that there is a different ("not radicalist ') understanding of the innovation

economy – as "the economy, the ability to efficiently use all useful for the society and its progress innovations - patents, licenses, advances in science and technological "know-how" [14]. It is obvious that such view on innovativeness of the economy may well be the basis of education strategy for many (if not most) of engineering areas.

Also often raised question is requires close attention: interdisciplinarity and transdisciplinarity as universal mechanisms to improve the quality of training engineers. Of course, the process of engineer training requires overcoming and breaking of the narrow boundaries subject of various sciences, "going beyond their limits." In this sense, the methodology of inter- and transdisciplinary, are guided by the transfer of ideas and methods of some sciences to other [15], is useful in engineering. However, this methodology does not reflect the current situation in the scientific and cognitive practice "post-academic science." Now work on the elaboration of knowledge are increasingly integrated directly into the process of creating, debugging, development and replication of new technologies. In other words, effective knowledge is now produced not only on the basis and methods of the subject-theoretical cognition (followed by inter- and transdisciplinary synthesis), but also in the technological processes that has been called "the second type» (mode-2) production of knowledge [16].

"The second type" of knowledge production is interesting because it provides a ready engineering ("heterogeneous") knowledge. In this regard, typical approach to the choice of metal cutting conditions. As practice shows, at the unthinkable high-speed processing and the unusual properties of the cutting tool that today we have, calculations of cutting conditions based on classical theories are untenable - construction materials processing technology cutting parameters have to identify exactly on the basis of the "second type" of knowledge production, i.e. in the "debug" technology.

And, finally, about the competence approach - it is certainly conceals in itself a lot of advantages. Thus, competences, being designed systematically allow to create what is called "the sighting", a variety of engineering model of engineering education. But the competence approach, unfortunately, has acquired fallacies and myths that generate the illusion of his omnipotence [17]. And according to the author [18] the interpretation of the competencies in existing Federal State Educational Standards (further FSES) - wrong and unjustifiable that dooms higher education in low quality.

Perhaps such an assessment too harsh. However, the abundance of methodological flaws in the implementation of the competence approach by FSES (and based on them) is obvious. It is, above all, to disregard the fact that competence - a measure of activity and its quality. Given this, any competence should be formulated and built so that it expresses the structure of activities and results to achieve its purpose. But in actual practice (in our FSES) reveals quite another - competence is often limited to a formulation of objectives, i.e. "declarations of intentions" or a list of elementary operations "action in a given situation" [19]. As a result, the competence of the "ability to participate" in something (in the choice and

use of materials, the development of production processes, in the preparation of work plans, the development of new products, etc.) in the areas of engineering competence structure preparation sometimes reaches 30%. But the fact that participation - is a form of communication that is not specified (e.g., engineering) activities requiring special training or special skills. Anyone can be a member of some events. In this sense, a promise 'ability to participate "is evidence of uncertainty competencies dictated by the FSES.

This is - just one of the examples showing need to review the role and status of the FSES in the development strategy of higher education in Russia. What is it about?

For overcoming the chaos that emerged in the 90s in the higher school until a certain time and were relevant tools direct impact "from above" on the high school process, including on the basis of prohibitive and restrictive mechanisms, what in fact is current FSES. Now the situation has changed - from the higher school today requires not only compliance the prescribed frameworks as dynamism in the development, innovation and scientific and technological creativity, meets the "time and place" challenges. Here begs standards conceptually orienting and motivating on the development plan, rather than a restrictive-prohibitive. When approaching from such positions, rather signify in the structure of the FSES set (circle) of enlarged competences types (e.g., design, engineering and technology, management, research, service and performance, innovation, marketing, etc.), permission the university the right to detail them at their discretion. With this cases organization changes the meaning of the competence approach - it ceases to be a control mechanism than it is today, becoming a variant modeling tool profile engineer and processes of its preparation- considering environmental (economic, technological) factors "here and now".

And yet, for all the mentioned problems most painful for the modern Russian engineering education remains "insufficient development of the young Russian capitalism" in general and a weak request to Research and Development (R & D) and innovation in small and medium-sized domestic business - especially in the regions. From that most affected universities in the regions ("provincial universities") aimed at align and to raise region culture in the broadest sense - the scientific, professional, technological, industrial and economic. A silent universities and institutions in the regions, edges and republics of Russia, which at one time created a "miracle of Soviet education" and now maintain a tolerable level of mass professionalism in the country - are degraded on a mask background actively declared on the discursive arena of a small circle universities in the metropolitan areas of the country. Is not it time in this context, to complement the existing status hierarchy of universities in the country (national, federal, Research) a system "leading regional universities' in order to each region (country, edge) at least one higher education institution disposal of the resource base and the technologies of the modern university process?

But in general, the situation is such that it is time to seek "compensation" (including non-market) mechanisms to

support regional engineering education. Such mechanism could be, for example, inter-university cooperation (the use of corporate resources). Today this mechanism of development of high school used only sporadically in the interests of scientific research works. More recently, attempts are made implementation of the network form of realization of educational programs, which means the organization of training using the resources of several organizations conducting educational and other activities. Meanwhile, such cooperation, being systematically organized, would make it possible in some measure to solve the acute problem of engineering education in the country - the problem of shortage of the resource base (equipment and technology) for the production and the practical training of engineers.

Probably, it is possible to raise questions about the "new industrialization" of the country, to seek forms of cooperation between the university and industry in market conditions, but in a situation of prolonged stagnation of the domestic engineering industry (which is now the case), and the apparent dominance of the public sector of higher education much more realistic to follow the concentration of resources strategies of university system - on the cooperation and integration of scientific and industrial-technological potential of universities. There are many possible options here. It is possible go, for example, towards the establishment of regional resource centers for Engineering Education. We have some experience of this kind - in the Kabardino-Balkarian State University, together with the Institute of Design and Technology Informatics of RAS created innovative scientific and educational center "High technologies in mechanical engineering", focused on the work (activity) in the following areas: training and retraining of the engineering staff; professional development of scientific and pedagogical staff; the development and introduction in manufacture modern technologies; development of recommendations for a comprehensive rearmament the industrial enterprises of the region [20,21]. We are ready for any form of mutually beneficial cooperation with universities and enterprises, for example, in exchange for providing modern workplaces for passing by students KBSU manufacturing practices.

The foregoing, we believe, gives reason to the following conclusions and suggestions:
1. In our discourses on the problems of engineering education overly prevalent sense of self a small group of relatively successful engineering schools and methodological optics "leading front of engineering in a globalizing world", is strongly demanding a "realistic adjustment" - taking into account the real state of the engineering activity and environmental diversity of its implementation in the conditions of modern Russia.
2. Requires a transition from the current supervisory and restrictive format of the standard, to the standards of the orienting and motivating to development of education, increase of university independence and the profile department in the construction of the model and engineer training strategy.
3. In the content and methods of engineering education should be reflected radical changes in the methods of obtaining scientific knowledge in the general context of developing "technoscience".

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Improve of Technical and Economic Indicators of Complex Technical Products Through the Use of Concurrent Engineering Technology at Design and Technological Manufacturing Preparation

Anna G. Troshina[1], Aleksey N. Ivutin[2]

*Department of Computer technology

Tula State Univercity

Tula, Russia

[1]atroshina@mail.ru, [2]aleksey.ivutin@gmail.com

Abstract – **The article provides information about problems that arise at the stage of design and technological manufacturing preparation and presents the way to improve the technical and economic indicators of the quality of complex products through the application of concurrent engineering technology.**

Keywords- Concurrent Engineering; design and technological manufacturing preparation

I. INTRODUCTION

Nowadays when because of crisis there is a strong competitiveness in different fields the enterprises manufacturing the complex technical products have to meet the needs of customers of these products best way. For this purpose it is necessary not only to ensure high quality of the technical performance of the product, but also to increase the economic efficiency of its manufacture to reduce its cost for the end user.

A specialty of complex technical products is the high percentage of the cost for design and technological manufacturing preparation (DTMP). Decisions made at this stage of the product life cycle define the main technical characteristics of the product and are the basis for all other stages.

Mistakes in pre-production, lead to not only a reduction in the technical attractiveness of the product to the end user, but also can significantly reduce the economic impact (eg, low manufacturability of the design can lead to significant increase of operational time on the manufacturing and increase of production costs, the incorrect material rationing – to high rates of material consumption, technology mistakes – to a high percentage of faulty products and so on [3]). To reduce the number of mistakes made at the stage of DTMP, it is reasonable to reduce the influence of the human factor by implementation of automation.

Another problem of DTMP is the conflict of the professional interests (CPI). Due to the consistency of the life cycle stages results of stage i-1 are the input data of the stage i. This leads to the dependence of the subsequent executors on the results of previous activities. If i-th executor considers the results of the activities of one or more executors from the set 1..i-1 as unsatisfactory it result in the appearance of the conflict of the professional interests.

The most frequently CPI within DTMP occurs between design and technological department. The reason is related with the situation when the design department does not always take into account the technical equipment of manufacturing that even if the design is made according to the expression of requirements can lead to significant increase of the costs for manufacture the product, or even to the actual impossibility of its manufacturing at the enterprise. To achieve optimum technical and economic indicators of the production quality (structural indicators of quality, technology, material consumption, labor intensity, cost price and so on) the work of these departments should be coordinated [2].

II. INFORMATION FLOW MODEL OF DTMP

One of the way to eliminate or at least reduce of the conflict consequences, i.e. reduce the percentage of mistakes caused by human factor is the comprehensive automation of manufacturing. There are many systems for the automation of the various stages of the product lifecycle, from of CAD-systems for designing products to the system of continuous information support of the product lifecycle – PLM (Product Lifecycle Management) that are based on integration and sharing of information at all stages of product lifecycle.

One of the benefits of PLM concept is the possibility of parallel execution of complex projects in several working groups (concurrent engineering). Concurrent Engineering is based on the co-design of products and processes of its manufacturing and maintenance, and it is coordinated by a specially created management team. The research shows that the product development time reduces up to 70% and the time

needed to change the project reduces of the 65-90%. It can be achieved through the integration and parallelism [1].

Integration implies that experts in the functional units who are involved in concurrent engineering process, and other persons concerned should work in close relationship. This integration can affect in the improvement of product quality.

Parallelism reduces time of product development and modification. This is due to the fact that problem solving is done in parallel, rather than sequentially. Using the concurrent engineering concept any problems related to the later stages of the life cycle can be solved at the design stage.

Parallelism includes not only the work of several participants in one stage DTMP (for example, several designers work simultaneously on the same complex product), but also parallel design and technology of the product preparation, that helps to avoid increasing of the number of design changes through timely accounting requirements and remarks from the chief technologist department.

At the current moment there is a steady growth of the market of PLM systems. Some of the most common systems are the following Dassault Systemes, Siemens PLM Software, Ascon, Top Systems with projects in Russia and all over the world.

It is necessary for concurrent engineering to organize the operation of the system of information flows shown in the figure.

Let's consider the diagram provided in figure in more details. DTMP begins with development of the product design, which should be made by the chief designer department (CDD). Descriptions of the products design (specifications, drawings, electronic model of a product), as well as changes to the project are transferred to the chief technologist department (CTD).

CTD performs four main tasks, and often has the relevant division responsible for their implementation:

- Development of technological processes for manufacturing of products (Technical Bureau);
- Development of technical equipment for manufacturing products (Design Bureau);
- Definition and monitoring of compliance with the material rationing (Material Rationing Bureau);
- Preparation of routes through the workshops for the details, as well as route-operating processes (Bureau of Shop-to-shop Routing).

If CTD have any suggestions for design changes in order to improve their manufacturability they sent them to the chief designer department.

After the development of technical documentation all technological routes sheets, material rations, notification of changes, manufacturing technology are sent to the automated enterprise control systems department. Using the system information is distributed to other nodes of the enterprise. If during the pre-manufacturing any divisions of the enterprise have some suggestions how to improve product processing technology, they can be sent to the automated enterprise control systems department.

Every change in the document leads to the issue of the notification of change of the established sample. After that, if the all departments agree with the necessity of the corrective action, staring date when the changes have to enter the force should be agreed. In this case, it is most probable that some division can miss the time when the changes enter the force, and it will lead to premature entry the adjustment into the force by one of the divisions.

Due to above mentioned sequence of information flow comprises many executors it is necessary to create an organizational structure where the information will be readily available in accordance with the right of access.
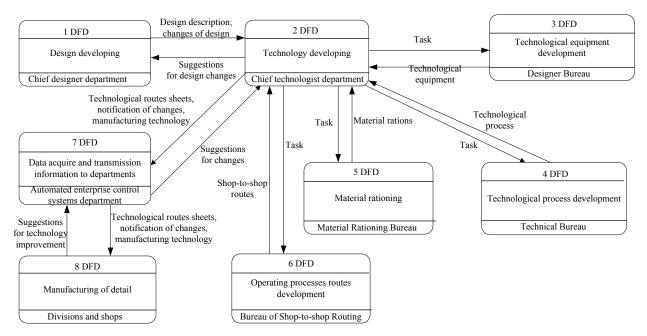
Fig. Scheme of transfer of the design and technological documents

Concurrent engineering technology covers all flows indicated in the figure that allows achieving the high level of parallelization, both in one department and between departments.

III. ADVANTAGES AND DISADVANTAGES OF CONCURRENT ENGINEERING

The main advantages from concurrent engineering are a temporary reduction in costs for DTMP as well as reducing the number of possible mistakes. Thus, concurrent engineering can improve the following technical and economic indicators of the product quality:

1. Automation level – by automation not only design stage, development of technological process and documentation, but also by automation of the process of transfer and approval of the documentation.

2. The coefficient of the efficiency of the interchangeability of certain parts of the product – the developed solutions can be applied more effectively in the design process and can be used as a standard by using the access to the common database of the design and technological solutions.

3. Indicators of manufacturability, namely the labor intensity, material consumption, the cost price of manufacturing – by the development of product design with the optimization according to technological criteria.

However it should be kept in mind that, despite of the above-mentioned advantages of using the concurrent engineering technology, the implementation of such systems to the enterprises faces a number of problems. The enterprise should organize IT-infrastructure with the high-speed networks and up-to-date equipment, solve the problems related to security and the distribution of access rights to users, which can be not only the various production divisions, but also partners, suppliers and customers, regulate the processes of entering the changes into the documents.

In addition, the issues related to the integration of various already existing and applicable in the enterprise systems, as well as design and technological databases containing electronic models, developed technical processes, etc. (probably performed in various CAG systems) appear.

IV. CONCLUSIONS

However, these difficulties do not reduce the attractiveness of this approach to the design and technological manufacturing preparation of complex products and it is necessary to introduce the model of the concurrent engineering concept systems to find the best way to integrate it in any enterprise.

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Interdisciplinary Research

Underlying Education at the Educational and Scientific Facilities for Innovative Economy

Urij L. Zhukovsrij

Department of Electric Energy and Electromechanical
Saint-Petersburg Mining University
Saint-Petersburg, Russia
spmi_energo@mail.ru

Bogdan U. Vasiliev

Department of Electric Energy and Electromechanical
Saint-Petersburg Mining University
Saint-Petersburg, Russia
vasilev.bu@yandex.ru

Abstract—**Direction for innovation-driven development of the native economy is set by energy security. In turn, energy security is based not only on sufficient resources, affordability, environmental and technological compatibility, but also on staff sufficiency. This paper focuses on the role of efficient staffing level in the development of innovative economy. The role of educational and scientific facilities at technical universities and significance of holding interdisciplinary research through the prism of personnel training are shown. Experience accumulated by Saint Petersburg Mining University in the establishment of an education and scientific center "Energy Saving and Energy Efficiency" is described.**

Keywords— education; innovative economy; interdisciplinary research; educational and scientific facilities.

I. INTRODUCTION

Russia's long-term strategic guidelines towards innovative economy determine the development of science and vocational education, and affect all economic realms. Russian economy is based on fuel and energy industry, which provides energy security and energy efficiency for the economic system, and acts as a driver and a goal the national innovative economy should keep moving towards.

Energy security means protection of the country, the citizens, society, nation, and economy against the threat to secure fuel and energy supply; energy security depends on sufficient resources, affordability, environmental and technological compatibility.

However, the said approach to energy security is not complete since it underestimates the role of professional staff in providing that security. Adequacy of resources determines deficit-free physical resourcing, while affordability means economic efficiency of provision of resources, and environmental and technological compatibility imply possible extraction, production and consumption of energy resources. But whether the system can provide energy security if staff shortage is experienced. If the national energy is not effectively staffed, we cannot speak of energy security [1-6].

II. BASIS FOR THE DEVELOPMENT OF THE RUSSIAN INNOVATIVE ECONOMY

First, Energy saving is a comprehensive continuous process, which must be the core of an enterprise. Energy-saving equipment or technology in and of itself can backfire, that is, increase energy consumption if no assessment of influence on functioning of interconnected systems within an enterprise is made. Implementation of energy-saving technologies must be accompanied by comprehensive assessment and monitoring of the implementation outcome. Energy management systems at an enterprise must always control the energy consumption process and make necessary adjustments to the energy efficiency program. The findings of the monitoring should affect the rates of consumption of energy resources during the production process, as well as at the stage of planning of energy costs of an enterprise. It is advisable to regard energy saving and energy efficiency as one of the primary sources of prospective economic growth. For this purpose, the effect to be achieved through technological and organizational measures, including by improvement of the energy management system and energy efficiency, is measured. It is by consolidating the technological and organizational components that we can reduce consumption of energy resources in production processes by 40% by 2020 as compared with 2007.

A crucial link within the system of energy saving and energy efficiency is staff training and advanced training. In the process flow, energy-saving equipment and energy-efficient mechanisms can be employed, or innovative solutions implemented, however, all this is controlled and managed by humans. Unless possessing adequate skills and knowledge, personnel cannot realize how the decisions they take may affect the process of inefficient use of energy resources. Staff of a modern enterprise must be aware of the energy strategy followed by the enterprise and by the state in general, the information must be communicated in understandable terms not only to energy professionals, but also to the staff of all departments, since inefficient consumption at a workstation may impair the overall energy saving process. Development of knowledge-intensive technologies gains a high momentum,

book skills obtained from a university become obsolete before you know it, so, equipment must be upgraded in step with personnel knowledge and with teachers' knowledge in the area. The government-funded program "Development of Education for 2013-2020" is targeted at the highest standard of the Russian education, meeting fast changing public demands and the prospective challenges the Russian people and economy face. In the modern world, which rapidly develops, the educational system must keep pace with galloping knowledge-intensive technologies and be as mobile and effective as possible. Mobility of the educational system suggests that the constantly extending area of scientific knowledge dictates how to manage the process of training, retraining and advanced training of specialists, bachelors, and masters.

To create an "energy-efficient society" in Russia is not a task to be solved for a year or two, this will take decades. The challenge must be seriously discussed within the system of higher education, starting from the first year and bringing the student gradually to the technologies to be used when implementing the energy-saving approach at an enterprise. Creation of an innovative society in Russia requires continuous learning in the area of energy efficiency, therefore, the centers teaching advanced innovative technologies are of paramount importance.

III. ENERGY SAVING AS A BASIS FOR INNOVATIVE ECONOMY OF RUSSIA

Energy saving is a comprehensive continuous process, which must be the core of an enterprise. Energy-saving equipment or technology in and of itself can backfire, that is, increase energy consumption if no assessment of influence on functioning of interconnected systems within an enterprise is made. Implementation of energy-saving technologies must be accompanied by comprehensive assessment and monitoring of the implementation outcome. Energy management systems at an enterprise must always control the energy consumption process and make necessary adjustments to the energy efficiency program. The findings of the monitoring should affect the rates of consumption of energy resources during the production process, as well as at the stage of planning of energy costs of an enterprise. It is advisable to regard energy saving and energy efficiency as one of the primary sources of prospective economic growth. For this purpose, the effect to be achieved through technological and organizational measures, including by improvement of the energy management system and energy efficiency, is measured. It is by consolidating the technological and organizational components that we can reduce consumption of energy resources in production processes by 40% by 2020 as compared with 2007.

A crucial link within the system of energy saving and energy efficiency is staff training and advanced training. In the process flow, energy-saving equipment and energy-efficient mechanisms can be employed, or innovative solutions implemented, however, all this is controlled and managed by humans. Unless possessing adequate skills and knowledge, personnel cannot realize how the decisions they take may affect the process of inefficient use of energy resources. Staff of a modern enterprise must be aware of the energy strategy followed by the enterprise and by the state in general, the

information must be communicated in understandable terms not only to energy professionals, but also to the staff of all departments, since inefficient consumption at a workstation may impair the overall energy saving process. Development of knowledge-intensive technologies gains a high momentum, book skills obtained from a university become obsolete before you know it, so, equipment must be upgraded in step with personnel knowledge and with teachers' knowledge in the area. The government-funded program "Development of Education for 2013-2020" is targeted at the highest standard of the Russian education, meeting fast changing public demands and the prospective challenges the Russian people and economy face. In the modern world, which rapidly develops, the educational system must keep pace with galloping knowledge-intensive technologies and be as mobile and effective as possible. Mobility of the educational system suggests that the constantly extending area of scientific knowledge dictates how to manage the process of training, retraining and advanced training of specialists, bachelors, and masters.

To create an "energy-efficient society" in Russia is not a task to be solved for a year or two, this will take decades. The challenge must be seriously discussed within the system of higher education, starting from the first year and bringing the student gradually to the technologies to be used when implementing the energy-saving approach at an enterprise. Creation of an innovative society in Russia requires continuous learning in the area of energy efficiency, therefore, the centers teaching advanced innovative technologies are of paramount importance.

IV. ROLE OF EDUCATIONAL AND SCIENTIFIC CENTERS IN THE DEVELOPMENT OF RUSSIA'S ECONOMY

A higher educational institution should pay great attention to educational and teaching activities in the area of energy saving and energy efficiency. From 2010, the Mining University has implemented the concept of continuous education in energy saving. Within this approach, the university established the educational and scientific center "Energy Saving and Energy Efficiency", with the target audience represented by specialists of enterprises, students, and postgraduate students.

The educational and scientific center "Energy Saving and Energy Efficiency" is required to implement up-to-date advanced educational programs in the field of innovative technologies of improvement of energy saving and energy efficiency for energy systems of enterprises of the mineral resources sector by training scientific and engineering staff able to deal with advanced energy management technologies. All scientific research results are integrated into the training programs of continuing vocational education implemented at the premises of the Mining University, as well as into the students' curricula.

Educational and scientific programs are formed according to the current trends in the development of the mineral resources sector as dictated by significant demand for highly skilled scientific and engineering professionals. Just within the only top-priority focus area "Energy Saving and Energy Efficiency", over recent years, the following topical areas have

been created, these are the monitoring system for energy efficiency at enterprises; wind-driven generator; instrument package for analysis and research of electrical power and electro-mechanical devices; energy saving by means of electrical drive; solar power generation; automation; smart systems. Right from the first year, the students are introduced to the fundamentals of electric energy saving. This, in turn, allows for understanding the necessity of sustainable use of energy resources. Energy saving must form good habits, both in daily life and work, with prospective students, bachelors, masters, and scientists.

Within advanced training in the field "Energy Saving and Energy Efficiency", workshops at production sites of innovative enterprises in Saint Petersburg are conducted. The auditors are provided with an opportunity to visit unique testing laboratories and design office, as well as to take part in round tables dedicated to exchange of experience in development and implementation of energy-saving projects. Permanent education focused on top-priority branches of science and cooperation with production activities will allow for achievement of the government-set goal of reduction of energy costs during production processes by 40% by 2020, since at least one third of the problem can be solved just by changing human attitude to resource consumption. Energy saving must become a permanent process for all people, which can be achieved only through a lifelong learning process.

V. Role of Interdisciplinary Research in the Development of Economy

Modern electrical units of industrial facilities represent a complex aggregate of electric devices. In most cases, such units include power and data management components.

For instance, let us consider the structure of an electrical unit of subsea carriage of hydrocarbons offshore. Prospective types of such units are constructed according to a mechatronic principle, that is, by integrating certain components into a single capsuled body, such as an actuating unit (multiphase pump); actuating unit drive (asynchronous drive of special design); operating mode power controller (semiconductor frequency converter); bearing units (active magnetic suspension apparatus); automated control system (electric power supply system), etc.

As it can be seen from the brief description of the subsea pumping aggregate, in order to analyze energy processes, develop certain measures to improve energy efficiency of these processes, and to achieve a high energy-saving level, experts must not only possess knowledge in electrical machine building, semiconductor equipment, microprocessor control and programming systems, and hydrocarbons carriage procedure, but also have a deep understanding of interconnection and mutual influence of the components of the unit.

To that effect, it is necessary to integrate new interdisciplinary courses based on the relevant fundamental and applied interdisciplinary research into the personnel training process. The issue of academic and scientific and research support of the said courses and disciplines becomes urgent as well. To carry out interdisciplinary research and education, the abovementioned educational and scientific centers are required.

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Flowering Plants Pollination Robotic System for Greenhouses by Means of Nano Copter (Drone Aircraft)

Renat N. Abutalipov[1], Yuriy V. Bolgov[2], Hamisha M. Senov[3]

Department of Mechatronics and Robotics

Kabardino-Balkarian State University "KBSU"

Nalchik, Russia

[1]dxssster@gmail.com, [2] yuriy6601@mail.ru, [3]XMSenov@mail.ru

Abstract— **Pollination is the vital process for all flowering plants. But, unlike animals, plants cannot move in search of the partner, and they should rely on the help of external forces like wind, water or insects that transfer pollen to other plant for creation of new seeds. In spite of the fact that external environment is capable to provide pollination of plants it is not enough for intensive agricultural production. In this regard there is a need of searching a new more efficient pollination instrument to increase productivity of crops. The article argues that the simulated pollination of agricultural plants by means of nano copter can provide collecting and delivering pollen in the mode of automatic control. A design of nano copter for pollination can be made on the basis of innovative modification of existing model by its reprogramming with regard to its flight controller that is to be fully adapted to computer interface. The robotic system is offered specially for artificial pollination in conditions of greenhouses and minor agricultural enterprises.**

Keywords— robotic system; drone; greenhouses; pollination; nano copter

Pollination is the vital process for all flowering plants. But, unlike animals, plants cannot move in search of the partner, and they should rely on the help of external forces like wind, water or insects that transfer pollen to other plant for creation of new seeds. In spite of the fact that external environment is capable to provide pollination of plants it is not enough for intensive ag-ricultural production. In this regard there is a need of searching a new more efficient pollination instrument to increase productivity of crops. The article argues that the simulated pollination of agricultural plants by means of nano copter can provide collecting and delivering pollen in the mode of automatic control. A design of nano copter for pollination can be made on the basis of innovative modification of existing model by its reprogramming with regard to its flight control-ler that is to be fully adapted to computer interface. The robotic system is offered specially for artificial pollination in conditions of greenhouses and minor agricultural enterprises.

Pollination is the vital process for all flowering plants, and the nature took care a lot to make it success.

Unlike animals plants cannot move in search of the partner and rely on the help of external forces (wind, water, insects) to transfer pollen to other plants (or other parts) for creation of new seeds.

Pollination is important for a plant because preservation of its look depends on it, while cross-pollination, when pollen is transferred onto a pestle of the flower of the same plant or the other's one presenting the same look can lead to mutation which will help this look to adapt to a surrounding environment better.

In spite of the fact that external environment is capable, though in small degree, to provide process of pollination, its volume is not obviously enough in the modern conditions of intensive agricultural production. In this regard there is a need of searching of paths for increasing productivity of crops.

The existing ways of pollination are rather labor-consuming and low productive depending on insect's pollinators, moreover they are injury-causing and ineffective. It is possible to eliminate defects of these ways of pollination of various plants in the open and closed soil (greenhouses) by means of the drone-copter, a pilotless aircraft with distance steering [1]. Such copter is characterized by its small size, weight and high maneuverability. There is a set of programming references for an automatic flight control of a copter both via the flight controller and onboard computing platform [8; 12]. Copter can be equipped with various hanged inventory (mainly the camera and the microphone), and also can transport containers with freight [5]. Program control by a copter allows to make various operations as with hinged inventory (first of all it is data exchange with the operating system: transfer of the image and sound), and with wearable freight [6].

Scientists investigate a possibility of implementation of groups of copters as a swarm of for pollination of plants [2] now. Recently there has been designed an super-micro (nano) copter that has been widely adopted around the world [9].

Nano copter differs in dimensions and smaller weight compared with a routine copter, its size does not exceed 10 — 15 cm, and weight is less than 100 g, while the same principle of management is applied. Besides, the nano copter is cheaper than the routine model.

Copters with their rather big weight and rigid housing due to their propellers quickly rotating constitutes danger of collision which can easily happen at shutdown of power supply making them uncontrollable [11].

The operating flight controller demands the difficult adjusting and uses various flight modes that makes management of a copter risky [10].

Nano copter is deprived of these shortcomings because its weight is small (about 40 — 50 grams)as well as its size (within 10 — 15 cm). Taking into consideration its dimensions a nano copter is similar to a large insect, for example, a butterfly or a humming-bird. It is prime in management and is safe. Dimensions and maneuverability of a nano copter allows to carry out the same movements and fly on the same trajectories as natural pollinators, and it is also possible to do with an automatic control [4; 7].

Nano copter can artificially pollinate plants, flying from one flower on another, collecting at the same time pollen and transferring (delivering) it on other flowers in 4 stages.

At the first stage the nano copter climbs a high arch with an inclination towards a stalk of a plant and reaches a flower in 1 — 2 seconds.
At the second stage the nano copter in the mode of automatic control makes positioning of a housing for the subsequent collecting / transfer pollen.
At the third stage at lag over a flower the automatic controller processes a pestle by the hanged equipment for pollen collecting / transfer.
At the fourth stage automatic control updates data of positioning and then lifts the nano copter from a flower for a flight to another flower.

Automatic control uses preliminary obtained coordinates of flowers received from the external source containing data array of aerial photograph showing the arrangement of plants. These data are processed by the program of mapping and updated in real time by results of positioning of a nano copter.

Thus, the nano copter can make simulated pollination of agricultural plants, collecting and delivering pollen in the mode of automatic control, using these aerial photographs of an arrangement of flowers for coordination its trajectory with regard to plants location during its flight.

Nano copter for simulated pollination of plants can be made on the basis of a standard nano copter by modification of his design, reprogramming of the flight controller and changing of a control unit for computer interface.

The main changes are those of functions of the flight controller, namely, automatic flight on the given points (modification); return to a take-off point, autolanding (modification); deduction of height and position (modification) [4].

All specified modifications are aimed at a possibility of an automatic flight control and are made on the basis of ready software solutions and represent the padding modes of flight.
Considering such features of a nano copter as small dimensions and, therefore, low resistance to demolition downwind, the nano copter can be used for greenhouses and hotbeds on the closed soil [4].

The utilization of a nano copter will allow to automate the main part of process of simulated pollination of plants, to eliminate dependence on insects pollinators, to increase effectiveness of process of simulated pollination and to provide independence of process of pollination of weather conditions

The innovative nano copter will be able to make simulated pollination of agricultural plants, collecting and delivering pollen in the mode of automatic control, using these aerial photographs of an arrangement of flowers for coordination of its situation concerning plants when flying.
Reprogramming of computer interface for the nano copter on the basis of a standard drone by means of its modification will allow to develop a flight controller and change its control unit. Thus, automatic flight on the given points, return to a take-off point, autolanding and keeping the height and position is achieved.
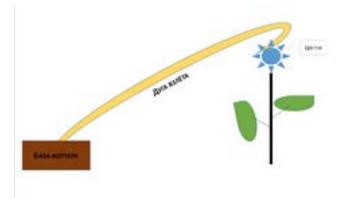
Fig. 1. Stage 1: the copter climbs a high arch and reaches a flower

Fig. 2. Stage 2: the copter positioning
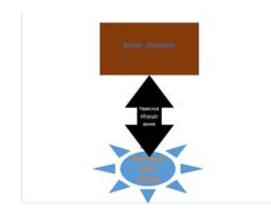
Fig. 3. Stage 3: the copter makes pollination
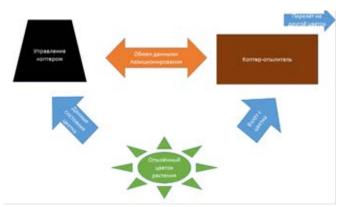
Fig. 4. Stage 4: automatic control updates data positioning
and the copter flies to the next flower

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Modeling of Nonlinear Rebuff Grounds by Finite Element Methods

Amirkhan Ya.Dzhankulayev[1], Zalimkhan R. Likhov[2], Alimbek A. Dzhankulayev[3], Islam A. Kaziyev[4]

Polytechnic Institute

Kabardino-Balkarian State University "KBSU"

Nalchik, Russia

[1]itf@kbsu.ru, [2]zalimhan@mail.ru, [3]alimdj@yandex.ru, [4]Kaziev1969@mail.ru

Abstract- **The article suggests modeling method with the resistance of various nonlinear factors for use in the finite element method, we find basic matrix relations that enable you to stepwise-iterative calculation.**

Keywords- nonlinear; finite element method; rebuff

I. INTRODUCTION

At a conclusion of a matrix of rigidity of the final element (FE) an important stage is the choice of model of the basis taking into account its real properties [1]. It is difficult to consider the difficult diverse phenomena in foundations of the bases occurring at their operation in strength and deformation calculations. Therefore various models of the basis are used. In MKE of the most widespread the linear model which does not consider the real properties of the basis depending on many factors is. In this regard we will set coefficient of a bed in the form of functional dependence

$$C = C(W, t).$$

(1)

II. OBJECT OF STUDY

Here $W = W(x, y)$ – KE rainfall in the plane of the basis, t – other possible factors influencing properties of soil in the basis (time, humidity, temperature). Repulse of the basis is accepted in the form of [2]

$$P_f(x, y) = C(W, t) W(x, y).$$

(2)

We set a form of a bend of KE in the form of [2]

$$W(x, y) = [S]\{q\}$$

(3)

where $\{q\}$ – a vector of the generalized nodal movements, $[S]$ – a matrix components of which are the functions defining KE draft form. Then (1) it is possible to write down in a look

$$C = [N][S]\{q\}.$$

(4)

Here [N] – the matrix containing functional dependences of coefficient of a bed on the chosen parameters considering soil work.

Taking into account (3) and (4) we will rewrite (2)

$$P_f(x, y) = [N][S]\{q\}[S]\{q\}.$$

(5)

Potential energy of the basis of KE at the same time has an appearance

$$U = k \iint_F P_f(x, y) W(x, y) dF.$$

(6)

or

$$U = k \iint_F [N][S]\{q\}[S]\{q\}[S]\{q\} dF.$$

(7)

From (7) we receive expression for a matrix of rigidity of the basis

$$[K]_f = \iint_F [N][S][S]\{q\}[S] dF.$$

(8)

Elements of a matrix $[K]_f$ are defined with an unknown vector of the generalized nodal movements, i.e. directly they cannot be found. In this regard it is possible to use a step and iterative method of calculation, having allowed at an initial step equal to zero a vector {q}. At the same time the matrix [N] has to correspond to elastic work of the basis. Each following step a matrix of rigidity of the basis is calculated by an iterative formula

$$[K]_f^i = \iint_F [N][S][S]\{q\}^{i-1}[S] dF.$$

(9)

We receive a matrix of rigidity of KE on each step in the form of the sum [3]:

$$[K]_o^i = [K] + [K]_f^i,$$

(10)

$[K]$ – a matrix of rigidity of KE of a plate without repulse of the basis. It is determined by the known integral

$$[K] = \iiint_V [B]^T [D][B] dV.$$

(11)

If in calculations physical or geometrical nonlinearity of the KE is not considered, then $[K] = const.$

Size $\{q\}^i$ is defined from the main equation of MKE:

$$[K]_o^i [q]^i = [F].$$

(12)

Step iterative process of calculation of a construction in interaction with the basis is based on the equations (9), (10), (12) and quickly enough meets.

III. CONCLUSIONS

The offered method allows to create more exact of final and element model taking into account various factors of repulse of nonlinear character in foundations of buildings and constructions. At the same time the method does not lead to complication of computing operations.

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Portable Device for Automatic Control of Hemodynamic and Biochemical Blood Parameters

Alina D. Elbaeva[#1], Raisa I. Elbaeva[*], Khamisha M. Senov[*]

[#]Medical Faculty;[*] Polytechnical Institute

Kabardino-Balkarian State University

Nalchik, Russia

[1]ajqueen24@yandex.ru

Abstract — **The establishment of reliable methods and devices for monitoring hemodynamic and biochemical parameters of blood is an urgent problem of modern medicine. New automatic device, whose work is based on modelling correlation parameters of systemic hemodynamic and blood biochemical indices, was designed and fabricated. The device can be used to measure arterial pressure, heart rate and blood glucose concentrations at patients with arterial hypertension and diabetes type II.**

Keywords- modelling; correlation; arterial pressure; diabetes mellitus; blood glucose; diagnostics

I. INTRODUCTION

Monitoring of hemodynamic and biochemical indices of blood, including blood pressure and blood glucose concentration in the diagnostics of cardiovascular diseases and disorders of carbohydrate metabolism, is an important problem of modern medicine [1, 2]. Laboratory diagnostics uses most commonly standard blood chemical research methods using biochemical analyser and enzyme kits [2]. Direct analysis of the invasio is based on the direct study of the drop of blood to get a result.

However, such analysis is associated with risk of entering additional infections, trauma to the patient, not convenient for daily use. The hand-held devices, the main link which is the test strip (sticker) with printed on it, or reagent biosensor, which changes color or different characteristics when exposed to blood are used for operational analysis. Most famous glucometers «One Touch Ultra Easy», «Trueresult Twist», «Akku-Check active», «One Touch Select Simple», « Akku-Chek mobile», «Akku-Check Performa», «Circuit TC», «Diacont» [http://ilive.com.ua/health/reyting-glyukometrov-ili-kakoy glyukometr-luchshe].

The disadvantages of these devices include the need to use the indicator test strips and additional appliances for blood collection because analysis is carried out invasive. In addition, the production indicator test strips increases the cost of testing greatly.

A promising direction is the development of noninvasive diagnostic devices (without blood sampling) for the study of the concentration of blood glucose. The devices use methods based on the use of electromagnetic rays similar to infrared frequencies or to infrared spectrum, fluorescence intensity measurements and eye lenses, dispersion methods geometric asymmetry of glucose molecules, which changes the light rays, causing a process called "circular dichroism" [3, 4]. However, these methods do not provide the required accuracy and security, are characterized by high complexity, so devices on their basis are not available yet.

II. AIM

The aim of the work was the creation of a new automatic device for noninvasive monitoring of hemodynamic parameters the blood and blood glucose levels.

In the proposed research method the diagnostics of carbohydrate metabolism is based on the correlation of indicators of systemic hemodynamics and blood glucose concentration. Such a relationship can be explained by the presence of pathogenetic correlation between arterial pressure levels and impaired carbohydrate metabolism at patients with arterial hypertension and diabetes mellitus [5, 6].

Modern computer programs and methods of mathematical modelling provide the opportunity to conduct analytical studies, processing large amounts of data and criteria of the studied correlations. An integrated approach to oscillatory hemodynamic processes, including blood pressure parameters, allows defining the criteria of the relationships for noninvasive monitoring of biochemical parameters of blood in medical practice [7].

III. MATERIAL AND METHODS

Statistical processing of the results of the survey were subjected to 182 the healthy and the sick, including those with type 2 diabetes mellitus and arterial hypertension in age from 42 to 70 years (mean age 50.4 ± 6.8 years)of disease duration up to three years. Arterial pressure (AP) was less than 160/100 mm Hg., fasting blood glucose level was less than 15 mmol/l. During patient's examination AP was measured with an accuracy of ± 2 mm Hg in sequence on the left and right hands on an empty stomach in the morning at 8:00 am and after a meal at 10:00 and 1:00 pm. Immediately after the AP measurement, the biochemical studies were performed on the analyzer Vital Diagnostics for the determination of blood glucose with an accuracy of ± 0.05 mmol/l. Computer processing of the survey data was performed.

IV. RESEARCH RESULTS

Laws of the relationship between blood glucose level and AP parameters were established during functional multivariate analysis using program "Statistica" by graphoanalytical method. The optimal criterion was chosen to characterize the correlation. Arterial pressure coefficient (C_{AP}) is the ratio of

the average systolic AP ratio to diastolic average AP, measured at the left and right hands.

Previous research has been shown that C_{AP} has a high coefficient of correlation with glucose measurements on empty stomach and after meals (r = 0.74-0.845) [8, 9]. As a result of the analysis of the survey data the mathematical regression equation adequate baseline data obtained. Graphic dependences, reflecting the relationship of blood glucose concentration and the C_{AP} at measurements on an empty stomach and postprandial are shown in Fig. 1
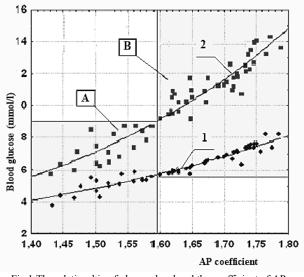
Fig.1 The relationship of glucose level and the coefficient of AP:
1-on an empty stomach; 2-postprandial;
A - Distribution of values of a normal level;
B - Distribution of values increased

The regression equation to describe the relationship of glycemic levels and the AP coefficient was invited:

$$Y = к*\exp(m*X),$$

where Y – blood glucose level, mmol/l; X – AP coefficient; k, m – regression coefficients.

The values of the regression coefficients are calculated depending on the time of analysis: when measuring fasting k = 0. 36 -0.39; m = 1.64 -1.77 (p < 0.001); when postprandial measurements k = 0.15 -0.17; m = 2.33 -2.43 (p< 0.001).

On the basis of research recommendations for distribution of values of normal and elevated blood glucose in the measurements on an empty stomach and after meals were established (fig. 1). The coefficient of AP from 1.35 to 1.6 corresponds to normal levels of fasting blood glucose from 3.5 to 5.5 mmol/l and from 5.5 to 9 mmol/l after meal. The coefficient of AP from 1.6 to 1.8 corresponds to increased fasting blood glucose over from 5.5 to 8 mmol/l and after meal from 9 up to 15 mmol/l.

Patent for an invention RU № 2368303 "Noninvasive method for determining the concentration of blood glucose" was obtained [10]. It is used in the development of portable device for automatic control of hemodynamic and biochemical blood parameters. The device allows an automatic control of

AP and noninvasive way to measure blood glucose levels. Patent for an invention RU № 2317008 "Device for noninvasive determination of the concentration of blood glucose" was obtained [11]. General view of the device is shown in Fig. 2

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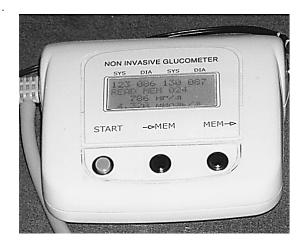
Fig. 2 Device for automatic control of arterial pressure and blood glucose

V. DEVICE STRUCTURE AND OPERATION

The device contains case with control panel and display, battery compartment power supply, attached mechanically compressor cuff to measure AP. On the front of the case there is a keyboard with buttons, liquid-crystal display indicator. The device is connected to the digital unit to enter information "on an empty stomach" or "after a meal". This unit is connected to microprocessor by conductor cable. Inside the case functional pneumatic blocks are placed connected by flexible hoses: forcing air compressor, pressure relief valve, pressure sensor, orifice to release the air. The electronic module is integrated to the case in the form of integral control board. The microprocessor, power keys for managing the process of forcing air, pressure sensor signal amplifier, analogy-digital 12-bit converter are mounted on it.

In patients' examination the systolic and the diastolic AP is measuring automatically consistently on the left and right hands on an empty stomach or after eating. The parameters are stored in the memory of the microprocessor. By pressing the control button microprocessor automatically starts the appropriate application program to determine the blood glucose level on an empty stomach or after eating.

Table correlations were laid on the basis of empirical formulas in microprocessor memory. They are used to determine the blood glucose level [10]. The microprocessor software is the computer program in DELPHI 5 OBJECT PASKAL language. The parameters on the device display are: AP on the left and right hands, pulse rate, blood glucose on an empty stomach or after a meal.

The device has two scales: OFF and ON. Scale OFF is used when measuring on an empty stomach. It appears when patient clicks on the button "Start" on and off itself through

1.5-2 minutes. Scale ON measurements are used after eating. Information "fasting" or "after a meal" are gaining on the digital block and entering by pressing "Enter" on the keyboard to control the microprocessor. Dialled parameters are reflected on the liquid-crystal display and are stored in the microprocessor memory.

AP was measured on the left arm of the patient, securing compression cuff on his left shoulder. Pressing the button "Start" will begin inflating the cuff. Specify pressure mode is depending on the possible value of the upper (systolic) patient's AP and adjust by pressing the "Start" button on the keyboard. Upon reaching the AP of 180 mmHg inflating the air stops, the screen displays readings of systolic AP and diastolic AP on his left arm which are stored by pressing the "Memory" button. Similarly, AP measurements are performed on the right hand, and then on the screen displayed readings of systolic AP and diastolic AP on the right arm. Indicators of study are read on the screen of the device: pulse; sugar (mg/dl); sugar (mmol/l). Translation: 1 mg/dl = 0.055 mmol/l.

The device provides the measurement AP range from 20 to 250 mmHg, blood glucose levels from 3.0 to 25 mmol/l. Accuracy of AP measurement is ± 3 mmHg; error of measurement of blood glucose ± (15-20%). The duration of AP and the blood glucose level measurement is 30-50 sec.

We made a prototype of the device, which confirmed the possibility of its industrial manufacturing and practical use. Overall dimensions of the device are within the 180 x 150 x 80 mm.

VI. CONCLUSIONS

The result of the work is to create a new portable device which provides automatic measurement of AP and of blood glucose level by noninvasive method with accuracy ± (20%)-15 in comparison with biochemical analysis that meets the requirements [2].

The device is safe to use because the examination of the patients is to measure the AP is with elastic cuffs, not injuring the patient's skin. This achieves reduction in time to complete the analysis due to the fact that the calculation of the blood glucose concentration is performed using a microprocessor, an application and the correlations table. The proposed portable device can be used in hospitals, as well as for individual self-control AP and violations of carbohydrate metabolism in diabetes mellitus, arterial hypertension and other cardiovascular diseases.

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Aspects of Circuit Design and Design EM with Regard to Electromagnetic Compatibility

Nikolay N. Grachev[#], Sergey S. Safonov[*]

[#]Department of Electronic Engineering, [*]Department of Computer Engineering
National Research University Higher School of Economics
Moscow, Russia
[#]nngrachev@mail.ru, [*]ssafonov@hse.ru

Abstract—**The work deals with issues of noise immunity and immunity in view of circuit design and features of electronic means. The paper shows the possibility of using the criteria of noise immunity and noise protection in the design of EM. The present approach allows us to formulate the design algorithm noise immunity EM with a predetermined criterion for noise immunity.**

Keywords—*noice immunity, noice protection, electromagnetic compatibility, electronic means*

I. Introduction

The problems associated with exposure to electromagnetic radiation that affect the operation of electronic means (EM), funds management and control of industrial systems for a long time to decide on the level of primitive ingenuity, which in most cases, with varying degrees of success, allowed to solve these problems. However, experience has shown that the same methods and tools that bring success in some cases, are useless in others.

Provide noise immunity and noise protection as a comprehensive task of ensuring the quality of the projected Electric, in its formulation provides a solution to the optimization problem. In this formulation, the problem is extremely complex and it is necessary to investigate the methods of design as a whole, while the problem of noise immunity solved for separate blocks nodes. At the stage of designing the basic methodology is to provide noise immunity designed product with inherent immunity.

Moreover, given the noise immunity defined circuit design principles and methods of their implementation of the circuit, which are incorporated electrical circuits developers. In this regard, the designer appears primarily designed equipment providing constructive interference resistance means, i.e. constructive design electrical circuits. But the actual construction involves the use of various design solutions characterized by weight and size and cost parameters.

The same should be said about the cost of funds at the given initial noise immunity designed hardware (complexity of circuit design) is a solution of the optimization problem on the weight and size, cost, etc. criteria. Thus, the designer task is a variation of the means and methods that provide the predetermined level noise immunity.

II. Object of Study

Development of EM for EMC noise immunity provides knowledge of the functional units, the principle of their operation, and the design of the blocks requires a detailed analysis of the structure, components, electronic components with regard to their susceptibility to electromagnetic influences and equally effects sources.

In this regard, it is necessary not only to establish an effective arsenal of anti-interference, but also the application of a systematic approach to designing noise immunity EM. It is unacceptable that, until recently, there is no methodology in the design noise protection EM, taking into account the organizational and technical, circuit engineering and design aspects of the design. Thus, the provision of the EMC is none other than the quality of software that must be set and achieved during the development and design of the relevant EM.

To assess the quality of EM in respect of electromagnetic compatibility (EMC) noise immunity seems necessary to use the concept of [1.2]. Immunity some electronic means is determined as follows:

$$N = Hh \tag{1}$$

where N - noise immunity of electronic equipment (system);
H - the effectiveness of methods to increase noise immunity;
h – parameter characterizing the effectiveness of the protection methods.

Enhance immunity EM can either increasing the effectiveness of protection h or noise immunity, or both. H setting provides a circuit design methods, the parameter h - design and technology.

System approach to design of EM leads to complex solutions ensure EMC problems at different levels in two main areas - improving noise immunity and immunity receptors and reducing interference in their energy sources and the propagation medium. In this formulation, introduction of

criteria characterizing EMC is necessary. The existence of a defined noise immunity *N* criteria specified by defining criteria *H* and *h* is a criterion equation which characterizes the quality of the projected EM EMC products. In this case, the criteria can be a numeric value, and some of the functional dependence.

Considering the variety of EM can with reasonable assumptions highlight two main classes - EM analog and digital. Mechanism distortion and attenuation signals as well as occurrence of interference in the analog units is the same as in the digital nodes. However, long lines are electrically in analog nodes only for UHF and HF in a predominant electrically short. Processes occurring in the analog EM usually described by means of the signals represented in frequency domain (spectral density characteristic). This analysis of the frequency characteristics of EM submitted multipoles with their transfer characteristics.

The digital nodes basic processes occurring in them, describes a time-domain signals (switching time delay, multipath, etc.). In this regard, the selection criteria for EMC analog and digital EM advisable to use frequency and time characteristics. Any mathematical description of noise immunity performance is a simplification of the actual situation (homomorphism). This simplification can be achieved by focusing on the most important conditions (dependencies) and exclude the others, for this study, non-essential.

Thus, in the spectral representation concentrates on a part of the signal frequency, and time dependencies are excluded. It is clear that the relationship between the parameter of the original signal and its homomorphic models are not equal (as with isomorphic), because they cannot be re*ver*sed (converted from the original model for the other). In this case you need to clearly evaluate the limits of applicability of the model adopted. Analyzing community problems to provide noise immunity for both digital and analog devices, the introduction of criteria is appropriate functions for analog EM as

$$N(j\omega) = h(j\omega)H(j\omega) \qquad (2)$$

characterizing the noise immunity in the frequency domain for digital EM - in time

$$N(t) = h(t)H(t) \qquad (3)$$

Functions $N(j\omega)$ and $N(t)$ characterize the potential noise immunity of the analog and digital EM, $h(j\omega)$ and $h(t)$ is the effective protection with its time-frequency characteristics. Causes of impulse noise in digital devices due to signal reflections in transmission lines from mismatched loads and irregularities in the waveform distortion of the lines of communication, the signals match in logical circuits, waveform distortion in the logic circuit and others.

Immunity *H(t)* of digital nodes is caused by physical processes occurring in the crystals, given the performance of the electronic device, manufacturing technology, the

dependence of pulse parameters on the supply voltage, temperature, and load capacity. Effectiveness of protection methods *h(t)* is due to quality designing interconnection assembly and integrated circuit devices providing no reflections logic signals from uncoordinated loads and irregularities, low attenuation and distortion of the desired signal when the distributed along the load line, decrease of crosstalk and stray connections between schemes through the power supply and ground, a decrease in the level of interference from external electromagnetic fields.

At the stage of engineering design analysis of the distortion signals for evaluating noise immunity of cells and perform on speed requirements for real embodiment of a circuit design.

III. METOD OF RESEARCH

Immunity EM is one of the quality parameters and requires a certain quantitative evaluation allows to objectively compare different types of EM on the normalized values of noise immunity, but the theoretical basis of the definition of interference immunity performance to date not been developed. In [2] noise immunity characteristics of the metrological characteristics identified as reflecting properties metrological measuring device under conditions of external influence factors, including interference.

Consider the effect of noise on the EM as an illustration, using the methods of sensitivity theory. We use this approach to determine the characteristics of the analog noise immunity EM. Figure 1 shows the model EM reflecting the impact of interference sources. Interference sources $E1$, $E2$, ... Ek affect elements the input circuit, its impact on the supply chain, *Em* on the control circuit or correction. X and Y are - signals at the input and output terminals of the functional unit EM.
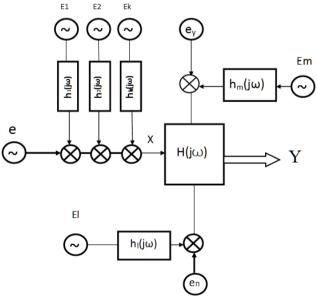
Fig.1 Model EM reflecting the impact of noise sources

Let the signal at the input terminals of the EM node

$$X = f(\alpha, e, E1, E2, \dots Ek) \qquad (4)$$

where α - a set parameters α1, α2, ... αm trunk (circuit) defining impact *e, E1, E2, ... Ek* the input signal *X*. The result of the impact of noise *E1, E2, ... Ek* can be

$$\Delta X = \frac{df}{dE1} E1 + \frac{df}{dE2} E2 + \cdots + \frac{df}{dEk} Ek \qquad (5)$$

where

$$\frac{df}{dE1} = \varphi 1(\alpha); \; \frac{df}{dE2} = \varphi 2(\alpha); \dots, \frac{df}{dEk} = \varphi k(\alpha) \qquad (6)$$

- the impact of interference functions *E1, E2, ... Ek* on the input signal.

Taking *E1, E2, ... Ek* = 0 except *Ei* ≠ 0, we obtain from (5) for the *i – th* interference source *Ei*

$$\varphi i(\alpha) = \Delta xi / Ei \qquad (7)$$

where Δx*i* - additive noise at the input, arising under the influence of the source of interference *Ei*. The set of functions φ1(α), φ2(α), φ3(α), ... φn (α) is a fairly complete description of the effectiveness of the protection of EM from the respective sources of interference. With the help of the influence functions can be determined additive noise on the EM node input from any source of interference *Ei*

$$ʒi = \Delta xi = Ei\varphi i(\alpha) \qquad (8)$$

Effect of noise on the output signal ʒ is *Y = F* (β, *e*, ʒ), where β - the set of parameters β1, β2, ... β*m* EM determine the impact of *e* and ʒ on the output signal; ʒ - additive noise at the input of EC defined by the expression (8), can be represented approximately in the following way

$$\Delta Y = ʒ \frac{df}{dʒ} \qquad (9)$$

where $\frac{df}{dʒ} = \Delta y/ʒ = \Psi(\beta)$ influence function ʒ additive noise on the output signal *y*, thus, the effect of the *i*-th interferer *Ei* to the output signal y with regard to (8) is given by *Yi*

$$\Delta Yi = \Psi(\beta)\varphi i(\alpha)Ei \qquad (10)$$

and the influence of interference sources *E1, E2, ... Em*

$$\Delta Y = \Psi(\beta) \sum_{i=1}^{n} \varphi i(\alpha) Ei \qquad (11)$$

Immunity from the effects of EM unit *i*-th noise source according to (10) is defined as

$$Ni = \Delta yi / Ei = \varphi i(\alpha)\Psi(\beta) \qquad (12)$$

Interference *E1, E2, ... Em* are functions of time and, in general, they should be viewed as random processes. Therefore, Δ*X*, ʒ and Δ*Y* are also stochastic processes, therefore, the study of random processes, the determination of influence functions move from temporary to spectral representations of signals. If we use the Fourier transform f to

$$\varphi i(\alpha) \frac{\Delta xi(j\omega)}{Ei(j\omega)} = hi(j\omega); \; \Psi(\beta) = \frac{\Delta y(j\omega)}{ʒ(J\omega)} = H(j\omega)$$

$$Ni = hi(j\omega)H(j\omega) \qquad (13)$$

where - *hi (j*ω) frequency response of stray communication *Ei* interference source input circuit; *H(j*ω) frequency response unit EM. Similarly, the noise immunity can be determined by the power and control circuits, and the frequency characteristic *H(j*ω) m and *H(j*ω) l defined by respective circuits. In some cases it is convenient to apply logarithmic transfer functions (for example, in assessing the performance of noise immunity in decibels) [3].

IV. REZALT AND DISCUSSION

The above criteria for noise immunity and immunity can be successfully used. To assess the sustainability of the amplifying devices in their constructive realization.

The above approachallows us to formulate the design algorithm noise protection EM with a predetermined criterion for noise immunity.

- define the criteria for noise immunity EM functional components under the influence of noise on the input circuits, power circuits and control;

- define the criteria for characterizing the effectiveness of the protection methods and the resulting electro-physical parameters of the selected constructive implementation of the device (installation);

- ensuring the specified noise immunity test by an appropriate choice of circuit solutions (with its noise immunity measure) and selected views of a constructive implementation.

In some cases, the electrical parameters of structures may improve noise immunity.

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Fiber Optic Sensor for Monitoring Vibration Load

Yury I. Gudkov[1], Vladimir N. Azarov[2], Alexander L. Tuv[3]

School of Computer Engineering

National Research University Higher School of Economics

Moscow, Russia

[1] ygudkov@hse.ru, [2] vazarov@hse.ru, [3] atuv@hse.ru

Abstract— **An important factor affecting the operation of any mechanical unit is the vibration of its individual components. Therefore, the development of tools for the continuous monitoring of vibration loads at critical points in the design of assemblies and mechanisms can be considered one of the most promising ways of increasing the quality and reliability of the technological equipment. Contactless fiber optic sensors with external amplitude modulation of the radiation flux can be a good basis for creating built-in vibration diagnostics of a wide class of industrial facilities, from high-precision robotic systems to systems operating in conditions of strong electromagnetic interference and harsh environments. The paper analyzes the main factors affecting the accuracy of the non-contact displacement measurement of an object via a fiber-optic sensor with external modulation. The structure and the algorithm of forming the measuring data of the sensor with automatic compensation of the influence of external factors intended for measuring the amplitude of vibration in industrial conditions are described. The results of the experimental research of the accuracy of the developed sensor on shape and surface quality of the controlled object, the sensor positioning errors during installation and state of the environment in the control zone are considered.**

Keywords— *vibration; noncontact sensor; optical fiber; automatic correction of sensitivity*

I. INTRODUCTION

One of the ways to improve the quality of technological equipment and reduce the risk of sudden failure is to use the built-in vibration monitoring systems at critical points in the design, drives and related components. It makes no sense to use in monitoring systems the precision sensors, which are characterized by high cost and require skilled maintenance. Sensors for such systems on the one hand should be relatively cheap and reliable, and on the other - have a range of amplitudes and frequencies, have a minimal impact on the characteristics of the monitored equipment and ensure stable operation under strong electromagnetic fields, aggressive and flammable environments.

The analysis showed that a fiber optic sensor with outer flux amplitude modulation fully meets these requirements [1]. The main advantages of such a sensor is a contactless method of obtaining the measurement information, frequency range from zero hertz to hundreds of kilohertz, no effect on the sensitive sensor element of electromagnetic fields, high reliability, long life, small size and weight, compatibility with the types of information processing devices [2].

The simple structure of the fiber optic sensor with external modulation includes a multicore fiber with one transmitting and one receiving channels, a light source and a photodetector. The flow of the light source via the transmitting optical fiber reaches the surface of the test object and the reflected flow through the receiving optical fiber returns to the photodetector. The output signal of the photodetector depends upon the design and dimensions of the optical fibers, the direction of movement of the object, the reflection properties of its surface, the gap between the object and the common end of fibers and absorbing medium in this gap. [3] Typically, in such a structure a light source is an infrared LED and a photodetector - a silicon photodiode, which provides maximum spectral matching of the sensor components [4].

II. SIMPLE FIBER OPTIC SENSOR WITH EXTERNAL MODULATION

A simple two-channel structure of the fibers of the sensor allows to construct two types of the measuring circuits. One - to control the movements of the object border parallel to the fiber end [5], and the other - to measure the movements of the object surface in a direction perpendicular to the plane of the fiber end (Figure 1). It is this measuring circuit mainly used for vibration control.

Fig.1 shows typical conversion functions of the sensor when measuring the displacement of glass objects (a), fiberglass (b) and metal (c). Their difference is related to the penetration depth of light flux into the interior of the object and depends on the wavelength of the incident flux. In accordance with the terminology the flow reflection may be "metallic" and "nonmetallic".

For "nonmetallic" reflection, which is characterized by "deep" penetration of the incident flux in the material the conversion function is the sum of three private functions generated by the movement of the near-to-end optical fibers interface "air-surface", the far-to-end optical fibers interface "air-surface" and moving the inner reflecting or scattering elements of the object material. Therefore, the value of the conversion function at a zero gap between the surface of the object and the end of the optical fibers is determined by the internal structure of the material.

At the "metallic" reflection the stream penetrating into the environment, is fully absorbed in a layer whose thickness is comparable with the wavelength of the radiation, that eliminates the influence the fluxes reflected from the inner

layers of the object on the conversion function. It was established experimentally that for such objects there is a linear dependence of the sensitivity of the sensor in the working portion from the voltage at the point of maximum of the conversion function. Therefore, to install the nominal sensitivity of the sensor it is sufficient to set at a maximum point the voltage that was measured during the initial calibration. It can be achieved by adjusting the emission current source that allows you to fully compensate the impact of the reflecting surface properties of the control object on the sensitivity of the sensor.
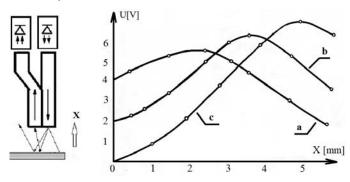
Fig. 1. Conversion functions of simple fiber optic sensor for objects made of glass (a), fiberglass (b) and metal (c)

However, such a procedure for installing the nominal sensitivity, which can be easily done in the laboratory, is non-applicable in a production environment, because it requires additional test equipment and trained personnel. It should also be noted that a single execution of the procedure when mounting the sensor does not guarantee a stable sensitivity during long operation due to degradation of the light source and the power source ripple and the changes of the optical properties of the medium in the gap.

III. PRINCIPLE OF OPERATION OF SENSOR

To implement a process of automatic compensation of sensor uninformative factors in real conditions of use can be when using the optical fiber with one transmitting and two receiving channels. The relative position of the sensor channels and the conversion function are shown in Fig. 2. Experimental research have shown that for the same size of the receive channels of a point maximum of conversion function of the first channel (PH1) practically coincides with the middle of the linear portion of the total conversion function formed by two receiving channels together (PH1 + PH2). Using the output signal of the first receiving channel as a pattern for adjusting the light source current can ensure long-term stability of nominal sensitivity of the sensor.
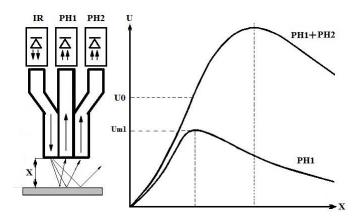
Fig. 2. Conversion function of fiber optic sensor with two receiving channels

A block diagram of the sensor with automatic compensation of uninformative factors includes one transmitting optical fiber, two receiving optical fibers and a processing circuit of measuring data (Fig.3).
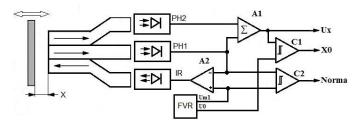
Fig.3. Block diagram of sensor

The processing circuit includes two photodetectors (PH1, PH2), a light source (IR), a summing amplifier (A1), a strong differential amplifier (A2), two comparators (C1 and C2) and a fixed voltage reference (FVR). The amplifier A2 actually is a part of a voltage stabilizer in the first receiving channel (PH1) with the feedback of light flux. The comparator with hysteresis C1 is designed to set the initial gap when mounting the sensor on the object, and the comparator C2 generates a signal when working correctly the circuit of automatic correction of nominal sensitivity of the sensor.

IV. EXPERIMENTAL RESEARCH OF SENSOR

In practical use the following factors influence the sensor sensitivity:
• Changes in the diagram of the reflected flux associated with the processing quality and the curvature of the object surface.
• The inaccuracy of initial installation of the sensor when mounting.
• Flux losses associated with the optical properties of the medium in the gap.

Therefore, the aim of the experimental study of the developed sensor was to determine borders of the listed above changes, within which the sensor error meets the requirements that apply to the operating vibration measurement.

Research was carried out for the sensor with three identical rectangular fibers 10x2 mm. The initial calibration of the sensor was performed on a flat surface (Ra = 0.04 μm) of the aluminium object. The relative sensitivity calculation error did not exceed 0.8% at the maximum upper boundary of the dynamic range of 0.7 of the length of the rising portion of the conversion function.

A. Influence of surface finish

The method and the object surface quality affect the diagram of the reflected light flow, and consequently the shape of the conversion function of the sensor. Figure 4 shows graphs of the actual sensor sensitivity changes obtained on samples of steel with known values of average height of microroughness and various kinds of surface treatment: cylindrical milling (a), face milling (b), surface grinding (c).
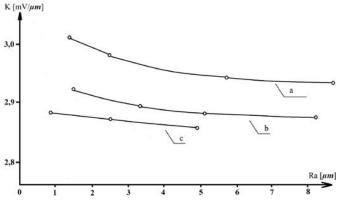
Fig.4. Dependence of sensor sensitivity on surface quality

At nominal sensor sensitivity 3.0 mV/μm, the limit of variation of its real value ranged from 2.87 mV/μm to 3.03 mV/μm. Thus, the error of nominal sensitivity for the entire set of samples did not exceed 5%.

B. Influence of surface curvature

A number of control objects (such as drive shafts and the like) are characterized by a certain radius of curvature in the measurement area, which leads to a change of the diagram of the directionality of the reflected flow and changing the shape of the conversion function of the sensor. Experiments were conducted for aluminium cylindrical objects with a diameter from 5 mm to 80 mm (Ra = 0,04 μm). Fig. 5 shows the dependence of the actual sensitivity of the sensor on the ratio of the cylinder diameter and the fiber end size.

It was found that when D/L > 10, the error of the nominal sensitivity did not exceed 3%.
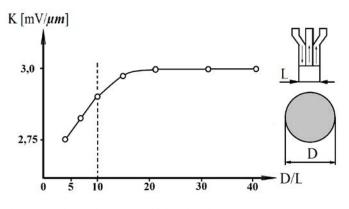
Fig.5. Dependence of sensor sensitivity of surface curvature

C. Influence of tilt of flat surface

The tilt of the flat surface of the object relative to the optical fibers end leads to a change in the flow entering the receiving channels and change of the sensor sensitivity.
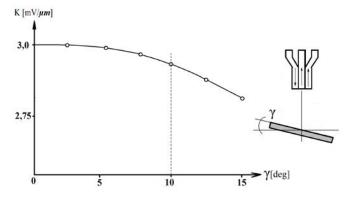
Fig.6. Dependence of sensor sensitivity on tilt flat surface

The experiments showed that in the range of tilt angles from 0 ° to 10 ° the error of the nominal sensitivity did not exceed 3% (Fig. 6). However, to exploit the sensor when γ = 10 ° is undesirable since the minimum gap between the optical fibers ends and the object surface is reduced almost 2 times, which can lead to mechanical contact with the object under the large amplitude of vibration.

D. Influence of sensor alignment over cylindrical object

The relative position of the cylindrical object and the end of the fibers will have the greatest effect on the sensitivity of the sensor at a ratio of D/L = 10 size, that is for the case of the maximum error of the nominal sensitivity when measuring the vibration of cylindrical objects. Fig. 7 shows the dependence of sensor sensitivity on the ratio ΔY/D, where ΔY- cylinder axis offset relative to the symmetry axis of the fibers end when D/L = 10.
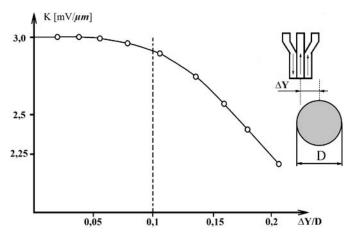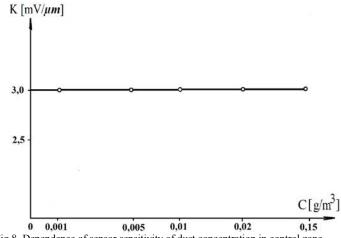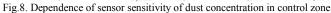
Fig.7. Dependence of sensor sensitivity on its position above cylindrical object

The graph shows that when the cylinder displacement does not exceed the size of the end of the optical fibers ($\Delta Y/D < 0.1$), the error of the nominal sensitivity does not exceed 3%. This reduces the requirements for the accuracy of the sensor mounting above the object.

E. Effect of dust between fiber and surface.

Dust in the measurement area leads to a dispersion of light flux and a sensor parameters change. For experimental research of the effect of dust on the sensor sensitivity, the optical fibers end and the object control with a flat surface were placed in a sealed chamber with a built-in fan providing a constant circulation of dust in the control zone. Portions of dust were weighed on an analytical balance and were introduced into the chamber through a special window. The range of dust concentrations in the experiment ranged from 0.001 g/m^3 up to 0.15 g/m^3 (Fig.8).

Fig.8. Dependence of sensor sensitivity of dust concentration in control zone.

It was found that the sensitivity of the sensor remained constant throughout the range of concentrations of dust up to a maximum, which is 15 times greater than the accepted limit (0.01 g/m^3) for industrial premises.

V. RESULTS

The results of the experimental research in determining the change ranges of uninformative factors, within which the developed sensor provides automatic correction of the nominal sensitivity are summarized in Table 1.

TABLE   RESULTS OF EXPERIMENTAL RESEARCHES OF SENSOR

№	Uninformative factor	Range	Error of sensitivity
1	Optical properties of surface	"Metallic reflection"	< 1%
2	Quality of surface roughness	0,16 µm < Ra < 10 µm	< 5%
3	Curvature of surface	D/L > 10	< 3%
4	Tilt of flat surface	γ < 10%	< 3%
5	Position of cylindrical object	ΔY < L	< 3%
6	Dust in control zone	C < 0,14 g/m^3	< 1%

Analysis of the results leads to the conclusion about the possibility of using the developed sensor as a working means of measurements in vibration monitoring systems for a wide range of industrial facilities.

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Fluctuation of a Beam with the Concentrated Masses on Elastic Mobile Support

Aslan M. Kaziyev[1], Valery Kh. Khuranov[2], Zalimkhan R. Likhov[3], Beslan V. Shogenov, Islam A. Kaziyev[4]

Polytechnic Institute
Kabardino-Balkarian State University "KBSU"
Nalchik, Russia
[1]kaziev1969@mail.ru, [2]valeri-archi@mail.ru, [3]zalimhan@mail.ru, [4]Kaziev1969@mail.ru

Abstract- **Kinematically excited transverse vibrations of multi-span beams with attached lumped masses. A mathematical model of the oscillations, which is based on two systems of differential equations. The first system describes the fluctuations of the constant part of the beam, and the second describes the linear and angular displacements of the discrete lumped masses. Defines a vector-function of displacements for harmonic disturbances of the supports. The influence of the phase shift of harmonic disturbances at the same frequency of oscillation.**

Keywords- kinematics of the excited oscillations; discrete-continuous systems; harmonic perturbation; phase shift

I. INTRODUCTION

The settlement scheme of the considered beam (fig. 1), consists of n of flights of various rigidity $G_j = E_j I_j$, the running mass of mi, and coefficient of viscous friction η_j. In knots of a beam are located N masses - M_j fluctuating in the cross direction. The beam is supported by the elastic damping support with coefficients of c_j and v_j. Fluctuations are caused by shifts of the z_j support.
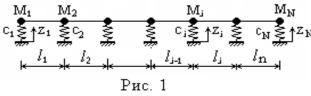
Fig. 1. The settlement scheme of the considered beam

We have the mixed system, from sites of a beam with the distributed mass of m and the concentrated mass of M. The model of cross fluctuations of such beam consists of two systems of the differential equations. The first system for continual sites in the form of the uniform differential equations

in private derivatives of hyperbolic type written down in a vector form

$$\mathbf{EJ} \circ \mathbf{u^{IV}} + \mathbf{m} \circ \ddot{\mathbf{u}} + \eta\mathbf{m} \circ \dot{\mathbf{u}} = \mathbf{0} \qquad (1.1)$$

The second system represents the ordinary differential equations for the concentrated dot masses

$$\mathbf{M} \circ \dot{\mathbf{v}} + \mathbf{v} \circ \dot{\mathbf{v}} + \mathbf{c} \circ (\mathbf{v} - \mathbf{y}) + \mathbf{f} = \mathbf{0} \qquad (1.2)$$

u (**x**, t) – a vector – the function of a vector argument corresponding to beam shifts in the cross direction; **v(t)** - a vector – the function of a scalar argument describing deviations of the concentrated masses; $x_j \in [0, lj]$; **m** – vector of running lot of flights of a beam; **z(t)** - the vector function setting kinematic movements of support; **0** – zero – a vector. (**c** = **a**∘**b** => $c_j = a_j b_j$). All vectors are considered a vector – columns; **f**(t) – a vector of the elastic cross forces of a beam operating on the concentrated masses

$$f_1(t) = G_1 u_1''(0, t), \qquad f_j(t) = G_j u_j'''(0, t) - G_{j-1} u_{j-1}''' (l_{j-1}, t),$$

$$j = 2, 3...., n; \qquad f_N(t) = - G_n u_n'''(l_n, t).$$

II. FREE FLUCTUATIONS

For free fluctuations it is necessary to determine a range of own frequencies, coefficients of damping and own forms corresponding to them. In that case fluctuations of support are absent $\mathbf{z(t)} \equiv \mathbf{0}$.

The equation (1.1) fluctuations for any j – ro flight of a beam, we will divide into Gj and we will write down

$$u_j^{IV} + \alpha_j \ddot{u}_j + \beta_j \dot{u}_j = 0, \qquad \alpha j = m_j/G_j, \ \beta_j = \eta_j m_j/G_j \qquad (2.1)$$

Boundary conditions according to the settlement scheme join the equations (2.1). On the left end the bending moment is equal to zero i.e.

$$G1\, u_1''(0, t) = 0, \ \Rightarrow \ u_1''(0, t) = 0 \qquad (2.2)$$

Fluctuations of mass of M1 are described by the first equation of system (1.2) with the account that $v(\ t) = u(\ 0, t)$

$$M_1\ddot{u}_1(0,t) + v_1\dot{u}_1(0,t) + c_1u_1(0,t) + G_1u_1'''(0,t) = 0.$$
(2.3)

On a joint $(j - 1)$ – ro and j – ro sites of a condition of interface:

- movements, angles of rotation and the bending moments at the left and to the right of the concentrated weight are equal among themselves

$$u_{j-1}(l_{j-1}, t) = u_j(0, t), \qquad u'_{j-1}(l_{j-1}, t) = u'_j(0, t),$$
$$G_{j-1}u''_{j-1}(lj-1, t) = G_ju''_j(0, t); \qquad (2.4)$$

- fluctuations of the concentrated mass of Mj are described by the equations of system (1.2) with replacement of yj by uj (0, t)

$$M_j\ddot{u}_j(0,t) + v_j\dot{u}_j(0,t) + c_ju_j(0,t) + G_ju_j'''(0,t) - G_{j-1}u_{j-1}'''(l_{j-1}, t) = 0$$
$$j = 2, 3, \ldots, n \qquad (2.5)$$

On the right end of a beam boundary conditions, are similar (2.2), (2.3)

$$M_N\ddot{u}_n(l_n, t) + v_N\dot{u}_n(l_n, t) + c_Nu_n(l_n, t) - G_nu_n'''(l_n, t) = 0.$$

$$u_n''(l_n, t) = 0, \qquad (2.6)$$

The solution of a task (2.1) - (2.6) is found by means of a method of division of variables

$$u_j(x_j, t) = X_j(x_j)\, e^{\lambda t}, \qquad (2.7)$$

where

$$\lambda = -\varepsilon + i\omega \qquad (2.8)$$

- a characteristic indicator, ε and ω – coefficient of attenuation and frequency of free fluctuations.

Substitution (2.7) in the equations. (2.1) - (2.6) gives.

$$X_j^{IV} - \gamma_j^4 X_j = 0, \qquad \gamma_j^4 = -\alpha_j\lambda^2 - \beta_j\lambda \qquad (2.9)$$

$$X_1''(0) = 0, \qquad (\lambda^2M_1 + \lambda v_1 + c_1)X_1(0) + G_1X_1'''(0) = 0,$$
$$X_{j-1}(l_{j-1}) = X_j(0), \qquad X'_{j-1}(l_{j-1}) = X'_j(0),$$
$$G_{j-1}X''_{j-1}(l_{j-1}) = G_jX''_j(0),$$
$$(\lambda^2M_j + \lambda v_j + c_j)X_j(0) + G_jX_j'''(0) - G_{j-1}X_{j-1}'''(l_{j-1}) = 0,$$
$$j = 2,3., \; n, \qquad X_n''(l_n) = 0,$$
$$(\lambda^2M_N + \lambda v_N + c_N)X_n(l_n) - G_nX_n'''(l_n) = 0.$$
(2.10)

The common decision of the equation (2.9) has an appearance

$$X_j(x_j) = D_{j1}sin\gamma_jx_j + D_{j2}cos\gamma_jx_j + D_{j3}sh\gamma_jx_j + Dj4ch\gamma_jx_j, \qquad (2.11)$$

where for constants of integration of j – number of flight. After its differentsirovaniye we will receive

$$X'_j(x_j) = \gamma_j(D_{j1}cos\gamma_jx_j - D_{j2}sin\gamma_jx_j + D_{j3}ch\gamma_jx_j + D_{j4}sh\gamma_jx_j)$$
(2.12)

$$X''_j(x_j) = \gamma_j^2(-D_{j1}sin\gamma_jx_j - D_{j2}cos\gamma_jx_j + D_{j3}sh\gamma_jx_j + D_{j4}ch\gamma_jx_j)$$
(2.13)

$$X'''_j(x_j) = \gamma_j^3(-D_{j1}cos\gamma_jx_j + D_{j2}sin\gamma_jx_j + D_{j3}ch\gamma_jx_j + D_{j4}sh\gamma_jx_j)$$
(2.14)

Let's enter designations

$$p_j = \sin\gamma_jl_j, \qquad q_j = \cos\gamma_jl_j, \qquad r_j = sh\,\gamma_jl_j, \qquad s_j = ch\,\gamma_jl_j,$$
$$e_j = \lambda^2M_j + \lambda v_j + c_j, \qquad a_j = G_j\gamma_j^3, \qquad \mu_j = \gamma_j/\gamma_{j+1},$$
$$g_j = G_j\gamma_j^2/G_{j+1}\gamma_{j+1}^2, \qquad h_1 = e_kp_n + a_nq_n, \qquad h_2 = e_kq_n - a_np_n,$$
$$h_3 = e_kr_n - ansn, \qquad h_4 = e_ks_n - a_nr_n.$$

The support (2.11)-(2.14) in (2.10) also gives system of the equations

$$\mathbf{Q}(\lambda)\,\mathbf{d} = \mathbf{0} \qquad (2.15)$$

concerning a vector of constants of integration of $\mathbf{d} = \{$ D_{11}, D_{12}, D_{13}, D_{14}, D_{21}, $D_{22}, \ldots$, $D_{n,n-1}$, $D_{nn}\}$ which components are required coefficients, $\mathbf{Q}(\lambda)$ - a square matrix of an order 4n

$$\mathbf{Q} = \begin{pmatrix} & -1 & & 1 & & & \vdots \\ -a_1 & e_1 & a_1 & e_1 & & & \vdots \\ p_1 & q_1 & r_1 & s_1 & -1 & & -1 & \vdots \\ \mu_1q_1 & -\mu_1p_1 & \mu_1s_1 & \mu_1r_1 & -1 & & -1 & \vdots \\ -g_1p_1 & -g_1q_1 & g_1r_1 & g_1s_1 & & 1 & -1 & \vdots \\ a_1q_1 & -a_1p_1 & -a_1s_1 & -a_1r_1 & -a_2 & e_2 & a_2 & e_2 & \vdots \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \vdots & \ldots & \ldots & \ldots & \ldots \\ & & & & & & & & \vdots & -p_n & -q_n & r_n & s_n \\ & & & & & & & & \vdots & h_1 & h_2 & h_3 & h_4 \end{pmatrix}$$

Here zero elements are not written out. Lines 3-6 correspond to conditions of interface of the 1st and 2nd sites and are repeating for joints of other sites. I.e. as the repeating submatrix block.

Elements of a matrix of $\mathbf{Q}$ are functions of a characteristic indicator λ and through it - coefficient of attenuation of fluctuations ε and frequencies ω.

The condition of existence of the nonzero solution of system of the equations (2.15) gives the equation

$$\det \mathbf{Q}(\lambda) = 0 \qquad (2.16)$$

from which the range of own values is defined $\{\,\lambda_1, \lambda_2, \ldots\,\}$.

The equation (2.16) can be rewritten in a look

$$f_1(\varepsilon, \omega) + i\,f_2(\varepsilon, \omega) = 0.$$

From this it follows that attenuation coefficient ε and the frequency of free fluctuations ω have to be defined from system of two nonlinear transcendental equations

$$f_1(\varepsilon, \omega) = 0, f_2(\varepsilon, \omega) = 0 \qquad (2.17)$$

Roots of system (2.17) can be found only numerical methods. But also in this case the solution of a task because of its nonlinearity is connected with the known difficulties for a set of the reasons: 1) usually applied iterative methods of the decision are limited to convergence conditions which performance in this task it is difficult to check and provide; 2) there is a calculating infinite set of couples of roots $(\varepsilon_k, \omega_k)$ satisfying to system of the equations and it attracts danger of loss of some of roots in the course of calculations; 3) it is

difficult to execute a necessary stage of preliminary office of roots, i.e. roots can be "very close". These difficulties can be overcome by means of trial computing experiments on the COMPUTER and applications of effective numerical schemes. Use of modern computing MatLab computer systems allows to combine very successfully advantages of both numerical, and graphic ways.

We will look for the solution of system by means of a method of pokoordinatny descent. For this purpose we form support non-negative function

$$\Phi(\varepsilon, \omega) = |\det Q(\varepsilon, \omega)| = [f_1^2(\varepsilon, \omega) + f_2^2(\varepsilon, \omega)]^{1/2},$$

addressing in zero only in those points where

$$f_1(\varepsilon, \omega) = f_2(\varepsilon, \omega) = 0.$$

Thus, the solution of initial system (2.17) will be at the same time a point of a zero minimum of scalar function of a vector argument F (ϕ) so now it is necessary to solve simpler problem

$$\Phi(\phi) = 0, \phi = \{\varepsilon, \omega\} \quad \in R_2 \bigcap (\varepsilon > 0, \omega > 0).$$

Here the vector ϕ corresponds to required sizes, F (ϕ) represents the multimodal function having a set of local minima.

The essence of the applied method consists in creation of the sequence of points (approximations to the decision) ϕ_k, k = 0, 1...., meeting to a point of a local minimum ϕ_*. At the same time in the course of calculations it is necessary to try to obtain that values of support function were monotonously decreasing and limited from below

$$\Phi(\phi_0) \geq \Phi(\phi_1) \geq .... \geq \Phi(\phi_k) \geq .... \geq \Phi(\phi_*)$$
(2.18)

Condition of the termination of the computing procedure and, so and with a necessary accuracy performance of inequality is a sign of achievement of a root

$$\Phi(\phi_{k+1}) < \delta$$
(2.19)

and δ – the accuracy of calculations.

Repeated repetition of such procedure of calculations gives ranges of coefficients of attenuation and own frequencies

$$\{(\varepsilon_1, \omega_1), (\varepsilon_2, \omega_2), ... \}.$$

After definition of the required number of roots ϕ_i, i = 0, 1...., p a task consists further in definition of own forms corresponding to them.

Carrying out the specified calculations, it is necessary to remember that $X_j(x_j)$ found on (2.11) are complex functions. The valid own forms have an appearance

$$\phi_j^r(x_j) = \text{real}[X_j^r(x_j)], r = 1, 2....., j = 1, 2..., n,$$

r – number of own form, j – number of flight.

Example. Let's consider free fluctuations of a steel beam from the rolling two-Tauri No. 20 with three sites at the following entrance data
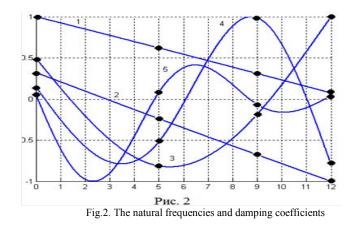
$\varepsilon = 5$ with-1,   **M** = [500, 400, 300, 200] kg,   *l* = [5, 4, 3] m.

with = [8, 6, 6, 5] kN/m , **v** = [15, 20, 20, 15] with-1.

TABLE .   THE NATURAL FREQUENCIES AND DAMPING COEFFICIENTS

№	1st form		2nd form		3rd form		4th form		5th form	
1	ω1	η1	ω2	η2	ω3	η3	ω4	η4	ω5	η5
2	3,75	18,7	4,317	31,5	19,65	27	60,62	31,2	209,0	25

The first five own frequencies and damping coefficients are specified in the table (damping coefficients in the table are increased in one thousand times). In the figure 2 the forms corresponding to them are shown. It is visible that the first two frequencies correspond to fluctuations of a beam as a solid body (1 – inphase fluctuations, 2 – anti-phase fluctuations of masses) i.e. flexural fluctuations of a beam are not shown yet. Already begin with the third frequency, flexural fluctuations of a beam are shown. Joint fluctuations of a beam with a masses (curves 3,4,5) remind already the first, second and third forms of a usual beam without masses. It is visible that with increase in frequency the concentrated masses deviates less, and the distributed mass of beams uchuvstvut in fluctuations more actively.

Рис. 2
Fig.2. The natural frequencies and damping coefficients

III.   KINEMATIC EXCITED HARMONIC OSCILLATIONS

For a set of the reasons (seismicity, vibration of the bases, the movement of people and cars etc.) of a support of a beam make movements in the cross direction that are a source of the compelled fluctuations. Let the indignations of z(t) arising for these reasons will be harmonious with identical frequencies Ω, but at the same time with different amplitudes of ak and initial phases αk

$$z_k(t) = a_k e^{i\Omega t}, \quad A_k = a_k$$
(3.1)

The resulting fluctuations made by a beam and discrete masses will be harmonic oscillations of the same frequency.

Let's define functions of movements and amplitudes for the established fluctuations (in this case entry conditions to system of the equations (1.1), (1.2) are not required).

The task (1.1), (1.2), (3.1), has the common decision

$$\mathbf{u}\,(\mathbf{x},\,t) = \mathbf{H}\,(x)\,\mathbf{A}\,e^{i\Omega t},\ \mathbf{x} \in (0,\,l),\quad t \!>\! -\infty \qquad (3.2)$$

$$\mathbf{y(t)} = \mathbf{W}\,\mathbf{A}\,e^{i\Omega t},\quad t \!>\! -\infty \qquad\qquad (3.3)$$

Let's consider in detail reaction of system to indignation $\xi k(t)$.

In this case

$$u_j\,(x_j,\,t) = h_j(x_j)\,e^{i\Omega t},\quad j = 1,\,2,\dots,\,n;\quad y_j(t) = w_j\,e^{i\Omega t},$$
$$j = 1,\,2,\dots,\,N \qquad (3.4)$$

Substitution (3.4) in (1.1), (2.1) gives regional tasks concerning amplitudes of $h_j\,(x_j)$

$$\gamma\,h_j(x_j) + 2v\,h_j'(x_j) - a^2 h_j''(x_j) = 0,$$
$$\gamma = (i\Omega)^2 + 2\varepsilon(i\Omega) \qquad (3.5)$$
$$h_j(0) = w_j,\ h_j(l_j) = w_{j+1},\qquad j = 1,\,2,\dots,\,n. \qquad (3.6)$$

Their decisions are looked for in a look

$$h_j(x_j) = e^{\lambda x_j},\ j = 1,\,2,\dots,\,n \qquad (3.7)$$

Substitution in (3.5) leads to the characteristic equation

$$a^2\,\lambda^2 - 2v(i\Omega)\lambda - \gamma = 0$$

and further to roots

$$\lambda_{1,2} = [\,v(i\Omega) \pm \sqrt{v^2\,(i\Omega)^2 + \gamma a^2}\,\,] \,/\,a^2.$$

Now (3.7) takes a form
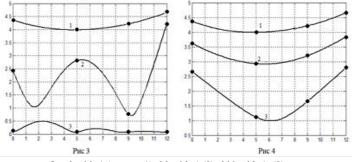
$$h_j(x_j) = B_j\,e^{\lambda_1 x_j} + D_j\,e^{\lambda_2 x_j}\qquad\qquad j = 1,\,2,\dots,\,n,\quad (3.8)$$

where j – numbers of flights. Constants of integration of B_j and D_j can be found, having brought (3.8) in boundary conditions (3.6)

$$B_j + D_j = w_j,\ B_j\,e^{\lambda_1 l_j} + D_j\,e^{\lambda_2 l_j} = w_{j+1},\ j = 1,\,2,\dots,\,n. \quad (3.9)$$

We find a vector of amplitudes of fluctuations by means of (3.2)

$$\mathbf{a_u(x)} = |\,\mathbf{H}\,(x)\,\mathbf{A}\,| \qquad (3.10)$$

For a beam with the parameters specified above at kinematic indignations of $a_1 = a_2 = a_3 = a_4 = 10$ mm and shifts of phases $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$ are executed the calculations presented by schedules of fig. 3. Curves correspond to the increasing values of frequency of indignations

Рис 3   Рис 4

$\Omega = 8$ with-1 (a curve 1); 20 with-1 (2); 200 with-1 (3)

The analysis of schedules shows the following. With rather small frequencies of indignations of fluctuation occur in the first form of free fluctuations as movements of support of a sinfazna. With increase in frequency the mnogovolnovost is shown, but at the same time amplitudes begin to decrease. With big frequencies, even close to own frequencies, amplitudes of fluctuations of a beam tend to zero. It is explained by existence of dampers and springs in support. Presence of heavy masses increases a share of inertial forces too. In the figure 4 with a frequency $\Omega = 8$ with-1 changed shifts of phases between even and odd support. The curve 1 corresponds to zero shift, a curve 2 – to shift$\pi/2$, a curve 3 – to shiftπ. It is possible to notice fluctuation of support in an antiphase considerably reduces amplitude (it for frequency 8 with-1 which is close to the first own frequency, for other frequencies is possible increase).

IV. KINEMATIC EXCITED CASUAL FLUCTUATIONS

In scientific and technical literature there are numerous data that often sources of the compelled kinematic excited fluctuations have obviously expressed casual character. As a result, cross fluctuations of a beam will also be casual, and need and expediency of transition to stochastic models of movements appears.

Let's consider a question in more detail. The equations (1.1), (1.2) remain in the previous form

$$\mathbf{u}_{tt} + 2\varepsilon\,\mathbf{u}_t + 2v\,\mathbf{u}_{xt} - (a^2 - v^2)\,\mathbf{u}_{xx} = 0,\ \mathbf{x} \in (0,\,l),\quad t \!>\! -\infty \qquad (4.1)$$

$$m\,\mathbf{y}_{tt} + 2v\,\mathbf{y}_t + \mathbf{c}\,(\mathbf{y} - \mathbf{z}) + \mathbf{b} = 0,\ t \!>\! -\infty \qquad (4.2)$$

Let in (4.2) vector – the $z(t)$ function will be stationary casual process with permanently connected components and the set spectral matrix

$$S_z(\omega) = \begin{pmatrix} s_{11} & s_{12}\dots\dots s_{1N} \\ s_{21} & s_{22}\dots\dots s_{2N} \\ \dots\dots\dots\dots\dots \\ s_{N1}\ s_{N2}\dots\dots s_{NN} \end{pmatrix},\qquad s_{jk}\,(\omega) = s_{kj}\,(\omega) \qquad (4.3)$$

Then $\mathbf{u}\,(x,\,t)$ and $\mathbf{y}(t)$ will be the casual vector field and casual vector process with the characteristics which are subject to definition.

Let's study further installed (in probabilistic sense) fluctuations systems. Therefore entry conditions to the equations (4.1), (4.2) will not be required, boundary conditions will remain the same, i.e. in the form of (2.1)

$$u_j\,(0,\,t) = y_j\,(t),\ u_j\,(l_j,\,t) = y_{j+1}(t),\ j = 1,\,2\dots,\,n \qquad (4.4)$$

In that case the vector casual field $u(\mathbf{x},\,t)$ will be non-uniform on spatial coordinate and stationary on time, and $\mathbf{y}(t)$ will be stationary casual process.

The task consists in that on the set spectral matrix (4.3) to find a spectral matrix of $S_u\,(\mathbf{x},\,\omega)$ the casual field of deviations of a beam and dispersion. The question of determination of population mean is not raised in view of the fact that it can be

given to the known deterministic tasks including the types considered in item 4 easily.

For definition of a spectral matrix of deviations of $\mathbf{S_u}$ ($\mathbf{x}$, ω) we will use earlier found matrix of transfer functions H ($\mathbf{x}$, iω) and we will write down

$$\mathbf{S_u}(\mathbf{x,}\omega) = \mathbf{H}(\mathbf{x}, i\omega)S_z(\omega)\,\mathbf{H}^{*}(\mathbf{x}, i\omega). \qquad (4.5)$$

Here the asterisk means transition to the transposed matrix with the complex interfaced elements. On (4.5) the square matrix of dimension of n × n is result of calculations. Elements of its main diagonal are spectral density $S_u^{jj}(x_j, \omega)$ beam deviations in flights with the corresponding numbers j, elements of collateral diagonals are mutual spectral density $S_u^{jk}(x_j, x_k, \omega)$ processes of deviations of a beam in two various flights with numbers j and k.

When determining dispersions of movements we use the known ratio

$$D_u^j(x_j) = \int_{-\infty}^{+\infty} S_u^{jj}(x_j, \omega)\,d\omega \qquad (4.6)$$

For carrying out concrete calculations we will take model of kinematic indignations in the form of vector N − measured stationary casual process with permanently connected components having the hidden frequency (characteristic frequencies). In that case elements of a spectral matrix $\mathbf{Sz}$ can be presented in the form

$$s_{kl}(\omega) = \frac{2\,\alpha_{kl}\,\theta_{kl}^2\,\rho_{kl}\,\sigma_k\,\sigma_l}{\pi[(\omega^2 - \theta_{kl}^2)^2 + 4\alpha_{kl}^2\,\omega^2]},$$

$$\theta_{kl}^2 = \alpha_{kl}^2 + \beta_{kl}^2, \qquad k, l = 1, 2, \ldots, N.$$

As before, here α_{kl}, β_{kl} − parameters of a shirokopolosnost and the hidden frequency. It is not possible to execute integration in the right part (4.6) analytical methods. An exit consists of such difficulty in application of numerical methods.

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Bending Resistance of Reinforced Concrete Elements under Various Classes of Concrete and Ratios of Reinforcement

Valery K. Khuranov , Zalimkhan R Likhov,
Aslan M. Kaziev, Aues S.Tsipinov
Kabardino-Balkarian State University
Nalchik, Russia
valeri-archi@mail.ru; zalimhan@mail.ru;
kaziev1969@mail.ru;

Vadim D. Mailyan
Academy of Civil Engineering and Architecture
Don State Technical University
Rostov-on-Don, Russia
usp-dr@yandex.ru

Abstract— **In this paper, the influence of the coefficient of reinforcement and grade of concrete strength, crack resistance and deflection of reinforced concrete bending elements. The analysis is performed on the basis of numerical experiments three series of beams with different design resistances of rebar and interest reinforcement of stretched zones.**

Keywords— the bending strength; the coefficient of reinforcement; grade of concrete; mixed reinforcement

I. INTRODUCTION

In the design of reinforced concrete elements should be set to the most efficient class of concrete. Compressed reinforced concrete elements, as a rule, it is advisable to use concrete of high classes. In bending the elements improve the grade of concrete, given that it requires a great amount of money, it is not always economically profitable.

Increasing the class of concrete in bending reinforced concrete elements in many cases does not lead to a substantial increase in their bearing capacity and fracture toughness, as well as to reduce deflections [1, 2].

Proved that the use of reinforcement in the stretched zone of bending elements it is advisable, as it saves the consumption of steel and the cost of creating a pre-stressed [3,4]. It also contributes to the approximation of reinforced concrete elements to the structure "equal" resistance [5].

II. OBJECT OF STUDY

We show an example of a reinforced concrete beam of I-section with a span of 12m with parallel faces (*h=89cm, b=8cm, $b_f'=b_f=28$ cm, $h_f'=12$ cm; $h_f=15$ cm*) with mixed reinforcement the rate of change of the main technical characteristics of the beam with increasing concrete class B30 to B50.

The reinforcement ratio of the compression area in all beams is assumed to be μ *'=0,25%.* Pre-stressed and non-stressed (interrupts) reinforcement of stretched zone adopted high strength of the same class, reinforcement of a compressed zone conventional class A500. Pre-stressing reinforcement σ_{sp}=900 MPa.

The results of numerical experiments three series of beams (tab.1) characterized in that in the I-series valves stretched zone has the estimated resistance Rs=815 MPa and a reinforcement ratio of μ =1.2 %, in which the neutral axis crosses the shelf of a compressed beam, in the II series Rs=1000 MPa and μ =1,2 %, in which the neutral axis intersects the rib.

This makes it possible to establish the impact of the concrete class in various forms of cross-section of the compressed zone (rectangular and T-bar).

TABLE I. CHARACTERISTICS OF REINFORCED CONCRETE BEAMS WITH MIXED REINFORCEMENT

№№ series	R_s, MPa	μ, %	Concrete class B	Coefficient of reinforcement K_p	ξ/ξ_R	$x>h_f$,
I	815	1.2	B30	0 0,5 1	0,61 0,59 0,36	>1
			B50	0 0,5 1	0,37 0,32 0,18	<1
II	1000	1.2	B30	0 0,5 1	0,99 0,82 0,77	>1
			B50	0 0,5 1	0,51 0,44 0,33	<1
III	1000	1.8	B30	0 0,5 1	1,33 1,33 1,23	>1
			B50	0 0,5 1	1,19 0,98 0,82	>1

Note: Other characteristics of reinforced concrete beams of all three series are taken as equal, they are given in the text.

The beams in series III when Rs=1000 MPa adopted a higher percentage of reinforcement in tensile zone so that, if x>hf' ratio was greater than or close to one. It is obvious that with increasing values of, i.e., area of the compressed zone, the influence of the concrete class increases. Followed to find out what the extent of this influence for different values of Kp.

In figures 1-3 presents the results of determining the strength of the normal sections of M, the relative height of the compressed zone ξ / ξ_R of the cross section of the relative time of formation of cracks M_{crc}/M, the opening width of the cracks of the a_{crc} and the beam deflection f in the middle of the span beam with uniformly distribution over the regulatory burden. Regulatory moment in determining the widths of cracks and deflection is assumed to be Mn=0,8M. Considering the graphs of the last two characteristics should be considered that when various grades of concrete moments Mn, as well as a few M different, especially when crossing the neutral axis of the rib section of the beam (Fig. 2 and 3).

Change all of the characteristics of the beams shown in Fig. 1-3, this depending on the class of concrete and the coefficient of reinforcement

$$K_p = A_{sp} R_{sp} /\left(A_{sp} R_{sp} + A_s R_s\right)$$

, where A_{sp} and A_s is the sectional area of the pre-strained and free of tension reinforcement of stretched zones, and the R_{sp} and R_s – is the estimated resistance.

The most effective solutions, which are pre-stressed and non-stressed rebar are made of the same class. In this case, which is adopted in this paper, $K_p = A_{sp} /\left(A_{sp} + A_s\right)$.

From Fig. 1 shows that the impact of the class of concrete technical specification-key concrete at the intersection of the neutral axis of the compressed beam flange of T - (I), and rectangular cross sections very marginally.

When replacing in a beam of concrete class B30 class concrete B50 normal strength sections with any value of Kp increases by only 4 %. Practical does not affect the strength of the beams, the value of the coefficient of reinforcement, i.e. the prestressing does not provide in this case a significant a great influence on the strength of the beam.

A significant decrease ξ / ξ_R with the increase of the coefficient of Kp or the efforts of pre-stressing is due to the increase ξ_R caused by the prestressing. The ratio ξ / ξ_R at any value of Kp is less than one, i.e. the root

cause of destruction in this case is the achievement of the stretched zone reinforcement design resistance.

With the increase of grade of concrete the coefficient of elasticity of concrete v age-et, the concrete becomes less plastic, resulting in a ratio fully you plot the compression concrete ω decreases. Thus, increase in grade of concrete from B30 to B50 leads to a decrease of the coefficient ω with a 0.71 to 0.63, i.e. by 11.3 %. This leads to a reduction of the boundary values ξ_R in the absence of prestressing from 0,342 to 0,274, i.e. by 20%.

In the second series beam neutral axis beam crosses the edge, and values significantly higher than in the beams of the first series. In this case, the increase of concrete class B30 to B50 for any value of Cu ratio leads to a noticeable increase of strength of the beam by 15 % at Cu =0 and by 10 % when Kr =1.

Even more significantly the effect of increasing the class of concrete strength reinforced concrete beams with ξ / ξ_R a larger one (over-reinforced elements) or close to 1 (third series), because the root cause of the destruction of the beam in these cases is the exhaustion of the strength of the concrete compressed zone. In the cases studied, with the increase of concrete class B30 to B50 with the strength of a reinforced concrete beam is increased by 31...39 %. With such a significant increase in strength of the beams the increase of the concrete class, despite the increase in the cost of materials, it may be economically feasible.
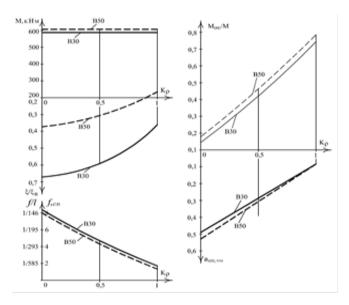
Fig. 1. The effect of grade of concrete and ratio of reinforcement Kp on characteristics of reinforced concrete beams with Rs = 815 MPa (series I – neutral axis crosses the flange of I-beam section)
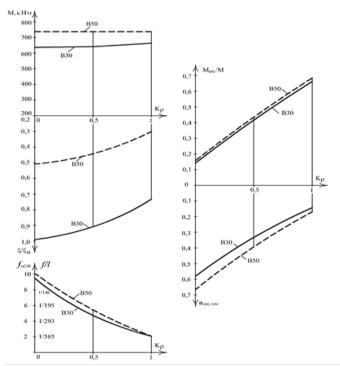
Fig. 2. The effect of grade of concrete and ratio of reinforcement Cu on characteristics of reinforced concrete beams with Rs = 1000 MPa (series II – neutral axis intersects the rib of I-section)
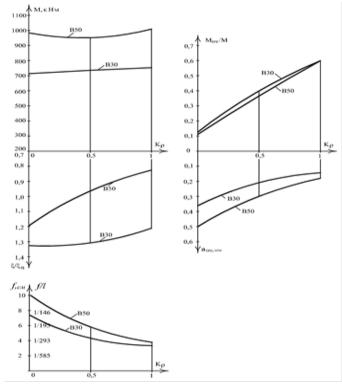
Fig. 3. The effect of grade of concrete and ratio of reinforcement Cu on characteristics of reinforced concrete beams with Rs = 1000 MPa, x>hf, and high values of ξ/ξR (III – series)

Analyzing the impact strength of reinforced concrete beams with a partial prestressing ratio of reinforcement Kp, it can be noted that in all classes of concrete relationships, it is relatively small. So, with the increase of the coefficient Cu from zero to the unit strength of the beams increased only by 2...8 %. The increasing ratio ξ / ξ_R and reduction of concrete class influence coefficient Kp increases slightly.

The influence of concrete class on the value of the relative moment of cracking M_{crc}/M for any coefficient of reinforcement slightly, with an increase in the last it decreases (see Fig. 1-3). If we compare the absolute values of the moments of cracking (table. 2), it is obvious that with increasing the class of concrete and the level of pre-compression, the moment of cracking will increase.

TABLE II. MEANING CRACKING MOMENTS WHEN DIFFERENT CLASSES OF CONCRETE AND THE COEFFICIENT OF REINFORCEMENT

№№ series	μ, %	R_s, MPa	K_p	M_{crc}, MPa		Increase M_{crc} in % of the increase in the concrete class
				B30	B50	
I	1,2	815	0	86,2	108,4	26
			0,5	239,5	276	15
			1	420	464,5	11
III	1,8	1000	0	89	112	26
			0,5	284	340	20
			1	460	598,4	30

In the absence of prestressing (Kp=0) the moment of cracking is almost proportional to the strength of concrete tensile Rbt, therefore increasing the class of concrete in this case leads to a noticeable increase of the fracture toughness (in the considered beams – 26%). In the precast elements with mixed reinforcement the rate of change of the moment of cracking of M_{crc} with the increase of the concrete class depends on the level of compression of the concrete. With a reduced level of compression (I series) of M_{crc} with higher concrete class increase the balance wheel increases by 11...15% and in case of strong compression (III) – 20...30%.

As one would expect the moment of crack formation increases significantly with increasing Cu ratio. In comparison with the beams without post-tensioning (Kp=0) when the pre-stress of the entire rebar stretched zone (Kp=1) of M_{crc} in the considered beams is increased by 4...5 times.

Crack widths a_{crc} defined in the normative moment Mn=0,8 M, if the concrete class B50 was slightly more than the concrete class B30 (Fig. 1-3), however, it is noted that the values of Mp at the determination of the values of the acrc are different – with a higher grade of concrete more Mp.
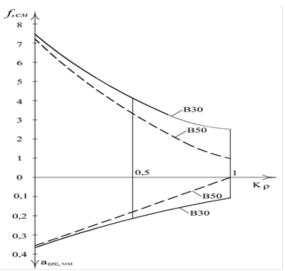
Fig. 4 Effect of concrete and the coefficient Kp for the beam deflection and width of crack growth are at the same value of the moment Mn=564 MPa (III – series)

When comparing the widths of cracks in concrete beams from different classes with the same absolute value of the moment Mp, the picture changes crack widths in beams of concrete class B50 less than in beams of concrete class B30 (Fig. 4). With the increase in Mp, i.e. prior to compression, the crack widths is reduced in several times.

At low values of ξ / ξ_R the concrete grade has no significant effect on the deflections of beams defined with the same level of normative moment Mp=0.8 M (Fig. 1-2). In the case of high values (Fig. 3), especially in the elements without pretension with class rise concrete moment Mp increases significantly, therefore increases and the resulting deflection.

If we take moment at which deflection is determined, the same with any value of Kp, the increase of concrete leads to a decrease in deflection (Fig. 4).

With increasing Kp increases the camber, and the total deflection is significantly reduced.

III. CONCLUSIONS

1. In reinforced concrete beams with mixed reinforcement in rectangular or I-beam (t-section and neutral axis in the shelf, while increasing the class of concrete when any coefficient of reinforcement Cu increases the strength slightly (the replacement of concrete class B30 class concrete B50 only 4%). In this case, given the increase in the cost of concrete with high grade concrete of high classes is not advisable, because and other mechanical characteristics of the beams vary slightly.

2. The increase of the reinforcement of stretched zones of beams and races-even the characteristics of the reinforcement, which leads to more relations   and to higher utilisation of the compressed zone (in tanks I-beam or T-beam with neutral axes that intersect the edge) influence of concrete strength significantly increases when moving from class to class B30 B50 – 15% at Kp=0 and by 10% when Kp=1.

3. When   greater than one (over-reinforced beam) or close to 1 the primary cause of the destruction of reinforced concrete beams becomes the exhaustion of the strength of the concrete compressed zone. In such cases (beams and slabs of reduced height, etc.), the influence of the concrete class much – for these later classes, the strength of the beam increases by 31...39%.

4. The results of all three series show that at any of the classes of concrete and the influence   of the coefficient of reinforcement of the Kp on the strength of reinforced concrete beams is relatively not large (with an increase in Kp from zero to 1 strength of beams is increased by 2...8% with a tendency to increase at high   and low classes of concrete).

5. With increasing of class of concrete values of relative moment of cracking Mcrc/M for any coefficient of reinforcement vary slightly, but the absolute values of Mcrc significantly who will melt (30%). The increase in the coefficient Kp from 0 to 1 causes a significant increase in fracture toughness (in 4...5 times).

6. Increasing the class of concrete leads to a significant decrease of the opening width of cracks and deflection of the element at a constant value of normative time.

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The Influence of Pre-Settings of the Automated System Rapid Prototyping on the Qualitative Characteristics of Formation

Mikhail Yu. Kulikov, Maksim A. Larionov,
S.A. Sheptunov
Institute of Design & Technological Information of RAS
Moscow, Russia
muk.56@mail.ru

Denis V. Gusev
Moscow State University of Railway Engineering (MIIT)
Moscow, Russia

Abstract —The article discusses possibilities of applying innovative and advanced CALS – technologies, and advanced automation of production through the introduction of rapid prototyping techniques. As well as the process of forming in their application, effect presets automated system for rapid prototyping, in the form of a schema-based samples in the working chamber of the installation, the quality of the surface layer in the process of FORMATION in three-dimensional printing of parts with straight planes. The authors described the life cycle gives a complete picture of manufacturing parts using rapid prototyping technology Direct Light Projection (DLP). The entrance testing DLP technology Produced a three-dimensional picture of the condition of the surface layer of the samples allow us to conclude about the effect presets on the quality and selection of the optimal scheme-based components, in which the roughness is minimal, which in turn gives the conclusion about the possibility of using DLP technology in the engineering industry as a whole.

Keywords—Automation; CALS – technologies; prototyping; products, three-dimensional printing; the error shaping

I. INTRODUCTION

To date, the ultimate goal of any business is profit. One of the characteristics of modern industrial production are stringent requirements on the competitiveness of products. That requires rapid development and launch of the product in production, and makes high demands on product quality. One of the key roles of the modern scientific-technical progress plays – automation. The increasing complexity and diversity of engineering technologies and the need for the issue of the diversity of products has created a problem of coordination and management of information about the life cycle of the product.

Only the integration of state of the art information technology in manufacturing, such as, for example, CALS - technologies, can provide the necessary interaction of all departments across the enterprise [3]. In proceedings of engineering products CALS-technologies include the following types of software information systems:

CAE - Computer Aided Engineering (automated calculations and analysis);

CAD - Computer Aided Design (computer aided design);

CAM - Computer Aided Manufacturing (automated technological preparation of production);

CAPP- system design process.

Due to the wide application of CAE/CAD/CAM, ensure the organization of exchange data between the project and manufacturing systems at the stage of creating and manufacturing the product, managed to completely realize the Informatization of the product lifecycle from initial conception, the transition to manufacturing processes, operation to full recycling. This significantly reduces the time to design, manufacture and introduction of new products, as the data on component parts, assemblies, units and systems stored on a network server production, available to users of CALS technologies working in the enterprise, in turn, this gives you the opportunity to move to a paperless relationship between the stages of design and realization of the finished product [4].

Now hard, and often impossible to represent a major engineering and also small factory without automated systems, which is comprehensive. Modern automated system of production imply a wide use of industrial robots and robotic technology systems, computers and computerized systems, the introduction of computer numerical control (CNC) designed to replace human labor in General, or reduce to the minimum its involvement in the production of the product. One of the promising areas of manufacturing automation may be the introduction of innovative 3D technology of additive layer-by-layer synthesis, such as rapid prototyping (Rapid Prototyping - RP). Methods of rapid prototyping are based on creating individual layers of a given thickness and their serial connection with each other.

Prototyping is the process of layering the physical building based on three-dimensional parametric solid computer model. The effect of the application of rapid prototyping is reflected in a significant reduction of time and cost to develop new products and to improve the quality of the finished product. Human involvement in the manufacturing process is minimal, the build process is largely automated, significantly reducing the duration of a full cycle of manufacture, the person is only involved in the technological preparation of machine a and in the final stage and finishing of the finished product (the removal of supporting structures, the final polymerization of the upper layers of the model in the UV oven).

The use of automated systems for rapid prototyping has the following advantages:
- Increase the volume of production;
- Improve product quality;
- More efficient use of machinery and equipment;
- Introduction of non-waste technologies enabling the most efficient use of raw materials and energy;
- Reduce the level of reject of the prepared products due to the exclusion of the human factor during production of the product;
- Transition to continuous end-to-end automated processes;
- Lowering the level of environmental pollution.

In application the prototyping life cycle of products is reduced to the following form shown in figure 1.
- The cycle begins with a basic concept, that is, with thoughts of the future product or prototype to evaluate geometric shapes of the outer contours, functionality, design and just the aesthetic appearance;
- The next stage is the design phase where the concept turns into a working design documentation, sometimes you can skip this step;
- Next is the creation of parametric solid model with dimensions corresponding design documentation in the computer aided design (CAD, CAE/CAD);
- Compilation parametric solid model in STL format. The company 3DSystems in 1988 introduced the so-called STL data format [1]. The modern installations of three-dimensional printing, all without exception use the STL format. This data format serves to establish working relationships between the created in the computer aided design 3D model and installations of 3D printing;
- Recompiled STL file by means of the software package provided along with installations of 3D printing is decomposed into sections, or so-called layers;
- Recompiled into layers, the model is transferred to a 3D printer by means of a Flash-drive or direct connection of the computer and then begins growing a model in 3D printer, top-down layer by layer until the complete manufacturing;
- After the prototyping phase the finished product in two ways, either the product is used in the form in which it

turned out either sent to revision (UV-oven, removing support structures, sanding, tapping, etc.);
- The last stage is disposal of the product, which passed all the test or fulfilled working hours.
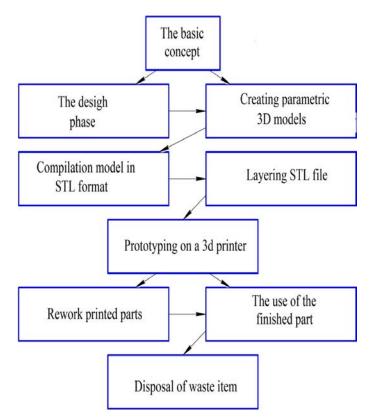
Fig.1. Life cycle prototypying products.

One of the most promising technology for the production of products from polymeric materials is the technology of Direct Light Projection. This technology is one of the most fast, accurate and requires minimal material and labour resources, which is important in modern conditions of market of engineering products. Quality characteristics are particularly important, requirements for them are constantly growing, so this problem requires special attention during the implementation method of rapid prototyping in the engineering industry.

When prototype manufactured by technology DLP process (printing) is automatic, without human intervention, and all the basic settings are made previously by the operator, such as schema-based model in the working chamber, the layer thickness, the correction, step platform in the Z-axis, etc.
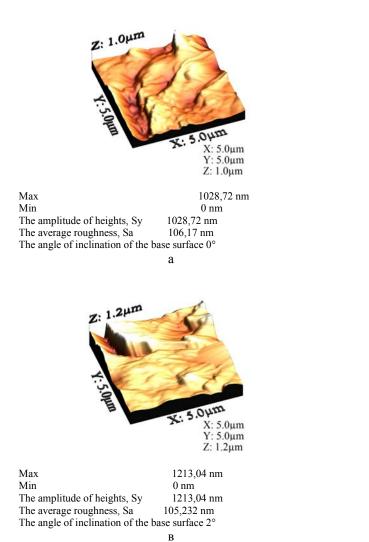
II. AN EMPIRICAL STUDY
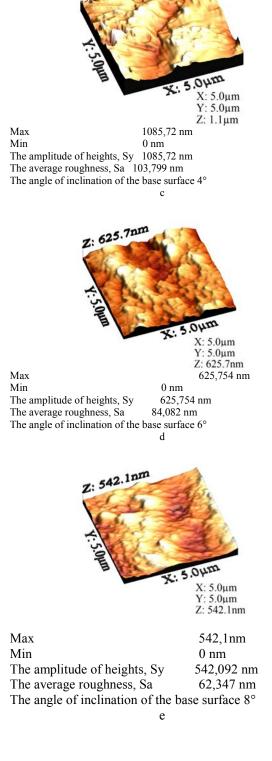
The aim of this work was to identify the impact of a schema-based on the quality of the surface layer during the forming process by the method of rapid prototyping. As samples were chosen plate size 10x10x3 mm, and the investigated surface – plane of 10 x 10 mm. Several series of

plates from high temperature photopolymer HTM 140 at the DLP technology was printed on a 3D printer – Envisiontec Ultra2. Plates manufactured of HTM-140 after removing from the printer, have a temperature resistance of 140 °C without any further mechanical modifications. Material HTM-140 one of the most popular among the Envisiontec in mechanical engineering. The series consisted of 5 plates, each of which differ by the fact that the angle between the test base surface and a Contact window was varied from 0° to 10° in increments of 2°.

To determine the surface microrelief of the samples and more accurate depth studies of this effect have used a method of atomic force microscopy (AFM) as the primary tool for the study of the surface microrelief has been used scanning probe microscope "Solver Pro".

Obtaining the AFM images of the surface microrelief of each of the investigated series of samples are presented in figure 2, respectively.

Max	1085,72 nm
Min	0 nm

The amplitude of heights, Sy 1085,72 nm
The average roughness, Sa 103,799 nm
The angle of inclination of the base surface 4°

c

Max	625,754 nm
Min	0 nm

The amplitude of heights, Sy 625,754 nm
The average roughness, Sa 84,082 nm
The angle of inclination of the base surface 6°

d

Max	1028,72 nm
Min	0 nm

The amplitude of heights, Sy 1028,72 nm
The average roughness, Sa 106,17 nm
The angle of inclination of the base surface 0°

a

Max	542,1nm
Min	0 nm

The amplitude of heights, Sy 542,092 nm
The average roughness, Sa 62,347 nm
The angle of inclination of the base surface 8°

e

Max	1213,04 nm
Min	0 nm

The amplitude of heights, Sy 1213,04 nm
The average roughness, Sa 105,232 nm
The angle of inclination of the base surface 2°

B

Max   609,3 nm
Min   0 nm
The amplitude of heights, Sy   609,352 nm
The average roughness, Sa   83,1501 nm
The angle of inclination of the base surface 10°
                                    f
Fig. 2. A three-dimensional picture of the condition of the surface layer of the samples

III.   RESEARCH

From the presented results it is clear that when forming a flat surface by the methods of rapid prototyping technology DLP the most optimal scheme-based is one in which the angle of inclination of the reference basic corresponds to 8°. This is because the area of the manufactured layer is smaller than when the angle of inclination 0°, and in the process of detachment from the "Contact window", the impact of the following minimum layer to the previous layer, which still has not hardened. And when the angle of inclination of the base surface of more than 8° the negative impact carries the force of gravity, which leads to a shift not hardened layer and increasing the roughness.

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Program Complex on Processing of Experimental Data of Wetting by Fusions of Metals of Firm Substrates

Vadim N. Lesev[#1], Anna O. Zheldasheva[#2]

[#]Institute of Physics and Mathematics, Department of Differential Equations

Kabardino-Balkarian State University

Nalchik, Russia

[1]lvn_kbsu@mail.ru   [2]Anna.zheldasheva@mail.ru

Abstract— **In work the problem of handling of experimental data on wetting is studied by fusions of firm substrates. The algorithm of the automated matter research is offered. In an analysis result of the made natural experiments and theoretical researches the offered method allows to minimize an error of measurements in case of reduction of time expenditure by handling of images of small drops of fusions.**

Keywords - droplet; dispersion; experiment

I. INTRODUCTION

Problems of development of fundamental bases and application of modern information technologies for research of properties of real objects are one of the most demanded and perspective directions of development of program designing. At the same time the particular interest is caused by development, reasons and approbation of the mathematical methods used in case of sale of software products. An essential role is played here by development of qualitative and approximate analytical methods of research of the corresponding models allowing to study physical properties of systems at various external influences.

II. EXPERIMENTAL PART

For the purpose of improvement of quality of the developed software product the whole series of natural experiments has been prepared and executed. All experiments on wetting by fusions of firm surfaces have been made on the installation consisting of a vacuum post, the heater, the case and photosystem.

The detailed scheme of laboratory installation for research of properties of small drops of fusions is submitted in fig. 1.

The casing is intended for sealing of working volume, and also for a possibility of mounting of internal elements of constructions. The casing is executed in the form of the vertical cylinder from stainless steel of brand 12X18H9T which lower base is fixed on the support plate, and the remaining part rises by means of a counterbalance. Such configuration gives the chance of good access in case of open installation to the internal accessories strengthened on the lower part of the casing. Besides, instead of two multiplexing

of big diameter used in installations with the vertical casing with two flanges in this installation windows were used that reduces probability of overheating of the vacuum furnace.
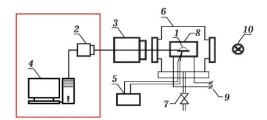
Fig. 1 – Installation elements:

1 – a drop of the studied fusion on a substrate, 2 – the camera, 3 – the cathetometer, 4 – the computer, 5 – a potentiometer with the thermocouple, 6 – the case, 7 – the gate of a vacuum-tube, 8 – the heater, 9 – conclusions to the transformer, 10 – a lamp

In the top part of the case two flanges for windows through which photography of a sample and its lighting is made are welded on diameter. The window is made of flat optical quartz and becomes stronger in flanges rubber or ftoroplastovy washers. As installation is calculated on obtaining high temperatures, for water cooling the shirt is welded on upon the case. Cooling prevents an overheat of the case and the failure of elastomeric consolidations connected with it.

The most responsible part of the case is its bottom which is not movably fixed on the support plate and has a number of the inputs which are carrying out certain functions. Through vacuum-tube connection of installation with a vacuum post is performed.

For power supply of the single-phase short-circuited heater there are two current lead. As they bear big current loading and contact to the heater, current leads are executed from copper cores with a diameter of 25 mm and are cooled through an internal cavity with water.

For electric isolation of current lead from the case and simultaneous ensuring vacuum consolidation ftoroplastovy washers of a certain configuration serve.

The clip of current lead, necessary for consolidation, to the flanges welded in a bottom is performed by superimposed nuts. For a movement possibility the holder of a substrate is strengthened on three rods moving down, the bellow valves which are movably connected to the case basis from stainless steel. By the screws which are outside movement of level of a substrate in installation can be made. As in case of high temperatures many metals considerably evaporate and there can be a turbidity of windows, in installation also face screens of the heater are provided radial.

And, at last, through a bottom the thermocouple for temperature measurement is entered into the casing. The base, as well as the casing, is cooled with water. The seal a chromel – the alyumelevy thermocouple, protected by a cover and placed closely to a sample, was used as the recording instrument. By indications of the voltmeter connected to the thermocouple then temperature was determined by the calibration table. Before experiment vacuum installation was pumped out within 40 minutes. Further helium was filled the camera.

As a result of realization of this approach pictures for systems tin-indy, tin-barium, lead-lithium, the indy-titan have been received at various temperature conditions. In the following drawing one of the pictures executed in the course of carrying out natural experiments is presented.

Fig. 2 – A picture of a drop of fusion of Sn + 0,1%In on a quartz cup

By us it has been established that at high temperatures the strong thermal stream creates an aura or causes effect of reflection on a substrate and on the sites close to a drop apex. It negatively affects classification of the boundary points defining a drop profile in the analysis of the digitized images therefore the main objective at a stage of processing of pictures consists in leveling the distortions of a profile created by thermal streams and to minimize an error when determining calculated parameters of system. This result can achieve, having consistently solved the following tasks: definition of boundary points of object on the basis of gradient methods; establishment of the deformed profile sites; interpolation of the values received at the previous stage; finding of coordinates of a profile and required physical parameters.

III. THEORETICAL RESEARCHES

It is known that process of formation of a drop in some cases is followed by formation of a precursory film or just a precursor, i.e. the film extending before a moving liquid meniscus. In particular, for different fusions process of spreading of liquid drops can be followed by an effluence of monolayers from a drop in a zone of the line of three-phase contact. Therefore, we have considered two cases characterizing a zone of three-phase contact (fig. 3).
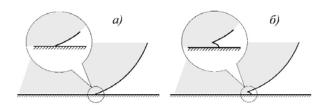
Fig. 3 – A zone of three-phase contact of a drop of partially moistening liquid on a horizontal substrate: a) without precursor; b) with a precursor

In view of the fact that when determining a regional angle of wetting of a point of a precursor aren't considered we would reduce a case b) to a case a). For this purpose, it is enough to execute parallel translation of abscissa axis, having combined it not with substrate level, and with a point of transition of liquid to a precursor. This transformation has reversible character and allows to calculate in case of need objectively such parameters as drop height in an apex or the area of her radial section.

Thus, without breaking a community of reasoning's, we will stop on a case a).

As it is known [1], on border of environments with various illumination sharp change of levels of gray tone takes place that easily is established by calculation of the corresponding gradient in the direction of a normal of the section of environments. In spite of the fact that today there is a set of various gradient masks, will apply 3×3 the operator Sobelya [2]:

$$G_x = \frac{\partial h(\tilde{x}, \tilde{z})}{\partial \tilde{x}} = h(\tilde{x}_{i+1}, \tilde{z}_{j+1}) + 2h(\tilde{x}_{i+1}, \tilde{z}_j) +$$

$$+ h(\tilde{x}_{i+1}, \tilde{z}_{j-1}) - h(\tilde{x}_{i-1}, \tilde{z}_{j+1}) -$$

$$- 2h(\tilde{x}_{i-1}, \tilde{z}_j) - h(\tilde{x}_{i-1}, \tilde{z}_{j-1}), \qquad (1)$$

$$G_z = \frac{\partial h(\tilde{x}, \tilde{z})}{\partial \tilde{y}} = h(\tilde{x}_{i+1}, \tilde{z}_{j+1}) + 2h(\tilde{x}_i, \tilde{z}_{j+1}) +$$

$$+ h(\tilde{x}_{i-1}, \tilde{z}_{j+1}) - h(\tilde{x}_{i+1}, \tilde{z}_{j-1}) -$$

$$-2h\left(\tilde{x}_i, \tilde{z}_{j-1}\right) - h\left(\tilde{x}_{i-1}, \tilde{z}_{j-1}\right),$$

where G – an intensity gradient vector for pixel with coordinates $\left(\tilde{x}, \tilde{z}\right)$.

The operator (1) has been chosen because he differs from operators 2×2 or 3×1 in higher precision, and from operators 4×4 smaller time expenditure on implementation in case of almost equivalent error.

We will designate the set of the points forming border of a liquid phase of the studied system received as a result through $\left\{\tilde{x}, \tilde{z}\right\}$.

It is obvious that in the presence of deformations in the field of decrease display $x_i \rightarrow z_j$ won't be bijective on this site, that is there will be points for which to the same values of an abscissa there will correspond two or more values of ordinate z_j.

Beginning the movement on profile points along abscissa axis from an apex $x_0 = 0$ to a point $x_N = R$ we will define the first five consecutive points

$$h_{i-2}\left(x_{i-2}; z_{i-2}\right), h_{i-1}\left(x_{i-1}; z_{i-1}\right),..., h_{i+2}\left(x_{i+2}, z_{i+2}\right),$$

$\left(i = \overline{2, N-2}\right)$ so that straight lines $h_{i-2}h_{i-1}$, $h_{i-1}h_i$, h_ih_{i+1}, $h_{i+1}h_{i+2}$ formed with the positive direction of an axis *Ox* acute angles $\varphi_{i-2}, \varphi_{i-1}, \varphi_i, \varphi_{i+1}$, differing among themselves no more than by degree that is so that the ratio was carried out:

$$\varphi_j - \varphi_{j+1} \le \delta, \qquad (2)$$

where $j = \overline{i-2, i}$, and $\delta = 1°$ – the geometrical parameter characterizing smoothness of a curve $h(x)$. Also points of area of decrease are similarly checked.

After definition of a set of the points forming the distorted areas of border of object it is possible to pass to the following stage – interpolation.

At a stage of realization of this stage the regression of a general view representing a linear combination of power functions was used $x^m, m = \overline{1,3}$ and the equilateral hyperbole $\dfrac{1}{x+\alpha}$, where numerical parameter α I was defined from a condition of convergence of regression to the data obtained experimentally for the previous and subsequent five points of a profile concerning the deformed site.

Results of a large number of computing experiments allow to claim that the specified way of approximation gives the chance not only to minimize errors determination of physical parameters of system, but also to check informational content of data processing.

The algorithm which mathematical bases are described above has been realized on Delphi.

Calculations show that the offered method allows in the shortest possible time and with a fine precision (the error, doesn't exceed 0,97%) to determine key parameters of system which will be coordinated with results of other researches [3, 4].

However, in cases when the substrate during experiment has a deviation from a horizontal and for negative and positive values of an abscissa the corresponding ordinates differ more than for 10^{-5} percent, that is corners of an ottekaniye and a natekaniye take place, and, therefore, the drop is not axisymmetric, the error begins to increase under the parabolic law. For corners of an ottekaniye and a natekaniye of not exceeding 2 degrees this problem can be solved by averaging of the corresponding coordinates for various half-planes. This procedure is also realized in algorithm that allows in the specified conditions to provide calculation of parameters of the system with a margin error which is not exceeding 1,5%.

IV. Conclusions

The problem of highly effective segmentation in optically low-contrast systems plays an important role in carrying out researches of the capillary profiles directed to studying, especially in cases when the object is in the field, non-uniform on illumination.

The offered method directed to the solution of this problem and based on creation of tangents significantly differs from others (for example [5-8]). It allows to minimize a tool error of measurements in case of reduction of time expenditure by handling of images, and also to establish sets of the boundary points which are negatively influencing the accuracy of determination of values of calculated parameters.

In addition to the listed benefits, the developed algorithm can be used also in case of implementation of completely automated methods of determination of coefficients of a superficial tension and viscosity of liquid, and also in other applications of the theory of a capillarity connected with handling of images with poorly expressed limits of the section of phases.

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Monitoring Safety Construction and Operation of Buildings and Structures

Marita H. Mashukova[1], Muzarib I. Bzhahov, Amirkhan J. Dzhankulaev[2], Fatima M. Shogenova[3]

Kabardino-Balkarian state University

Nalchik, Russia

[1]mashukovamarita@yandex.ru; [2] itf@kbsu.ru; [3]shogenova-1982@mail.ru

Abstract— **The article describes the security systems at all stages of the construction of buildings and structures, the analysis at the sites during operation risk monitoring measures, taking into account possible emergencies.**

Keywords— buildings; structures; safety of buildings; control buildings; risk assessment

I. INTRODUCTION

Questions of security of buildings and facilities require the development of measures to control the design, construction and operation, with the condition that. It will take into account the basic structural and functional features of buildings. In this case it is more expedient and effectively prevent the development of dangerous and emergency situations that requires the process to strengthen the quality control of the physical, geometrical and technical condition of buildings and structures.

The main objective of the work - the analysis of safety measures in the construction industry, both on the stages of its production, and after commissioning.

Approaches to ensure the safety of high-rise buildings and structures, both technically complex systems, should identify and analyze the risks and then taking action to reduce them, or handled in accordance with the concept of security.

Overall risk assessment involves the following steps:
•definition of intended and possible foreseeable misuse;
• hazard identification;
• risk assessment;
• achieving an acceptable risk.

As a result of the creation of the complex to ensure the safety of high-rise buildings are taken into account, the following features:
• appointment of the buildings;
•architectural and artistic appearance of buildings;
• construction of buildings;
• complexity of the technology of construction of buildings;
• placement of the facility;
• hazard identification;
• the consequences of the implementation of prejudicial influences.

II. OBJECT OF STUDY

At the stage of preparation of project documentation for each of these components, produce all kinds of scenarios.

Surveying during the development of project documentation are implemented in order to receive the following materials:
•about the natural conditions on the territory of which are under construction;
•layout of buildings on the implementation and adoption of constructive and space-planning decisions;
•calculation of the bases and foundations, approvals documentation and approvals.
Select the following risk reduction measures:
at the stage of development of design documentation:
• project documentation with security solutions;
• protective systems and facilities;
• Safety information.
the operational phase of the object:
• additional protective systems and facilities;
• the provision of safety information;
• personal protective equipment;
• organization of safe operation.

When designing systems related to safety of buildings in relation to the initial risk, you can take the residual risk, which was taken as a consequence of structural and space-planning decisions of buildings and structures, duly approved.

In determining the hazards in the preparation of project documentation should consider the following points:
• mechanical safety is responsible for the conditions in which there are constructions and foundation of the building, in which there should be no risk to avoid physical damage and injuries that can result in harm to life and health of citizens, as well as the negative impact on the environment as a consequence of the collapse or loss of stability of structures or parts thereof.
• Fire safety is responsible for security in a fire.
• System monitoring of engineering systems of buildings intended for the early detection and prevention of accidents and emergencies at the site and the building.

During the construction phase should carry out the control, which ensures compliance with the state of the construction described in the project documentation, in consequence of that is done internal and external control.

Internal control is necessary to carry out in the course of construction and installation works: foremen, craftsmen, engineers in accordance with the observance of geometric and strength parameters set in the project.

External control is necessary to carry out both the construction phase and upon completion of authorized organizations.

The main indicators of reliability of construction products quality are the following:
• operability;
• durability;
• maintainability.

Operability - a good state of objects in which they are able to perform specified functions at specified regulatory and technical parameters approved in the documentation.

Durability - the ability to maintain the health of the technical state of the object for an extended period of time.

Maintainability - the ability of an object or its separate elements to restore in good condition while eliminating defects.

III. METOD OF RESEARCH

The following control methods are used in assessing the quality of construction:
• visual;
• mechanical;
• physical.

The visual inspection method involves detection of external defects and damage. This method is not sufficiently complete for the quantitative and qualitative characteristics that serve the purpose of prevention and elimination of emergency situations.

Mechanical control method is carried out by means of special metering damage the building structure. The reliability of this method depends on the errors of the instrument, from the environment in which the method is carried out and on the structures themselves.

Physical control method, in turn, is divided into two methods: pulse and radiation.

With the help of the pulse method can determine the mechanical properties of materials, regardless of the structural shape of the product by measuring the velocity of propagation of elastic waves in a group test material and dissipate their energy in unsteady transition process.

The essence of the method is to reduce the radiation intensity of the gamma rays in passing last through the material of the test object.

IV. RESALT AND DISCUSSION

Throughout the construction period is monitored for subsequent commissioning.

Commissioning includes the following list of acts and documents:
• geodetic instruments breakdowns;
• acts on the hidden works and hydraulic test;
• maintaining the general log production work;
• collection of passports on materials, products and equipment.

Provided for the project construction and installation work, the quality of their performance and compliance with rules and regulations controlled the state acceptance committee, which consists of: the customer, the general contractor, project organization, sanitary and fire control, technical inspection, operators of a building or structure, organization, exploiting external engineering networks, authorities on the use and protection of natural resources.

Ensuring the safety of buildings is a major requirement for commissioning. building safety involves finding people in the construction in accordance with the function it has been designed, which increases the quality of work and living comfort.

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Analysis of Special Positions of Parallel Structure Mechanisms for Aggressive Media

G.V. Rashoyan
Dept. Mechanics & Control of Machines,
A. Blagonravov Mechanical Engineering Research Institute
of the Russian Academy of Sciences (IMASH RAN)
Moscow, Russia
gagik_r@bk.ru

S.A. Sheptunov
Institute for Design-Technological Informatics RAS
Moscow, Russia
ship@ikti.ru

A.K. Aleshin
Dept. Mechanics & Control of Machines
A. Blagonravov Mechanical Engineering Research Institute
of the Russian Academy of Sciences (IMASH RAN)
Moscow, Russia
aleshin_ak@mail.ru

M.F. Slavutin
Research Center of Mechanical Engineering School
Tel-Aviv University
Tel-Aviv, the State of Israel
Slavutin@post.tau.ac.il,

S.A. Skvortsov
Dept. Mechanics & Control of Machines,
A. Blagonravov Mechanical Engineering Research Institute
of the Russian Academy of Sciences (IMASH RAN)
Moscow, Russia
1691skvorcov@mail.ru

Abstract — **The given paper depicts a conducted analysis of special positions of manipulation systems basing on the parallel structure mechanisms used in aggressive media. Motional systems of these mechanisms are not located within the border of an operational zone, with this aim a development of algorithms is requested for withdrawal of mechanisms from special positions. The obtained research results can be applied for further development of a control system.**

Keywords — a parallel structure mechanism; a special position; a wrench; a matrix of Plucker coordinates. INTRODUCTION (*HEADING 1*)

Parallel structure mechanisms are under review, in which the kinematic chains connecting the basement with an exit unit, have a parallel connection of units and actuators.

Manipulation mechanisms of parallel structure [1-5] in special positions lose control. In this case a system of
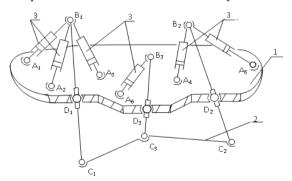
Fig. 1. Structural scheme of a manipulation mechanism

wrenches, which define the interaction between the kinematic chains and the exit unit, degenerates [6-12]. In this paper there is considered the problem of determining the twists, deducing the spatial mechanisms from special positions. Generalization is made concerning a number of other mechanisms. As all the considered mechanisms differ by the following - if all drives are placed outside the operational area, then they can be used as manipulators for aggressive me-dia. Besides, the considered mechanisms can be used as surgical robots. Various aspects of proximity to the special positions [7-15] have been investigated for these mechanisms, particularly pressure angles, types of singularity zones.

Let's consider the definition of wrenches that express the interaction between kinematic chains and an exit unit, taking the example of the manipulation mechanism (Fig. 1), which has a different connection of the linear displacement drives into the connecting kinematic chains.

An exit unit is under impact of a six-member group of single wrenches (i = 1,2, ..., 6), these single wrenches should be defined.

There are known absolute coordinates of the centers of kinematic pairs Ai and Hj (i = 1,2, ..., 6; j = 1,2,3), belonging to the basement 1, the absolute coordinates of the points Kj of the exit unit 2, as well as there are determined the generalized coordinates of Li – a length of units which contain the drives 3 (i.e., the inverse problem of positions is solved for the considered configuration of the mechanism).

Determinant that consists of the Plucker coordinates of the wrenches mentioned above is as follows:
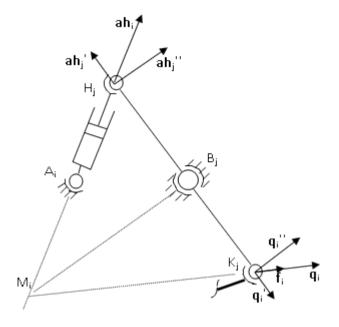
Fig. 2. Kinematic sub-chain of the mechanism under review

$$\det(F) = \begin{vmatrix} f_{1x} & f_{1y} & f_{1z} & f_{1x}^0 & f_{1y}^0 & f_{1z}^0 \\ f_{2x} & f_{2y} & f_{2z} & f_{2x}^0 & f_{2y}^0 & f_{2z}^0 \\ . & . & . & . & . & . \\ f_{6x} & f_{6y} & f_{6z} & f_{6x}^0 & f_{6y}^0 & f_{6z}^0 \end{vmatrix}, \quad (1)$$

the vanishing of the determinant (1) is due to the special positions.

Fig. 2 shows the i-th kinematic sub-chain that corresponds to the mechanism depicted in Fig. 1, in this case the linear displacement drive is located at an angle to the connecting rod. In a general case, using a retarded drive 3, a wrench axis belongs to a plane characterized by the segments AiHj and HjKj, these axes passes through the point Kj and is perpendicular to the direction of possible elementary displacement of the point Kj, the displacement is defined by a rotation of the point Hj around the center of a spherical hinge – the point Ai. For the considered mechanism (Fig.1) the indices vary within limits i = 1.2, ..., 6, j = 1,2,3; and take the following values: with j = 1, i = 1, 2, 3, with j = 2, i = 4, 5; with j = 3, i = 6. In Fig. 2 ahj is the velocity alongside the actuator, ahj* and ahj** are the velocities along the chain and perpendicular the chain correspondingly.

Considering the possible motion of the point Kj with-in the plane characterized by the segments AiHj and HjKj, let us find an instant speeds center of the link HjKj – a point Mi. The possible displacement of the point Kj of the exit unit is perpendicular to the segment MiKj, hence, the straight line defined by this segment, is the axis of the required wrench.

We have for a vector part of the mentioned wrench (this component describes the direction of the required axis of the wrench):

$q_i = q_i{}^* + q_i{}^{**} = A_iK_j + [h_j /k_j - (1/b_j + 1/k_j)(A_iK_j \cdot B_jK_j)/k_j]B_jK_j$

where: qi – a vector of the i-th wrench; qi*, qi** - the projections of a vector qi, respectively perpendicular and parallel to the vector HjKj; AiKi, BjKj – are the vectors located between the points Ai and Kj, and Bj of Kj, respectively; hj, kj, bj - correspond to the lengths of the vectors

H_jK_j, B_jK_j, H_jB_j; (J = 1, i = 1,2,3; j = 4.5 i = 2; j = 3, i = 6).

In order to operate with the single screws, let us divide the vector by its module:

$$\mathbf{f}_i = \mathbf{q}_i / |\mathbf{q}_i|,$$

where $\mathbf{f}_i$ - vector of the i-th single wrench.

Moment part of $\mathbf{f}_i{}^0$ equals to a vector product:

$$\mathbf{f}_i{}^0 = \boldsymbol{\rho}_{\kappa\iota} \times \mathbf{f}_i,$$

where f_i^0 is the moment of the i-th single wrench; $\boldsymbol{\rho}_{\kappa\iota}$ is a radius-vector of the point K_j of the exit link.

Thus, there can be determined the main part and the moment part of all wrenches, which correspond to the kinematic sub-chains for the mechanism shown in Fig. 1.

It is known that in a special position corresponding to the presence of the unmanaged instant mobility, there is both a single screw-gradient which is the fastest while deducing the mechanism of the particular position, and a five-member group of screws that transfers into specific states infinitely close to this one. It is obvious that for a withdrawal of the mechanism from a special position, an exit unit displacement should be predesigned according to the mentioned screw-gradient. Assume finding the gradient-screw. Let us find the increments of the identifier which can be regarded as a scalar function of the Plucker coordinates wrenches connecting kinematic chains during the elementary motion of the exit unit of the given mechanism. Let the point Kj of the exit unit performs an infinitely small displacement, δp_{k_j}, , alongside some elementary twist, δT ($\delta\xi$, $\delta\eta$, $\delta\zeta$, $\delta\xi^0$, $\delta\eta^0$, $\delta\zeta^0$). It is obvious that in this case wrenches will take the new position and the determinant of the matrix of the Plucker coordinates will obtain some increment:

$$\det(F) + d(\det(F)) = \begin{bmatrix} f_{1x} + \delta f_{1x} & \dots & f_{1z}^0 + \delta f_{1z}^0 \\ f_{2x} + \delta f_{1x} & \dots & f_{2z}^0 + \delta f_{2z}^0 \\ \dots & \dots \dots & \dots \\ f_{6x} + \delta f_{6x} & \dots & f_{6z}^0 + \delta f_{6z}^0 \end{bmatrix}.$$

Increments of the vector and the moment of the i-th wrench due to the exit unit motion alongside the elementary twist, $\delta \mathbf{T}$, we mark as $\delta \mathbf{f}_i$ and $\delta \mathbf{f}_i^0$, respectively. Moreover, while determining the increment of the moment during the vector multiplication, we reject the infinitesimals of the second order:

$$\delta \mathbf{f}_i^0 = (\rho_{K_j} + \delta \rho_{K_j}) \times (\mathbf{f}_i + \delta \mathbf{f}_i),$$

$$\delta \mathbf{f}_i^0 = i(y_{kj}\,\delta f_{iz} - z_{kj}\,\delta f_{iy} + \delta y_{kj}\,f_{iz} - \delta z_{kj}$$

$$\delta f_{iy}) - j(x_{kj}\,\delta f_{iz} - z_{kj}\,\delta f_{ix} + \delta x_{kj}\,f_{iz} - \delta z_{kj}\,\delta f_{ix}) +$$

$$k(x_{kj}\,\delta f_{iy} - y_{kj}\,\delta f_{ix} + \delta x_{kj}\,f_{iy} - \delta y_{kj}\,\delta f_{ix}).$$

Furthermore, while modeling elementary motions of the operational body, we obtain the corresponding increments of wrenches, which are linearly dependent on the coordinates of the twist of the exit unit.

As examples, we may consider the elementary displacement alongside the X-axis of the working unit of the manipulator (Fig. 1), to which corresponds the twist, $\mathbf{T}^{\xi^0}$ (0, 0, 0, ξ^0, 0, 0). The increment of the vector part of the i-th wrench (i = 1,2, ..., 6) is being determined by the equations:

$$\delta f_{xi}^{\xi^0} = \xi^0 \frac{1}{|q_i|} \left\{ \left[1 + \frac{h_j}{b_j} - \frac{A_iK_j \cdot B_jK_j}{k_j}\left(\frac{1}{k_j} - \frac{1}{b_j}\right) \right] + \right.$$

$$\left. + \left[\frac{x_{B_jK_j}}{k_j}\left(\frac{h_j}{b_j^2} + \frac{A_iK_j \cdot B_jK_j}{k_j \cdot b_j}\left(\frac{1}{k_j} - \frac{1}{b_j}\right)\right) + \frac{(x_{A_jK_j} + x_{B_jK_j})}{k_j}\left(\frac{1}{k_j} - \frac{1}{b_j}\right) \right]x_{B_jK_j} \right\}$$

$$\delta f_{yi}^{\xi^0} = \xi^0 \frac{1}{|q_i|} \left\{ \frac{y_{B_jK_j}}{k_j}\left(\frac{h_j}{b_j^2} + \frac{A_iK_j \cdot B_jK_j}{k_j \cdot b_j}\left(\frac{1}{k_j} - \frac{1}{b_j}\right)\right) + \frac{(y_{A_jK_j} + y_{B_jK_j})}{k_j}\left(\frac{1}{k_j} - \frac{1}{b_j}\right) \right\}y_{B_jK_j}$$

$$\delta f_{iz}^{\xi^0} = \xi^0 \frac{1}{|q_i|} \left\{ \frac{z_{B_jK_j}}{k_j}\left(\frac{h_j}{b_j^2} + \frac{A_iK_j \cdot B_jK_j}{k_j \cdot b_j}\left(\frac{1}{k_j} - \frac{1}{b_j}\right)\right) + \frac{(z_{A_jK_j} + z_{B_jK_j})}{k_j}\left(\frac{1}{k_j} - \frac{1}{b_j}\right) \right\}z_{B_jK_j}$$

Increments of a moment part are equal:

$$\delta f_{ix}^{0\xi^0} = y_{Kj}\,\delta f_{iz}^{\xi^0} - z_{Kj}\,\delta f_{iy}^{\xi^0} + \xi^0(z_{Kj}f_{iz} + y_{Kj}f_{iy})$$

$$\delta f_{iy}^{0\xi^0} = z_{Kj}\,\delta f_{ix}^{\xi^0} - x_{Kj}\,\delta f_{iz}^{\xi^0} + \xi^0 y_{Kj}f_{ix}$$

$$\delta f_{iz}^{0\xi^0} = x_{Kj}\,\delta f_{iy}^{\xi^0} - y_{Kj}\,\delta f_{ix}^{\xi^0} - \xi^0 z_{Kj}f_{ix}$$

Values $\delta f_{ix}^{\xi^0}$, $\delta f_{iy}^{\xi^0}$, ..., $\delta f_{iz}^{0\xi^0}$ (i=1,2,...,6) can be represented as the product of a screw coordinate of a twist, $\delta \xi^0$, on some scalar factor that depends only on the position of the mechanism:

$$\delta f_{ix}^{\xi^0} = \delta \xi^0 \cdot N_{f_{ix}}^{\xi^0}, \delta f_{iy}^{\xi^0} = \delta \xi^0 \cdot N_{f_{iy}}^{\xi^0},$$

$$\delta f_{iz}^{0\xi^0} = \delta \xi^0 \cdot N_{f_{iz}^0}^{\xi^0} \quad (i=1,2,...,6).$$

Then we have:

$$d(\det(F))^{\xi} = \delta\xi S^{\xi}, \ d(\det(F))^{\eta} = \delta\eta S^{\eta},$$

$$d(\det(F))^{\zeta} = \delta\zeta S^{\zeta}, d(\det(F))^{\eta^0} = \delta\eta^0 S^{\eta^0},$$

$$d(\det(F))^{\zeta^0} = \delta\zeta^0 S^{\zeta^0}.$$

Thus, the increment of the determinant while moving on elementary screw, $\delta\mathbf{T}$ ($\delta\xi$, $\delta\eta$, $\delta\zeta$, $\delta\xi^0$, $\delta\eta^0$, $\delta\zeta^0$), equals

$$d(\det(F)) = \xi S^{\xi} + \eta S^{\eta} + \zeta S^{\zeta} + \xi^0 S^{\xi^0} + \eta^0 S^{\eta^0} + \zeta^0 S^{\zeta^0}$$

The coefficients, S^{ξ}, S^{η}, S^{ζ}, S^{ξ^0}, S^{η^0}, S^{ζ^0}, are partial derivatives, $\partial(\det(F))/\partial\xi$, $\partial(\det(F))/\partial\eta$, $\partial(\det(F))/\partial\zeta$, $\partial(\det(F))/\partial\xi^0$, $\partial(\det(F))/\partial\eta^0$, $\partial(\det(F))/\partial\zeta^0$, and express the gradient of a scalar function from the variables ξ, η, ζ, ξ^0, η^0, ζ^0.

For the quickest withdrawal of the mechanism from a special position, there should be performed a finite small displacement of the exit unit on the screw $\delta\Psi$, Plucker coordinates of which are related as factors found S^{ξ}, S^{η}, S^{ζ}, S^{ξ^0}, S^{η^0}, S^{ζ^0}.

So, the coordinates of the screw-gradient are found, this screw-gradient is the fastest while withdrawing the mechanism out of a special position, and the predesigned problem is solved.

In Fig. 3 (a, b, c) parallel structure mechanisms for different applications are shown. In the synthesis of these devices are partly used the approaches de-scribed in this paper.

Fig. 3a Various parallel structure mechanisms

Fig. 3b Various parallel structure mechanisms

Fig. 3c Various parallel structure mechanisms

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Simulating of Reliability of the Robotics System Software on the Basis of Artificial Intelligence

Sergey A. Sheptunov Maksim V. Larionov
Institute for Design-Technological Informatics RAS
Moscow, Russia

Nataly V. Suhanova, M.R. Salakhov,
Yuri. M. Solomentsev, Il'ya S. Kabak
Moscow State University of Technology (STANKIN)
Moscow, Russia
ikabak@mail.ru

Abstract— **The evaluation model of the software reliability is implemented on the basis of artificial intelligence methods, using artificial neural networks.**

On entry of the model the debugging time is served, on return the outlook the value of the failure rate is formed. For the model implementation a special type of neural network - a vertically-layered neural network is worked out. The model accuracy is increasing leads up to the buildup of layers in the neural network. The implementation of an artificial neural network of this type of multi-layer modular way is considered. The main results are protected by the RF patents for inventions and useful models.

This article is devoted to research of the complex software reliability of control systems of different functions and is based on the previous researches of the author in this area. In the article the following questions are considered:

1.Adaptation of earlier published model for an assessment of reliability of the procedure oriented software to the object-oriented software.

2. Reduction of a known formula of predicting model of reliability to a look convenient for creation of an artificial neural network.

3.Creation of an artificial neural network for forecasting and an assessment of complex software reliability.

4.The description of a new way of realization of the constructed neural network.

The main results of the work described in article are protected by patents for inventions and useful models in Russia.

Keywords— simulating; software reliability; artificial neural networks

I. INTRODUCTION

The evaluation model of the software reliability by the example of automated control systems is worked out in the article. The evaluation model of the software reliability is implemented on the basis of artificial intelligence methods, using artificial neural networks.

On entry of the model the debugging time is served, on return the outlook the value of the failure rate is formed. For the model implementation a special type of neural network - a vertically-layered neural network is worked out. The model accuracy increasing leads up to the buildup of layers in the neural network. The implementation of an artificial neural network of this type of multi-layer modular way is considered.

This article is devoted to research of the complex software reliability of robotics control systems of different functions and is based on the previous researches of the author in this area. In the article the following questions are considered:

1. Adaptation of earlier published model for an assessment of reliability of the procedure oriented software to the object-oriented software.

2. Reduction of a known formula of predicting model of reliability to a look convenient for creation of an artificial neural network.

3. Creation of an artificial neural network for forecasting and an assessment of complex software reliability.

4. The description of a new way of realization of the constructed neural network.

The main results of the work described in article are protected by patents for inventions and useful models in Russia.

Modern robotics software is complex and expensive product. Reliability is a measure of software quality. Improving the software reliability is an important and topical task.

Software for robotics automatic control systems is often multi-component, i.e. it is a complex system of many programs that were developed in parallel by several independent groups of specialists, possibly using a variety of techniques and styles of programming, testing and debugging.

The software of the automated control system is characterized not only by a large volume and complexity, but also it consists of different purposes of subsystems, which includes optimized specialized databases, specialized operating or control systems, the numerous and varied unit control modules, equipment and management of quality, finance, personnel, etc.

However, in estimating and predicting the software reliability it was traditionally regarded as a single product, using the principle of "black box". For software automated systems this approach provides a substantial error in the estimation and prediction of reliability.

The purpose of this work is to reduce the cost of development of software automated production systems, to increase their effectiveness through estimation and prediction

of the reliability of their software on the base of the artificial intelligence methods. It is achieved by creating intelligent software reliability model, which has a higher adequate than the currently used models and allows to determine the optimal debug time on the basis of this model.

There are the known reliability models offered by foreign authors such as Nelson, Schumann, Dzhelinski-Morandy, Schick-Wolverstone and others models. These models were created mainly in the generalization of experimental data and used for program debugging of small volume. Issues of the software reliability simulation models for procedure-oriented approach had previously been considered by the author , for example in articles [1-2].

In this paper the developing of model is proposed for the software reliability estimation at all stages of the life cycle for both procedure-oriented and object-oriented approaches. The model for software reliability estimation should determine the forecast value of the failure rate based on data of the reliability of the preceding working out and the expected debugging time. On entry of the model the debugging time is served, on return the outlook the value of the failure rate is formed.

As a tool for the model implementation the learned artificial neural network is offered to use.

II OBJECTED AND ORIENTED APPROACH TO PROGRAMMING AND PREDICTIVE RELIABILITY MODEl

In deriving software reliability model the problem-oriented approach to the development of large software systems was used while the modern concepts of programming focused primarily on object-oriented approach. This paper shows that the worked out reliability model is applicable to object-oriented software.

In the earlier developed reliability model [1] the formula that relates the flow of failures rates and software debugging time was used. All commands, operators and subprograms are divided into several types, with the same reliability characteristics.

The transition to object-oriented programming allows to the user to create his own personalized virtual machine under which software system is developed. Creating such a virtual machine is based on the software-oriented approach. The principles of encapsulation, polymorphism and inheritance are used.

At its core, every method in object-oriented program is the new operator of the virtual machine.

In object-oriented approach the software runs on some virtual machine. The forecast software reliability will take into account not only the reliability of the program itself, but also the reliability of the aforementioned virtual machine.

As seen from above-mentioned, the presuppositions of reliability simulating under the problem-oriented and object-oriented approach are the same.

In work [1] the analytical formula for software reliability estimation was derived:

$$H(t) = -\sum_{i=1}^{N} v_i \cdot \frac{1}{\tau_i} \cdot \ln\left[1 - \left(1 - \alpha^{-h_i^0 \cdot \tau_i}\right) \cdot \alpha_i^{\frac{t}{\sum_{i=1}^{N} v_i \cdot \tau_i}}\right],$$

where N - number of order types, operators, subroutines and procedures; H- software failure rate, $\tau_1, \tau_2, \tau_3, \ldots \tau_N$ - debugging time of commands, operators, routines; $v_1, v_2, v_3, \ldots v_N$ - frequency coefficients; $\alpha_1, \alpha_2, \ldots, \alpha_N$, - the model coefficients.

The logarithmic function was expanded in a Taylor row. Taking into account the rapid decrease in terms of therow it was, limited to first member . After the transformation of variables we obtained the mathematical model:

$$H(t_1, t_2, \ldots, t_N) = \sum_{i=1}^{N} v_i \cdot \beta_i \cdot exp(-\gamma_i \cdot t_i)$$

(1)

where N- number of types of instruction of the virtual machine; H- failure rate of software systems; $t_1, t_2, t_3, \ldots t_N$ - time debugging; $v_1, v_2, v_3, \ldots v_N$ - frequency coefficients; $\beta_1, \beta_2, \beta_3, \ldots, \beta_N, \gamma_1, \gamma_2, \gamma_3, \ldots, \gamma_N$ - coefficients of the model.

III THE CONVERSION OF FORMULA FOR SIMULATING THE FAILURE RATE OF SOFTWARE

Simulating and forecasting of complex software reliability was carried out on the basis of mathematical model of reliability of analytical output (1).

For high prediction accuracy reliability the decision system requires a large number of non-linear equations, each of which comprises an exponential function. Known methods for the solution of systems of equations (Newton's method of simple iterations or descent) are not only quite complicated, but also require the selection of the initial approximation near the roots of equations. Typically, they are used for systems of two equations with two unknown parameters. For three or more unknown parameters, there are not satisfactory prediction accuracy methods of selection of the initial approximation [3-5].

There is the resulting mathematical model of the software reliability (1) used to form suitable for simulating and forecasting neuron network models.

Note that the values of the times $t_1, t_2, \ldots t_N$. can be obtained from the total time debugging t:

$$t = \sum t_i$$

Transform the formula (1) to (2):

$$H(t) = \sum_{i=1}^{N} a_i \cdot \exp(-b_i \cdot t)$$

(2)

where N - number of different in terms of reliability of classes of operators; $a_1, a_2, a_3, \ldots, a_N . b_1, b_2, b_3, \ldots, b_N$ – parameters of the model. The minus sign in the formula (2) is related to the monotone decreasing of the flow rate of failures over time.

For most software systems N value is difficult to assess. The approximate value of N we obtain during debugging and testing programs. To estimate N it is required to accumulate and to process information about the current reliability of the product. Statistical processing of the sample for each value of the time t and the corresponding failure rate H of formula (2) can obtaine the variables a_i and $b_{i/.}$ Solving the system of equations, we determine the coefficients a_i and b_i then on the models we can predict changes in the reliability and describe the intensity of the failure of a software system depending of the time of its debugging.The result is a theoretical value of the failure rate,, however, its practical application is largely limited to:

1.   Analysis of the resulting system of equations shows that there are the known workarounds. However, when the number of equations to be solved consists of a too much more, the equations solving is essentially complicated. For the problem of accurately predicting of the software reliability the number of equations is to be substantially higher, making the task of approximate solution of the equations to be unpromising.

2.   For a real programming system it is difficult to determine even an approximate value of N, and hence the number of equations in the system, which is equal to 2 N.

It is easy to show that the formula (1) can be converted into (3):

$$H(t) = \sum_{i=1}^{N} \exp(-b_i \cdot t + \hat{a}_i) \quad (3)$$

where the values of a_i and b_i have the same meaning as in the formula (2).

From this formula (3) it can be concluded that the reliability of the complex software system is the sum of the exhibitor.

IV USING ARTIFICIAL NEURAL NETWORKS TO PREDICT THE SOFTWARE RELIABILITY

Prediction of software failure time series is the prediction of the future behavior of the complex software system according to the available observational results [7-9].

As part of the task, software reliability prediction is carried out by the time parameter, when viewed while debugging.

There are various methods for solving the problem of forecasting, and one of the most promising is the use of artificial neural networks (ANN), for example, [7-12]. Simulating of reliability of complex software systems, also refers to the problems solved time series prediction.

We used for simulating software reliability ANN models. We assume that during debugging were fixed times of software system failures. These times were the source of information for forecasting software ANN models.

For the simulating and forecasting of complex software reliability systems using the ANN, it is necessary to solve several key problems:

1.   Identify the structural features of the ANN used to predict reliability.

2.   Determine the method of implementation of the ANN, with regards to its structure.

3.   Determine the way of training ANN with regards to its structure, which was used in the simulation and prediction of reliability of complex software systems.

The architecture of ANN used to predict the reliability will be discussed later.

The method of implementation of the intellectual systems is considered in [10].

Before using the ANN it must be trained. For training ANN the failure row information recorded in earlier times is used. The general scheme of training of the ANN is shown in Pic. 1
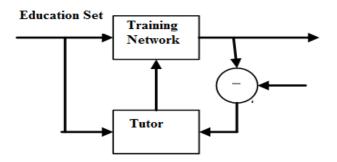
Fig. 1. Scheme of ANN training

ANN training scheme is that at the input of the neural network and also to a special unit Teacher data supplied from the input sample. Artificial neural network fulfills received inputs and generates an output value. This output value is compared with a reference to sample output value from the training set. The resulting difference values output from the ANN and is the reference information to adjust the parameters of the ANN, during her training. Adjustment parameters ANN factors associated with changes in information transfer between neurons ANN and exercise by program-tutor. ANN training process and especially for learning complex software reliability models will be discussed later.

Simulating and forecasting of the reliability of using ANN is as follows:

1.   ANN provides training as shown in pic. 1, during the debuging and testing of the software. Based on a sample input and output values ANN obtain the dependence of the reliability of the software since its debugging.

2.   The trained ANN serves in debugging complex software to estimate the debugging time.

As a result of the ANN at its output the value of the failures flow rate will appear
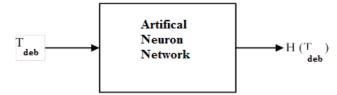
Fig.2. Simulating of the reliability of a software system using artificial neural network model.

V DEVELOPMENT OF A MODULAR COMPUTER SYSTEM FOR SIMULATING SOFTWARE RELIABILITY

Artificial neural network can simulate the operation of any of the algorithmic device, but the cost of such a model is quite high.

It is necessary to develop a model taking into account the requirements of its efficiency and cost of implementation. For the simulation of algorithmic processes involved quite a large number of neurons.

In implementing the program ANN method will lead to significant time delays for simulating the ANN, when implementing hardware or software and hardware methods, this will lead to a significant complication of hardware solutions.

The developed model of software reliability is used quite a number of operations and exponentiation summation. To implement this model was developed by a multi-layer modular computing system. Multilayer modular computer system includes a plurality of layers. Each layer contains different types of modules - algorithmic and intelligent. Intelligent modules include fragments of the ANN.

This system includes intelligent modules (similar to subnets of ANN) and algorithmic modules that perform exponentiation operations and summation.

Complex computational procedures perform algorithmic modules. Decision-making, pattern recognition, forecasting and other tasks corresponding artificial intellect methods are performed by intelligent modules that contain fragments of trained artificial neural network.

Features and benefits of the implementation of the software reliability model based on ANN described in [3,4,10-14]. This models were derived from the mathematical models (3) and are the new reliability models, called neuron network models.

VI DEVELOPMENT OF MULTI-LAYER STRUCTURE OF A MODULAR COMPUTER SYSTEM FOR SIMULATING RELIABILITY

The predictive model of reliability of software (2) allows obtaining an estimation of the failures flow rate and software system as the sum of exponents of linear functions of time debugging (3).

Assume that each of the terms in equation (3) is realized by the individual fragments of the neural network. Then, the

ANN for the entire model generally consists of several such fragments.

Note that the ANN is used to model the reliability of the software is a special kind. In fact, this is a group of the ANN similar standardized elementary modules. Each module simulates a single term in (3) - exponential of a linear function of debugging time.

Interconnected modules form in their totality the intellectual network. This network is different from the traditionally accepted horizontally layered neural network. Developed network has vertically layers. A typical form of such a neural network is shown in pic. 3.
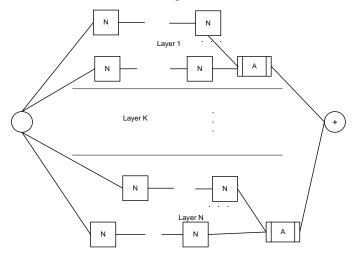
Fig. 3 Structure of vertically layered intelligent network

The structure of the vertically-layered intelligent network includes - individual neurons (N), self-contained pieces of ANN (intelligent modules), and algorithmic modules (A). Algorithmic modules provide, such as addition and exponentiation.

Since the model is composed of a plurality of individual layers, its implementation called multilayer computing system.

Figure 3 shows the horizontal layers ANN. Each layer includes fragments of the ANN, and the last element in the intellectual network layer is an algorithmic unit that performs exponentiation.

Inputs were received simultaneously on all layers, each layer was processed in parallel and provided to summer as the output.

It should be noted that vertically-layered network is a special type of network that was not described in the literature yet, but may have significant practical application for solving some classes of problems, such as the problem of complex non-linear approximation of empirically derived data, functions or mathematical statistics.

Vertical layered ANN is the characteristic of mathematical or statistical simulating of processes and functions that can be described by the formula:

$$F(x_1, x_2, \ldots x_\kappa) = \sum_{i=1}^{\kappa} f_i(x_i) \tag{4}$$

For this class of processes and functions the ANN has the ability to use the new training method based on the sequential addition of layers. In the case where $f_i(x_i)$ is a decreasing sequence of functions, it is possible to train the ANN with a given level of accuracy of their decision, without the need to previous determine the strickt number of terms in formula (4).

CONCLUSIONS

1. The complex of the mathematical and neuron network models for the software reliability estimation was developed. This complex is universal and allows to evaluate the reliability, as to procedural and object-oriented software.

2. To implement the neuron network model of software reliability has been developed multilayer neuron networks and computing systems, which were protected by patents.

3. Multilayer computer system provides an estimation of the failure rate as the function of of the software debugging time.

4. Improving the precision of the software reliability estimation is achieved by increasing the number of layers in a modular computer system.

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Optimization of the Complex Software Reliability of Control Systems

Sergey A. Sheptunov, Maksim V.Larionov,
Institute for Design-Technological Informatics RAS
Moscow, Russia

Nataly V. Suhanova, Il'ya S. Kabak,
Dana A. Alshynbaeva
Moscow State University of Technology (STANKIN)
Moscow, Russia
ikabak@mail.ru

Abstract-**Development of complex program software of automated control systems is connected with essential expenses. Failure of the software can lead to control system fail as a whole and to connected with these economic or other losses. Ways of rational decrease in expenses and losses are given in this article. In article three questions are considered:**

Problem definition of optimization of reliability of the software and method choice.

The solution of an optimizing task on the basis of Bellman's principle

The solution of an optimizing task with use of artificial intelligence.

The approaches offered in article are protected by patents of Russia.

Keywords- optimization of expenses; optimization of losses; simulating; reliability of the software; artificial neural networks.

I INTRODUCTION

The costs of developing complex software for automated control systems depend on the requirements for its quality and in particular to its reliability. Software failures of automated control systems are connected not only with large financial losses but can also create dangerous situations, threat to the life and health of people. The essential differences of this software class are a logical complexity (a number of conditional branches in the program text), and the necessity for the usage of expensive and sometimes unique equipment for complex debugging. Reliability growth of software for automated control systems is an important and relevant task.

In practice, the task of the software reliability growth under restrictions on costs and total debugging time appears. Another task is debugging timing between modules comprising the software of industry control systems.

In this article the predictive reliability model implemented on the basis of artificial intelligence using artificial neural networks is used to evaluate the costs of software development.

II COST ESTIMATION OF SOFTWARE DEVELOPMENT

Total costs of software reliability growth include two elements.

The first element is the costs per unit of software product debugging. Costs of searching and troubleshooting in the software product are proportional to the debugging time and include the costs of: the equipment rental of the production complex, computers and other supporting equipment, the cost of workpieces and tools under non-productive activities, salary for specialists, electrical and thermal energy, and others.

These costs are shown with the dashed line in picture 1:

$$C^1 = c \cdot \Delta t \tag{1}$$

where c is the cost per unit in a unit of time, Δt - debugging time.

The second element is the loss in case of the software failure. Every software failure leads to some losses. To determine the losses from software failure, it is necessary to know the dependency of failure rates on debugging time. This dependence was described in the articles of the authors [8-12].

The failure rate was determined by the author's software reliability model [8]:

$$H(t) = \sum_{i=1}^{N} a_{i.} \cdot \exp(-b_i \cdot t) \tag{2}$$

where N is number of operators or classes which are different on the reliability; $a_1, a_2, a_3, \ldots, a_N. b_1, b_2, b_3, \ldots, b_N$ — coefficients of the model equation.
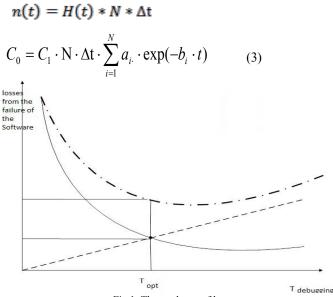
Let's specify the average cost of software failure C_1 in time Δt and obtain a formula relating the losses from the control

system software failure with C_0 to the number of failed operators or classes of n (t) in the interval Δt:

$C_0(\Delta t) = C_1 * n(t)$

In picture 1, the curve is depicted with continuous line.

Substitute the value of H(t) =n(t)/N/ Δt from formula 1 and as a result obtain:

$$n(t) = H(t) * N * \Delta t$$

$$C_0 = C_1 \cdot N \cdot \Delta t \cdot \sum_{i=1}^{N} a_{i.} \cdot \exp(-b_i \cdot t) \qquad (3)$$

Fig.1. The total cost of losses

The total cost of the losses from software debugging can be defined as the sum of both losses (4):

$$C = C^1 + C_0 = c \cdot t + C_1 \cdot N \cdot \Delta t \cdot \sum_{i=1}^{N} a_{i.} \cdot \exp(-b_i \cdot t) dt$$

In picture 1 the total costs are shown with dot-dashed thick line. Function C has a minimum, as illustrated in pic. 1. Thus, there is an optimal time software debugging (T_{exc}) for which the total financial losses are minimized.

For complex technical systems in mechanical engineering under software debugging the most important will be the factor of the production equipment idle time. If the cost of the metalworking equipment exceeds 10 million U.S. dollars, the depreciation expense will be from 1 to 2 million per year or about 5-10 thousand U.S. dollars per day or about $ 1000 per hour.

III PROBLEM STATEMENT OF SOFTWARE RELIABILITY OPTIMIZATION AND THE CHOICE OF A METHOD

In work [8] there is a formula linking the software failure rate to its structure, the failure rate of its modules and runtime of modules. According to this formula, the software failure rate is:

$$H(t_1, t_2, \ldots, t_N) = \sum_{i=1}^{N} v_i \cdot h_i(t_i) \qquad (5)$$

where $h_i(t_i)$ is failure rate of modules of i-type, t_i - time of debugging of this module type, v_i – coefficient of frequency.

The dependence H(t) is considered in work [9], where the results of mathematical modeling of reliability are given. It was found that the value of the function H(t) is defined by the formula (6):

$$H(t) = -\sum_{i=1}^{N} v_i \cdot \frac{1}{\tau_i} \cdot ln\left[1 - \left(1 - \alpha^{-h_i^0 \cdot \tau_i}\right) \cdot \alpha_i^{\frac{t}{\sum_{i=1}^{N} v_i \cdot \tau_i}} \right] \qquad (6)$$

where v_i is the probability of i-type module, τ_i -time of its work ,- α - complex coefficient that takes into account the speed of debugging and a number of other parameters.

The dependency of failure flow rate on time of software work t is non-linear.

The total debugging time T_0 was fixed. This time consists of times of debugging of all modules. Time debugging of each module is a non-negative value:

$$\begin{cases} T_0 = \sum_{i=1}^{N} t_i \\ t_1 \geq 0, t_2 \geq 0, \ldots, t_N \geq 0, \end{cases} \qquad (7)$$

Changing the value t_i while meeting the system constraints (7), will obtain different values: the function $H(t_1, t_2, \ldots, t_N)$.

Set the problem to minimize the value of the software failure rate $H(t_1, t_2, \ldots, t_N)$ (6) under the constraints (7). Taking into account the non-linear functions $h_i(t_i)$, the optimization problem can be solved by methods of nonlinear mathematical programming.

Most of the methods of nonlinear programming has no constraints on the number of optimized variables N and t_i. With growth of N, the complexity of the calculations increases sharply, making it difficult to practical use. Real software for automated control systems consist of 100-500 and more software modules. With such large values of N many of the non-linear programming methods are not acceptable because of the large time relevant to these optimization methods programs.

The software often consists of small volume and simple structure of software modules. It is such software organization

which typically is aspired to create software systems of large volume such as software of FMS.

For this particular case an algorithm to optimize the reliability of the software, based on the principle of Bellman was proposed [4,5].

IV THE SOLUTION OF THE OPTIMIZATION PROBLEM BASED ON THE PRINCIPLE OF BELLMAN

Failure rate depending on time debugging can be estimated by the formula [2]:

$$h(t) = -\frac{1}{\tau} \cdot ln\left[1 - P^0 \cdot \alpha_i^{\frac{t}{\tau}} \right] \qquad (8)$$

Expand the logarithmic function

$$ln\left[1 - P^0 \cdot \alpha_i^{\frac{t}{\tau}} \right]$$ in a time series and substitute the

expression:

$$h(t) \approx \frac{1}{\tau} \cdot \sum_{j=1}^{\infty} \frac{\left(P^0 \cdot \alpha^{\frac{t}{\tau}} \right)^j}{j} \qquad (9)$$

Note that the value P^0 is very small and is 0.01-0.03. The value of α does not exceed one. Under razing to the index j the product $\left(P^0 \cdot \alpha^{\frac{t}{\tau}} \right)$ will decrease rapidly. The second element of the time series is not less than 100 times, and a third element is at least 15,000 times less than the first element of the time series.

Without a significant loss in accuracy, we can restrict only the first element of the time series:

$$h(t) = \frac{P^0 \cdot \alpha^{\frac{t}{\tau}}}{\tau}$$

Perform the second member of this equation to exponential form:

$$h(t) = \frac{P^0}{\tau} \cdot exp\left(-\frac{ln\left(\frac{1}{\alpha} \right)}{\tau} \cdot t \right)$$

To simplify further calculations, denote:

$$\frac{P^0}{\tau} = \beta$$

$$\frac{ln\left(\frac{1}{\alpha} \right)}{\tau} = \gamma$$

Then we get:

$$h_i(t) = \beta_i \cdot exp(-\gamma_i \cdot t) \qquad (10)$$

Substituting (9) into (6):

$$H(t_1, t_2, \ldots, t_N) = \sum_{i=1}^{N} v_i \cdot \beta_i \cdot exp(-\gamma_i \cdot t_i) \qquad (11)$$

The system of constraints (7) remains unchanged.

To optimize the function of the failure rate defined by the expression (11), use the method of dynamic programming, i.e. compose a sequence of recurrent formulas (12):

$$f_k(T_0) = \min_{0 \le t \le T_0} [f_{k-1}(T_0 - t) + v_k \cdot \beta_{ki} \cdot exp(-\gamma_k \cdot t)] \qquad (12)$$

Where, $f_1(T_0) = v_1 \cdot \beta_1 \cdot exp(-\gamma_1 \cdot t),$

$$\qquad (13)$$

Formula (12) includes the sum minimization operation of two functions, one of which is an exponent function. It can be shown that the function $f_k(t)$ for any admissible value of k will also be exponents. The proof of this statement is made in [8].

The minimization operation necessary for calculations by formulas (12) and (13) is associated with certain difficulties. To pass the next step – the value increment to k, one must define a function $f_k(t)$ in the interval $0 \le t \le T_0$..

For the calculated recurrent formulas we differentiate the expression (12), in square brackets (for k = 2) and equate the result of differentiation to zero, as is the convention in solutions of the extreme problems of classical mathematical analysis.

Solving the resulting equation with respect to t_1, and substituting it into the expression (12), we obtain an analytic expression $f_2(t)$. We present an expression for $f_2(t)$ to (13) and define the corresponding values of the coefficients of the new exhibitors and the argument t.

Proof of competence described above mathematical operations and a detailed derivation of the recurrent formulas is given in [1].

These recurrent formulas can be the basis for the development of an efficient optimization algorithm for the special case when the optimized function is the sum of the exhibitors.

To evaluate the practical results of the software reliability optimization the failure rates values of real software subsystems of Flexible Manufacturing System (FMS), as the chief

dispatcher of control system, were analyzed. Values of achieved failure rates were considered under commonly used nowadays technique of the allocation of time debugging when all program modules debug to approximately the same size of failure rates and under optimal planning of the time sharing.

The analysis was conducted on a range from 1500 hours to 3500 hours, which corresponded to a change of failure rate from $2,3*10^{-4}$ to 2.48×10^{-7} (mean time between failures ranged from 1.2 hours to 1140 hours). Usage of optimization reduced thee debugging time to 9- 20% compared to the same level of reliability without optimization.

V THE SOLUTION OF THE OPTIMIZATION PROBLEM WITH THE USE OF ARTIFICIAL INTELLIGENCE

Solve the optimization problem by a cost function C defined by formula (4), using artificial neuron networks (ANN).

Note features of this approach. First, instead of using the ratio of the formula (3) to define the function of the failure flow rate of ANN will be used similar to described ones in [10-12] and trained by the layer-by-layer method of ANN training, stated in [12-14]

Assume that ANN has been trained for a specific software system. Use the trained ANN to solve optimization problems by means of genetic algorithms.

Using genetic algorithms the initial value of the variables has the particular importance Since the formula (4) uses only one parameter - debugging time, the optimization is carried out for a single variable.

At the initial stage of optimization define the initial approximation. For this simplify extremely the task and will use only one exponent for simplicity instead of the sum of exponents.

Then, for the first approximation optimized function will be as follows:

$$C = c' \cdot t + C_1 \cdot a_i \exp(-b \cdot t)$$

The value t_0 is selected as a first approximation to the extreme.

Then, optimize the use of genetic techniques. Obtain the optimum time of software debugging – T_{opt}

CONCLUSIONS

1. The problem of the cost minimizing of the complex software development was set and solved in this work. To solve this problem it is necessary to minimize the software failure rate for a fixed debugging time. Minimizing of the failure rate is reduced to the classical problem of mathematical programming. Thus the failure rate is represented as a function of several variables, of debugging time and failure rates of software modules - software components.

2. It is shown that most of the methods are not applicable to non-linear programming optimization software reliability FMS.

3. Under the modest simplification of the mathematical model of software reliability without significant loss of accuracy, it is possible the application of the Bellman principle. On the bases of this principle recurrent formulas were derived, allowing to define debugging time of software modules.

4. The optimization problem of software reliability of complex control systems was solved using the methods of artificial intelligence - ANN and genetic algorithms.

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The Decision of Applied Problems of Designing Productions with the Use of Combined Genetic Algorithms

Aleksey Kh. Tlibekov[1], Martin M. Yakhutlov[2]
Kabardino-Balkarian state University (KBSU)
Nalchik, Russia
[1]tlibekov@weber.ru,   [2]martin_yah@mail.ru

Abstract— **Discusses the design of machine-building production, certain steps of which are formalized problems of the forecast of the number of parts and calculate their estimated time. Simulation of application tasks is performed by the approximation of the fractional - power series. The possibility is shown for the numerical solution of models using combined genetic algorithms.**

Keywords— mathematical programming; genetic algorithms; multi-parameter problems; multi-criteria problems; multi-modality goal functions; the fractional-power series; approximation; controlled parameters; manufacturing engineering

INTRODUCTION

In the manufacturing engineering to solve various tasks [1, 2]. Consider two of them: the forecast of the number of parts and the estimated time production of parts.

The forecast of the number of parts required, because that depends on the cost of upgrading technology. For the decision of tasks of the forecast Microsoft Excel uses the methods: "Forecast using a linear function", "Forecast using exponent" and "Prediction".

The estimated time production of parts depending on model of equipment can be calculated by various methods. When designing new technologies is most often used CAD. They are used for programming of control and they contain the estimated time. If necessary the calculation of several hundreds or thousands of parts have problems - while working on the project multiplied. Application tasks are tasks of mathematical programming. Such tasks have a large number of parameters (multi-parameter problem). Changing these parameters within the specified limits it is possible to define optimality criteria (multi-criteria problem). Optimality criteria are added to the goal function, which is determined by computing their optimal values. The problem is how to choose the best solution when the hypersurface defined goal function has some local extrema (multi-modality). This is one of extrema global, there is a solution to the problem. There is the possibility of defining one of the local extrema as a global.

Another problem is when the hypersurface defined objective function has no "breaks", "face" or "plateau". In the result, it is impossible to apply efficient computational algorithms based on derivatives.

Among the methods for solving multi-parameter, multi-criteria and multi-modality problems in the most efficient algorithms are the LP-search [3], Behavioral algorithms, such as the Bees algorithm [4, 5] and Genetic algorithms [6, 7].

I. STATEMENT OF THE PROBLEM OF MATHEMATICAL PROGRAMMING

The boundaries of which change the parameters $\alpha_1,...,\alpha_r$, or "parametric line" $\alpha_j^* \leq \alpha_j \leq \alpha_j^{**}$, $j = \overline{1,r}$, form an r-dimensional parallelepiped P the set $D \in P$. The length of the faces of the parallelepiped $I_j = \alpha_j^{**} - \alpha_j^*$ defines the length of the "line of uncertainty".

"Goal function" or "optimality criteria" $\Phi_\nu(\alpha), \nu = \overline{1,k}$ enable to compare alternative options of parameters.

"Optimality principle": the optimal solution is found when all optimality criteria have improved their values, i.e., those that should be increased - increased, and those which should decrease - decreased (the principle of Pareto optimality). According to this principle is required to find a Pareto set $P \in D$ for which $\Phi(P) = \min_{\alpha \in D} \Phi(\alpha),$ where $\Phi(P) = \{\Phi_1(\alpha),...,\Phi_k(\alpha)\}$ is a goal function. The solutions define a vector of parameters α^0 belonging to the set P and is the most preferred (or optimal) of all vectors of this set.

II. COMBINED GENETIC ALGORITHM (CGA)

The algorithm (Fig. 1) is the combination of two methods: "Passive search" and "Genetic algorithm" [8, 9]:

1. Setting the parameters for the Passive search (deterministic method). For each parameter, dividing the line of uncertainty I_j on F_q equally spaced points, where F_q is the number of the Fibonacci sequence. The sequence number q ≥ 10 Fibonacci numbers is the integer part of the maximum length of the line of uncertainty. Create a matrix of

parameters: rows of the matrix represent a linear grid for each parameter, the matrix columns contain the various parameters.

2.   The calculation of the optimality criteria for the parameters. By solving the equations of the model for each of the options create a matrix of optimality criteria.

3.   Returns the minimum value of the goal function.
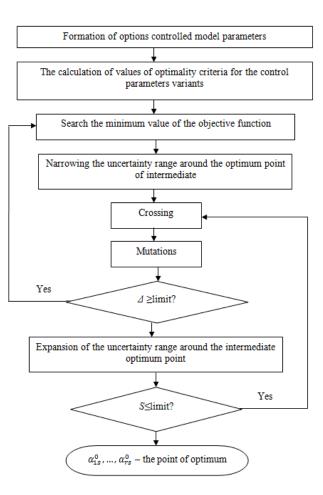
Fig. 1. The block diagram

4.   Narrows about a point intermediate optimum: $\alpha_j^* = \alpha_j^0 - K_c I_j$, $\alpha_j^{**} = \alpha_j^0 - K_c I_j$, where the $K_c < 1,0$ to the narrow ratio in the length of the line of uncertainty.

5.   Hybridization.

5.1.   The creation of the first "population of individuals" (formation parameters) deterministic method and the random number.

5.2. Hybridization of "individuals" the method of "panmixia". Generates a random number $1 \leq t \leq K_t$ (integer) and $0,0 \leq p \leq 1,0$. The situation matching numbers t excluded. Each "genes" (or parameter) is one of the numbers t. The mating pair is formed by choosing two pairs of random numbers t_1 and t_2; p_1 and $p_2 = 1,0 - p_1$. The creation of a new "genes" (new parameter) $\alpha_j = p_1 \alpha_{t_1} + p_2 \alpha_{t_2}$. New "genes" which form new "chromosomes" (one variants of parameters) and the new generation (all variants of the parameter values) of K_t "individuals".

6.   Calculation of "fitness of chromosomes". For each "chromosome" of the initial "population" is calculated its "suitability" (or for each parameter, calculate the value of the goal function). The minimum value of "fitness" corresponds to the "prospective chromosome."

7.   Mutation. Changed each "genes" prospective chromosome α_j^0 within $\alpha_j^* \leq \alpha_j \leq \alpha_j^{**}$. Calculates the "fitness" of mutated chromosomes and searches for the minimum value of "fitness".

8.   The increase in the length of the line of uncertainty around the point intermediate optimum: $\alpha_j^* = \alpha_j^0 - K_p I_j$, $\alpha_j^{**} = \alpha_j^0 - K_p I_j$, where $K_p \geq 1,0$ to the zoom ratio.

9.   The computation stops when there is a limit to the number of cycles of the search S (the number of "generations of individuals") and is the set value of the goal function Δ at each step of the iteration.

10.

Passive search of low realized in the first four blocks of the algorithm. As a result of his work is determined by the point of the intermediate optimum and the genetic algorithm (blocks 5 and 6) starts on the narrower lines of uncertainty which contains the optimal parameter values. Cyclic contraction and expansion of lines of uncertainty allows you to explore more parameters and reliably determine the minimum value of the goal function.

III.   FRACTIONAL-POWER SERIES

Fractional - power series, or series Puise with one variable is an algebraic expression of the form: $F(x) = \sum_{n=n_0}^{+\infty} \alpha_n x^{n/m}$, where the number n_0 is an integer, the number m is a natural (at m = 1 obtained by the usual power series), the coefficients a_n are rational numbers. Approximation of tabular values of functions of several variables was carried out on a limited sample of k tabulated values of the fractional - power series Puise from a few arguments x.

$$f(\alpha) = \sum_{i=1}^{d} A_i x_i^{\lambda_i} + \sum_{i=1}^{d-1} B_i x_i^{\beta_i} x_{i+1}^{\gamma_i} + B_{1d} x_1^{\beta_d} x_d^{\gamma_d} + C \prod_{i=1}^{d} x_i^{\delta_i},$$

where, $f(\alpha)$ - response of the model; the parameters α are designated as $B,C,\beta,\gamma,\delta,\lambda$, and for $d=1$, $f(\alpha) = A x^\lambda$, for $d=2$, $f(\alpha) = A_1 x_1^{\lambda_1} + A_2 x_2^{\lambda_2} + B x_1^{\beta} x_2^{\gamma}$.

IV.   THE FORECAST OF THE NUMBER OF PARTS

The purpose of the forecast is the calculation of the unknown values perspective the number of parts you plan to manufacture. Forecast method based on a statistical model of the number of parts produced in previous years.

On the basis of statistical, probabilistic and empirical principles, the forecast is 100% chance is impossible. The accuracy of the forecast is true (verified) the number of parts, which are manufactured in past years, not verified (planned) number of parts in the current year, the direction of the trend in the number of each parts and methods of forecast. Arguments model statistical prediction ($x_{i,j}$) is the number of each n ($i = 0, ..., n$) of parts that were made for m ($j = 0, ..., m$)

of past years. Investigated the response of the model – number of parts, that must be manufactured in the current year

$$f = f(x_{i,j}).$$

The goal function is the difference between the estimated and the actual number of parts $(f_{es} - f_{ac}) \rightarrow \min$.

The method of model approximation of the fractional - power series by minimizing the goal function. The relative error of the model

$$\varepsilon = \frac{f_{es} - f_{as}}{f_{as}}.$$
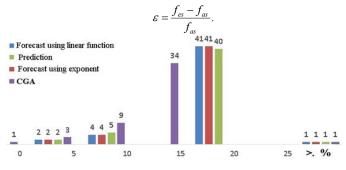
Fig. 2. The forecast error distribution, obtained by different methods

The results of the error calculation methods of statistical forecast is shown (Fig. 2) that the minimum error obtained by using combined genetic algorithms: the error of the forecast, 47 of the 48 parts is no more, then 15%.

The error is less than 15% obtained by the method of forecast using a linear function and using exponent for 7 of the 48 parts, and by prediction for 8 of the 48 parts.

V. CALCULATION OF ESTIMATED TIME PRODUCTION OF PARTS

Estimated time production of parts determines the number of manufactured parts (N_i), nomenclature (n), main (t_{oi}) and minor ($t_{вi}$) processing time of one part:

$$T_{bt} = \sum_{i=1}^{n} (t_{o1} + t_{b1}) N_i.$$

We define the accuracy of approximation based on the results of previously performed projects. Consider the laser cutting of sheet metal. In factories that manufacture parts with laser cutting, determined the actual time of cutting (response of the model) and measures of design 594 parts: thickness and tension of the sheet material, laser cutting the perimeter and the number of frames (argument). To check the accuracy of the approximation CGA, choose a group of parts k = 15 parts (2.5% of the total number). The approximation is performed on the k values of the time. As a result of the approximation had the coefficients and exponents of the fractional - power series. The estimated time production of parts was calculated by fractional - power series.

In a similar way obtained the original data and the approximation of estimated time production of parts on punch press and press brakes.

The table shows the approximation error of estimated time production of parts (ε) and computation time (t) on a computer

with processor Inter® Core™ i7-3630QM CPU @ 2.40 GHz 2.40 GHz and RAM of 16.0

RESULTS

1. The processes of change the number of parts and their estimated time of production contain random and deterministic components. Modeling of these processes made fractional-power series from a few arguments. The approximation error obtained by the solution of the model using a combination of the two methods containing blocks of random and deterministic search. The managed parameters in the Hybridization of "individuals" is done by random numbers, to block Passive search - a dividing line of uncertainty into equal segments.

Another feature of the combined algorithm is a process for the periodic increasing and narrows length of uncertainty line about a point intermediate optimum. The work of the CGA does not require initial values of the parameters. They are set when the passive search by increasing and narrows the length of the line of uncertainty.

2. The approximation estimated time of production allows to perform the calculations with the accuracy acceptable for practical use, and reduces design time. In this case, the simulation processing in the special CAD, or timekeeping to ensure accurate calculation of estimated time of production can be calculated for a small number of parts. In our cases (see table) to calculate the time punching on punch press from all parts, the simulation is performed only for 18% of the parts; for bending - for 17%, and for cutting laser for 2.5% of the parts. In this case, the approximation error of estimated time of production did not exceed 6%. If used for the approximation of large sample details, you can really improve the accuracy of the calculations.

TABLE. THE RESULTS OF EVALUATION OF APPROXIMATION ERROR

Technology and equipment of LVD company (Belgium)	Indicators of a real project		Indicators of approximation		ε, %	t, min
	n	T_{et}, min	k	T_{et}, min		
Punching on punch press Strippit V-30 1225	38	57,2	7	59,2	3,5	2,6
Free bending on press PPEB-EFL 80/15	23	111,1	4	110,5	-0,53	2,8
Laser cutting machine Axel-S Liner 3015	594	5434,8	15	5129,2	-5,6	33,8

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Methods of Quality Management of Innovation Process

Victor A. Vasiliev, Sergei A. Odinokov, Ekaterina V. Borisova, Gennady M. Letuchev

Moscow Aviation Institute (National Research University)

Moscow, Russia

uks@mati.ru

Abstract — **This paper is about process management in a limited amount of data. This situation is typical for innovation processes, with a little history, and at the time of the introduction of new products. It proposed a number of methods of quality management: technological audit, the iterative improvement of the quality, comprehensive statistical analysis and multivariate data analysis.**

Keywords— quality management, technological audit, decomposition of processes, statistical analysis, iterative improvement, analysis of data.

Creation, introduction and continuous improvement of quality management system, on the basis of standards of the ISO 9000 series are the well-known solution of the main objectives in the field of quality put today into practice for the enterprises of various branches. Implementation of requirements of the state standard specification GOST R ISO 9001-2015 standard gives the chance to create base for planning of activity, providing necessary conditions for work, management of the corresponding processes, improvements of production, etc. Level of achievable result is connected with degree of development of the decision and the accounting of features of this enterprise. Application of statistical methods for management of processes can be a characteristic with example. In this case there can be questions on management such as a choice of key process, a choice of parameters for control, a way of collecting, processing, analyzing and data storage, ways of decrease in influence of the destabilizing factors, etc. Firstly, there can be no clear understanding of a role of the influencing factors. Secondly, there is no enough data for the full statistical analysis and adoption of the relevant administrative decision at the initial stage of introduction. It is characteristic also for processes of receiving production by small various parties that is characteristic for innovative processes. It is offered to apply a number of additional methods and campaigns in such conditions for the solution in questions of quality management.

1. Application of process audits to assess and improve quality assurance is a comprehensive examination and identifying opportunities for process improvement, including the procedure of technological audit to confirm the outcome of an objective assessment of its potential.

The main technological difference of audit from audit of the quality management system is to focus inspection on one key process is usually most difficult in technical terms. Proposed three-stage model of assessment and capacity building of the technological process using a sequential application of the cycle PDCA or "Plan – Do – Check - Act".

a) Stage "Technology audit - Planning" is assumes in the first stage a set of and sequence of organizational and technical measures, including the formation and participation of a team of highly qualified specialists of the enterprise, planning of works for the inspection. In the second stage is formed by an initial set of criteria for the technical validation and audit process. With this aim takes into account both the requirements and provisions of GOST R ISO 9001-2015 and the requirements ESKD, of ESTD, ESTP for in-depth evaluation of the technology component. It is proposed the formation of lookreally structure, including additional sub-criteria, showing the main criteria in the form of a tree diagram. The third stage involves the analysis of primary criteria to pre-identify possible evidence of audit during future inspections. This creates a list of elements that the reviewer would like to see and confirm at the time of audit. The fourth stage involves the formation of a controlling package of documents and, above all, the questionnaires for the procedure of self-evaluation.

b) Stage "Technology audit - self assessment" is conducted by the process owner, and includes the planning stage of the self-assessment of its implementation, the formation of a set of evidence, based on the original, but augmented during its own checks. It is also assumes the implementation of corrective actions in case of lack of conformity of individual demand. The possibility of offering its own evidence of the audit is explained by the fact that during the examination of the innovation process owner of this process is usually the developer and has exceptional knowledge about the process.

c) the Stage of the "Technological audit – External audit" is involves the planning of inspections based on established criteria and expanded list of relevant evidence about the process and specification of testable components, the implementation of selective audit, results and conclusions. Thus, during the audit, the conditions when both parties have already exchanged information. The reviewer clearly knows what he needs to see and takes the least time. Check side knows what is required of her. This contributes to the implementation of the eighth principle of Deming, which is defined as "the removal of fear", in this case from the audit. Also provided by the more active involvement of employees in process improvement, allowing audit to be carried out with minimal effort.

2. The following recommendation is the use of iterative quality improvement of the technological process based on the polynomial dependency of the parameters. It is recommended for management under conditions of limited amount of data collected and is intended to support continuous process analysis by ensuring that identified requirements in terms of exposure to a large number of factors. Recommendation is related to the inability to collect enough data to build a full checklist. The presence of the variation is explained by the improvement of the process, a refinement parameter, the refinement of the process and desire to obtain a different product solutions. The model management is understanding the connections between input and output parameters of the process. Through the use of numerical methods and iterative control it is possible to view the output parameters in the form of polynomial functions of input parameters. This allows you to clear dependencies, easy to control process quality and to predict production results, it is important in the implementation of the quality management system, and when learning a new or a statistically unstable process.

3. The use of the model for process control on the basis of the sequential decomposition and evaluation of the interaction and influence of individual factors on the quality of the finished product using the system of algorithms of analysis, management, and sequential improvements based on the integrated use of statistical methods.

The proposed action is aimed at identifying, ranking and use of key technological parameters in two areas – the presence of the maximum level of variation and the role in shaping the final results. The methodology program is including:

a) Organizational-technical measures on the basis of a decision about running for the given process.

b) Analysis of technological process with the definition of system sub-processes in the form of graphical models and evaluate their importance relative to impact on product quality.

Collection of statistical data about the quality of the technological process, including inspection planning, statistical monitoring, processing of results of research (construction of variational series, characterization of the distribution center of the variational series (mid-level and structural characteristics), determination of size and intensity variations, characterization of the shape of the distribution), initial evaluation of the stability of the process. Approximation of distribution law of the experimental data is based on the verification of statistical hypotheses about the distribution of data.

c) Multivariate correlation and regression analysis in order to determine key quality indicators, identify the destabilizing factors and choosing the direction of improvement.

When modeling high-speed solidification in a simplified version used steam regressions that exclude minor factors influencing the formation of products. With increasing accuracy of the study these factors are added sequentially as possible items to build multiple regression models. Estimation of parameters of the multidimensional model, as in the case of pair regression is based on the traditional method of least squares.

d) Evaluation of the accumulated contribution of intermediate indicators of sub-process in the expectation and/or variance values of the indicator of product quality, and growth rate to determine the difference between the coefficients of the contribution of the output of the subprocess and the ratio of deposits of the previous process.

e) Analysis of trends and fluctuations in quality metrics. For analysis and assessment of technological process on the basis of identification and monitoring of trends proposed a statistical alignment and the use of a set of statistical indicators, including absolute growth levels, growth rates, and absolute, relative and average indicators.

f) Assessment of capabilities and stability of the process, including multiple choice test cards. The features of the process and, in particular, the presence of trends leads to the need for the use of cards of cumulative sums, providing for assessment of permanent displacement values of quality indicators. In addition, it is proposed a control chart that reflects the relative valuation of the variations and allows to control the process with a small controlled changes.

4. Evaluation method of destabilizing factors and quality improvement processes is based on the technology of multidimensional data analysis is an approach aimed at creating a single information space to facilitate the detection and elimination of adverse conditions of production.

Proposed the following sequence of actions to transform the single information space data:

a) The collection and classification of data is performed with using specialized forms of collection of process parameters and quality indicators, which is a database object. The system of classifiers is designed for a systematic representation of control objects necessary for the implementation of the management process.

Compliance with the collection and classification rules allows you to create a single information space of the quality management system.

b) The accumulation of data in a multidimensional storage by using the technology of analytical processing that allows to combine disparate data. IDs products provide the link between process parameters and quality indicators. A data warehouse is a database specifically designed for analysis of production and technological process with the purpose of decision support to prevent inconsistencies and improve product quality. The repository is based on a client-server architecture and relational database.

c) Analysis process by using developed algorithm, which allows to carry out a number of necessary actions, such as preparing data for analysis, creating arrays of parameters, the calculation of complex parameters and formation cards warning for detecting the destabilizing conditions of different factors and improve

As a result of comparison it is formed the set of process parameters that require greater attention because of the destabilizing impact on product quality. Revealed the destabilizing conditions are decoded and recorded in the card prevent non-conformities or reduce losses.

Realization of these approaches was carried out to MAI by group of graduate students of department "Quality Management and Certification" for improvement of the technology of high-speed hardening of fusion allowing to create a wide range of materials with unique properties which difficult or can't be received by traditional methods. For example, it is necessary for forming the steel fiber for making porous permeable materials and when receiving a wire of hardly deformed solder on a copper basis.

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Investigation of the Thermal Mode in the Composite Diamond-bearing Material in a Polymer Matrix

Martin M. Yakhutlov[1], Umar D. Batyrov[2], Marianna R. Kardanova,
Astemir A. Gutov, Zalim N. Deunezhev
Kabardino-Balkarian State University (KBSU)
Nalchik, Russia
[1]martin_yah@mail.ru,   [2]ubatyrov@yandex.ru

Abstract— **The simulation of the temperature field in the diamond-polymer matrix system was conducted. The influence of the matrix's thermal conductivity on the temperature field was explored. Ways of reducing the thermal load on the tool were suggested.**

Keywords— diamond; polymer matrix; numerical modeling; thermal conductivity; temperature field

Diamond grinding wheels on polymer matrices are widely used in engineering. It is explained manufacturability of their production, and the fact that the tool on the polymer matrix has a number of operational advantages and characterized by a large variety of properties.

The working part of wheels represents a diamond-bearing composite tool - a matrix system in which a binder is a continuous phase and diamond grains distributed therein as impurities. It is known that the main problem in the development of such materials is to ensure firm establishment of solid phase particles in the matrix and at the same time the maximum preservation of its chemical identity under operating conditions. This is confirmed by research and experience in operating diamond abrasive tools, which show that the majority of diamonds fall out of the matrix, without reaching significant wear.

During the work diamond grinding wheels are experiencing significant thermal perturbations. Ratio of heat outgoing in the tool may be up to 80% of the total heat generation in cutting and the local temperature in the cutting zone can reach ~ 700° C [1].

This fact determines the urgency of the problem of reducing the thermal load on diamond abrasive tools on the polymer matrix, wherein the low thermal resistance of the binder (100-200ºC). In these composites as the temperature increase strength of grain retention decreases abruptly especially at a temperature of mechanical vitrification of polymer. Above this temperature the mobility of segments of the polymer chains are appears, connection between macromolecules of the phenolic binder and the diamond surface are weakened. Further heating due to heat energy fluctuations contributes rubbery deformation and destruction of bonds providing the strength of fixation of grains [2,3].
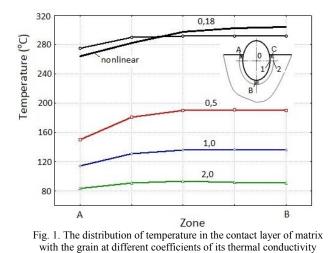
This work is devoted to the research of thermal processes in diamond grinding wheels on polymer matrix in order to develop methods to increase their efficiency.

The structure of the tool can select a diamond-matrix system, in which processes largely determine strength of retention in the matrix grain. The most effective way to research this system is the numerical simulation due to the complexity of experimental studies of the small grain size and heterogeneity of the composite properties [4].

Experiments on research of a temperature field in the system of diamond grain - polymer matrix were performed using finite element models. As an basic initial data in numerical experiments were adopted the parameters of the system, specific to the working conditions of diamond grinding wheels on bakelite binder. The thermal load on the system was set from terms of temperature corresponds to the known experimental data system [1,5].

The calculations were performed in the Cosmos / Works module of solid parametric modeling mechanical design system SolidWorks. Analysis of the results of calculations showing that the diamond grain in the process of warming up the instrument almost uniformly because of the low thermal conductivity of the polymer matrix. Fig. 1 shows a symmetrical temperature distribution in the contact with the grain layer of matrix with different coefficients of thermal conductivity of the matrix material $\lambda_{\text{м}}(\frac{W}{m \cdot K})$.

Fig. 1. The distribution of temperature in the contact layer of matrix with the grain at different coefficients of its thermal conductivity

Note that the value of the thermal conductivity $\lambda_{_M} = 0,18 \dfrac{W}{m \cdot K}$ corresponds to the use of bakelite binder. Numerical experiments have shown that the increase of matrix thermal conductivity results in a substantial decrease in the temperature in the system. With all the values of $\lambda_{_M}$ used diamond grain is warming almost uniformly. With the same heat load of basic variant with $\lambda_{_M} = 0,18$ corresponds to the average temperature in the grain 300ºC, $\lambda_{_M} = 0,5$ - 220º, $\lambda_{_M} = 1,0$ - 170º, $\lambda_{_M} = 2,0$ - 130º. The small temperature gradient in the grain is marked only in the cross section along the vertical axis of the grain.

As it follows from Fig. 1 the temperature in the transition layer (zone A-B-C) for a given value of $\lambda_{_M}$ also varies insignificantly - there is a slight decrease in approach to the cooling surface.

Temperature calculations were carried out at constant values of thermophysical properties of diamond, equal to their average values in the temperature range from 20 to 1000ºC.

Meanwhile it is known that the specific heat and thermal conductivity of diamond is greatly dependent on temperature (Fig. 2). Numerical experiments using the nonlinear model taking into account the relation have been carried out (Fig. 1). Calculation results vary by no more than 10%. Similar calculations for the tool on carbide matrix showed a difference of 20-25% [6].

Thus, numerical simulations show that because of the low thermal conductivity of bakelite matrix the diamond grains substantially uniformly warming during operation and stationary temperature field in the matrix greatly depends on its thermal conductivity. Note that the low thermal conductivity of the matrix is distinguished from the metal polymeric matrix (e.g., thermal conductivity carbide matrix M50 - $\lambda_{_M} \approx 150 \dfrac{W}{m \cdot K}$ [6]).

To improve the efficiency of diamond grinding wheels on polymeric matrix are often used coating the surface of the glass grains and metal (copper, nickel, tungsten, etc.). The simulation results of the influence of the thermal conductivity of the coatings on the temperature field are shown in Fig. 3 and 4.
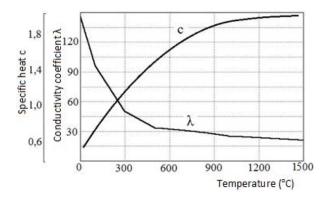
Fig. 2. Dependence of coefficient of thermal conductivity λ (W/(M·K)) and specific heat c (J/(kg·K)) of diamond of the temperature
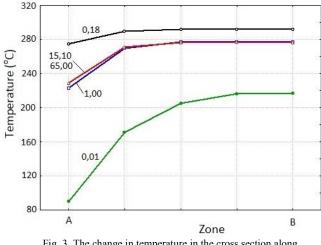
Fig. 3. The change in temperature in the cross section along the horizontal axis of the grain with different coefficients of thermal conductivity of the coating material

The coating material is taken widely used materials for this purpose - sodium borosilicate glass $(\lambda_c = 1,0 \dfrac{W}{m \cdot K})$, nickel $(\lambda_c = 65,0)$, and titanium $(\lambda_c = 15,1)$. To simulate the coating with extremely low thermal conductivity also used value $\lambda_n = 0,01$.

As can be seen from the pictures the most common application of the coatings does not significantly decrease the temperature of the matrix - for reducing the temperature of all material in the border with the coated layer is not more than 15ºC. Moreover this reduction is practically the same for all three coatings.

Significant reduction of the thermal conductivity coating (see graphics for $\lambda_c = 0,01 \dfrac{W}{m \cdot K}$) results to a corresponding reduction a temperature in the boundary layer of the matrix

coated and increasing the temperature of the diamond which is substantially aligned across the grain volume.

Fig. 4. The temperature distribution in the matrix contact layer with coated with different coefficients of thermal conductivity of the coating material

Simulation the influence of coating thickness on temperature field is carried out for two kinds of coating - glass and nickel, it showed that the thickness of the coating has practically no effect on the thermal field.

Thus, the results of numerical experiments disprove the widespread belief that these coatings provide thermal barrier dramatically reduces the impact of heat flows on polymeric binder [2].

Analysis of the simulation results shows that the increase in thermal conductivity of the matrix reduces the temperature in the matrix contact layer. For this purpose it is advisable to use special fillers with high thermal conductivity, mainly metal powders (copper, tin, bismuth, iron, etc.). Among the effective fillers for this purpose are marked as titanium dioxide, boron nitride, silicon carbide, molybdenum disulfide, carbon black, graphite, feldspar, nepheline, etc.

Usually the introduction of metal particles in polymers is not accompanied by an increase of physical and mechanical properties. At high concentrations of of dispersed metal filler is often observed a significant reduction in tensile strength and bending strength, because of the high porosity of the compositions obtained. Experimental data on epoxy resins filled with particles of iron and aluminum, indicate at complex dependence their physico-mechanical properties of the adhesive nature of the interaction at the interface boundary filler – matrix [7].

Fillers are generally used to create a given technological environment into diamond tool treatment zone by adjusting the intensity and nature of power and temperature loads of the matrix and interacting with the material being processed. For example, solved the problem of increasing the wear resistance of the tool, reduce the intensity of the friction tool and the material being processed, creating a corrosive technological environment in the treatment zone, improving the workability. As can be seen in some of these cases it is also provided a reduction of intense of heat flow from the cutting zone into the tool. There are also developments aimed at improving the diamond-bearing composites using systems that can be formed the active gas technological mediums in the cutting zone. Thereby, reducing the temperature in the work area is attained, reducing cutting forces and improve the quality of treated surfaces [8].

Thus the development of effective methods of reducing the thermal load on the diamond wheels must be based on experimental data, calculation methods for determining the properties of composites and mathematical modeling of thermal processes in the instrument. Thus the problem to be solved as an optimization considering that the fillers improving thermal conductivity should not impair other properties of the composite, resulting from the conditions to ensure the effectiveness of processing.

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Simulation of Dynamic Loads on Diamond Abrasive Tool

Martin M. Yakhutlov[1], Umar D. Batyrov[2], Aleksey Kh. Tlibekov,
Marianna R. Kardanova, Astemir A. Gutov, Zalim N. Deunezhev
Kabardino-Balkarian state University (KBSU)
Nalchik, Russia
[1]martin_yah@mail.ru,   [2]ubatyrov@yandex.ru

Abstract— **Stress-strain state in the structure of diamond abrasive tool at dynamic power load was simulated in grain-matrix system. For diamond tool with carbide tipped matrix was calculated amplitude and frequency characteristics and dynamic coefficients of construction for displacements and tension. Shown that the frequency of forced oscillations connected with the exploitation of the instrument considerably lower than the calculated values of the natural oscillation frequencies.**

Keywords— *diamond; matrix; mathematical model; stress-strain state; frequency characteristics; dynamic coefficient*

Diamond abrasive tools work primarily in conditions of dynamic power and thermal loads, defined features of the processed materials and operating conditions. Under the influence of variable loads in diamond crystals are progressing old cracks and formation of new, which is accompanied by a decrease in strength. In addition, under dynamic loads increased tool wear due to loss of grain matrix, which depends mainly on the resistance to fatigue failure at the boundary ligaments material with diamond. It was noted that the harsh conditions of the diamond tool the greater role played the wear by loss of the diamond. As a result, a potential resource tool is determined solely by the properties of the diamond (hardness, wear resistance, thermal conductivity, high cutting properties) are used very little [1].

This paper is devoted to the numerical simulation of the stress-strain state of the system diamond grain - matrix in dynamic power loads.
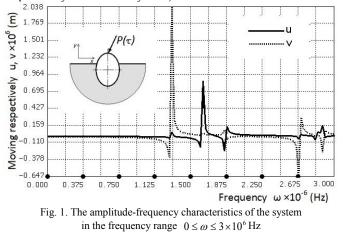
We consider a system consisting of a single diamond grain ellipsoid form immersed in a matrix (Fig. 1). The design is loaded by a concentrated force $P(\tau)$, applied to the vertical axis of the grain at its free contour. The components of the stress-strain state are determined on the basis of a decision of two-dimensional dynamic problem of elasticity theory by finite elements method.

Developed software and algorithmic support payments. The research and justification of the reliability of the calculation results. In particular, analyzed forms of vibrations of the structure when the symmetric and anti-symmetric relative to the y-axis load and analyzed the frequency of natural oscillations. Research resonances of structure, depending on the number of finite elements have shown that

for the determination of the lowest natural oscillation frequencies requires fewer finite elements than to determine stress component. This is because the natural vibration frequencies are integral characteristics of construction. The numerical experiments with different number of finite elements have shown that the displacements and stresses are obtained similar solutions, even for elements that are in the area of stress concentration, which is a zone of conjugation of free and clamped in a matrix of parts of the grain.

The numerical experiments were performed for conditions characteristic instruments on carbide tipped matrix, manufactured by powder metallurgy [2,3,4]. Dimensions of construction (mm): semi-axis ellipsoid form of grain – 0,5 and 0,75; the dive depth of the grain center – 0,25; construction thickness – 1,0. The physical properties of the structural elements: density (kg/m^3) diamond - $3,52 \cdot 10^3$, matrix - $10 \cdot 10^3$; elastic modulus (GPa) of diamond -900, matrix - 300; Poisson's ratio of the diamond – 0,072, matrix – 0,30.

In the first stage of the research determined the frequency response of the studied system. We consider construction loaded with a concentrated force $P_0 \sin(\omega\tau)$. The task is to determine the components of the stress-strain state from excitement frequency ω [5].

Fig. 1 shows the amplitude - frequency characteristic of the system in the frequency range excitation $0 \leq \omega \leq 3 \times 10^6$ Hz with frequency step $\Delta\omega = 0,025 \times 10^6$ (u and v - moving respectively in the x and y axis).

Fig. 1. The amplitude-frequency characteristics of the system in the frequency range $0 \leq \omega \leq 3 \times 10^6$ Hz

The picture shows that the amplitude frequency characteristic has several resonance peaks corresponding to the natural frequency. In this range, according to the protocol for solving the problem (change the sign of the determinant of the system of algebraic equations), the construction has six natural frequencies are located in the following ranges ($\omega^* \times 10^6$ Hz):

$$1{,}325 \le \omega_1^* \le 1{,}350; \quad 1{,}650 \le \omega_2^* \le 1{,}675; \quad 1{,}900 \le \omega_3^* \le 1{,}925;$$

$$2{,}750 \le \omega_4^* \le 2{,}775; \quad 2{,}875 \le \omega_5^* \le 2{,}900; \quad 2{,}975 \le \omega_6^* \le 3{,}000.$$

The influence of the system parameters on the frequency of natural oscillations of the system was investigated. Studies have shown that the frequency of natural oscillations of the system are determined by grain size, density and elastic modulus of the matrix material. The analysis showed that the lowest possible value of the lower frequencies of the natural oscillations of the system are approximately equal 4×10^4 Hz. Fig. 2 shows the dependence of the lower natural frequencies of the system by elastic modulus of matrix in a wide range of change. It is also shown that the different coatings on diamond grain used to improve tool performance, almost no effect on system natural frequencies, which is obviously due to their small size.

At the second stage of the research was simulated stress-strain state at loading system instantly applied force. It is known that the behavior of the structure at the same time along with the natural frequencies of the oscillations is an important characteristic of this system. It is characterized by the dynamic coefficient and determines the sensitivity of construction to dynamic influences.

Dynamic coefficient is defined as the ratio of any of the components of the stress-strain state under dynamic loading to the component under static loading:

$$K_D^Y = \frac{Y_{dyn}}{Y_{st}},$$

when Y - considered component of the stress-strain state.

If the dynamic coefficient is known and known static stress-strain state, there is no need to carry out dynamic analysis. Suffice it to multiply all the components of the static stress-strain state by a dynamism factor to get the values of the components under dynamic loading.
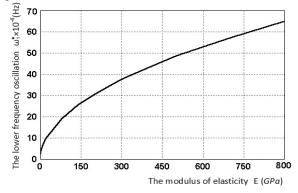
Fig. 2. Dependencies the lower natural frequency of the system by matrix elastic modulus

Fig. 3 shows the results of structure calculations at loading instantly applied along the y-axis to the top of free grain circuit strength of 100 N.

Moves the point of application of force v calculated at step of integrating the equations of motion, equal $0{,}00000004$ c. The continuous horizontal line represents the result of a static calculation. The picture shows that the dynamic coefficient of moving is:

$$K_D^v = \frac{v_{dyn}^{max}}{v_{st}} = 1{,}29.$$

Calculations of stress have shown that dynamic coefficients for the component σ_y and the stress intensity σ_i equal to:

$$K_D^{\sigma_y} = \frac{\sigma_{dyn}^{max}}{\sigma_{st}} = 1{,}12; \quad K_D^{\sigma_i} = \frac{\sigma_{dyn}^{max}}{\sigma_{st}} = 1{,}16.$$

The calculations for different values of the step of integration have shown that it increase leads to the filtered high frequency components solutions, which do not significantly affect the value of dynamic coefficient.

It is known that the instantly applied load is excites oscillation of construction with a period close to its lowest natural frequency. From Fig. 3 that

$$2T_{dyn}^1 \approx 2T_{dyn}^2 \approx 970 \cdot 10^{-6} s,$$

where we find

$$T_{dyn} \approx 4{,}85 \cdot 10^{-6} s.$$

This value agrees well with the value of the period of of the lower frequency of natural oscillations of the considered construction, obtained during solving the problem of harmonic vibrations equal $\approx 4{,}65 \cdot 10^{-6} s$.

The dynamic load of grain-matrix system, which take place in the operation of diamond abrasive tools was investigated. In particular the forced oscillation frequency single grain fixed to a grinding wheel under the action of the cutting forces on contact grains with a workpiece was analyzed. Also calculated the frequency of forced oscillation defined of discontinuous machining process by stone processing tools. In these cases, the forced oscillation frequency of the system considerably below certain above values of the lower natural frequencies.
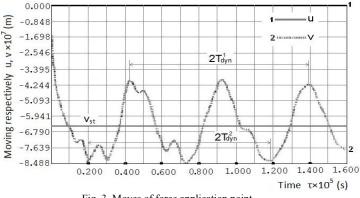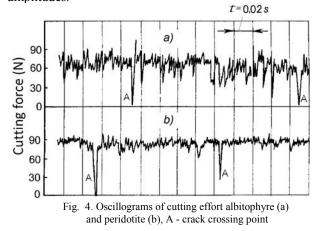
Fig. 3. Moves of force application point

Similar results were obtained for the boer tools. In [6] shows the experimental oscillograms of the cutting efforts a single diamond grain variety fractured rock. Fragments of oscillograms are shown in Fig. 4. These oscillograms are fairly regular sequence of triangular pulses with a period of 0,002-0,005 s and different height of amplitudes.

Fig. 4. Oscillograms of cutting effort albitophyre (a) and peridotite (b), A - crack crossing point

At the moment of crack crossing appears a single triangular pulse load with amplitude ~ 60 N and duration ~0,005 s.

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Study Ways to Improve the Efficiency of Operation of Mobile Cross Knife Grinders Food

Umar D. Batyrov, Pavel L. Ataev, Asker Z. Tokov, Timur H.
Kardanov Polytechnic Institute, Department "Quality Management
Kabardino-Balkarian State University
Nalchik, Russia
ubatyrov@yandex.ru, asker-tokov@mail.ru

Abstract - **In the article the analysis of structures of cruciform blades grinders food for energy efficiency. The proposed design of the knife, providing reduction of energy consumption in the process of operation.**

Keywords— ross-shaped movable knife, energy efficiency, the classic wedge, the wedge angle of the wedge, the blade of the knife grinding.

One of the main challenges facing food engineering is the development of highly efficient technological equipment, which is based on the use of advanced technology greatly improves productivity, reduces the negative impact on the environment and contributes to the saving of raw materials, fuel and energy and material resources [1].

In addition, respect for resources becomes a global problem: "If the whole world with its current population lived just as the inhabitants of North America, it would take three planets Earth to provide a similar standard of living to the population" [2].

Milling processes food media leading the process of many technologies used in the food industry, which are implemented in crushers, mills, cutters, grinder, etc these machines largely determine the qualitative course of the subsequent stages of processing of raw materials, shape the quality of the finished product.

It should be noted that the processes implemented in the cutters, choppers and other machines, are extremely energy intensive.

For example, the gyroscope K7-FVP-160-1, intended for secondary and fine crushing of meat raw materials, has a motor power of 32.2 kW, and the cutter L5-FCM intended final fine grinding of meat and cooking meat in the production of boiled-smoked, semi-smoked, smoked, boiled, liver sausages, frankfurters, sausages, has an electric motor with a capacity of 30.6 kW. Machine B9-FDM-01, used to grind frozen meat blocks, has a motor power of 55kW. These examples testify to the extremely high energy intensity grinding process of meat and meat products. For example, the

installed capacity of electric motors on machine tools, on average, does not exceed 8...10 kW.

We can't ignore the fact that at the present time there has been a growth in the prices of metals, electricity, water, on almost all supplies. Therefore, you should seek opportunities to reduce unit costs of resources per unit of manufactured products. Not an exception and operation of grinders of foodstuffs.

The energy efficiency of grinders of foodstuffs (meat, vegetables, and other raw materials) is largely determined by structural features of the movable crosswise of the knife.

It is known that milling processes conventionally divided into crushing (large, medium and small) and grinding (fine and ultrafine). Grinding of materials is carried out by crushing, splitting, abrasion, and impact. The choppers meat, vegetables, and other feedstock are used grinding the splitting (separation). In other words, process is the mechanical division of the product using wedging in it the working body. In this case, to form the separated pieces are no requirements. Only their blades to separate the pieces of product by cutting, not their separation.

Research the energy efficiency of the structure movable crosswise of the knife is the subject of numerous works.

For example, in [3], it is stated "... that, to reduce effort when grinding, the cutting edges of the blades formed by segments of arcs of circles centers of which are located near the pen, the angle of cut of each blade is 35-50°, and forming the front surface of the straight line".

If the cutting angle, as the author asserts, is equal to 35-50°, the wedge angle at the vertex of the cutting blade α=55-40o. Such a wedge angle of the cutting blade, from the point of view of energy consumption for the grinding process, is not optimal.

In [4], it is stated that "the Cutting edges of the blades of the knife are formed by the intersection of the holes arranged on the same concentric circles that pass-through openings with a diameter equal to the distance between the diameters of these concentric circles. On one pair of the blades, these holes formed at an acute angle to the working surface of the knife, and the other at a right angle, i.e. α=90o.

The disadvantage of this technical solution is that the wedge angle of the wedge cutting blade α =90o could not meet the energy efficiency requirements of the food chopper, and elevated energy costs negatively affect the quality of the ground product.

For example, the reduction of energy consumption of the grinding process food, at least, helps to preserve raw material quality in crushed product. Meat should be cut, not fray through and lose the juice!

Of particular interest is the work [5], where the objective of the proposed technical solution is the increase of cutting properties of the bilateral blade of the knife and the reduction of energy consumption during grinding of the product.

The problem is solved in that the knife blade comprising a hub with a bore hole in which is placed a blade having in cross section the shape of a parallelogram with cutting edges on opposite surfaces, according to the proposed solution, the blades have a cross-sectional area that decreases from the hub to the periphery."

If the blade of a petal (of a pen) should be made in the form of a wedge, we should recognize the bad design of the petal cross-section in the form of a parallelogram. A rotating petal knife continuously overcomes the resistance of the ground environment. And this resistance is greater, the larger the area of the maximum axial section of the lobe measured in the plane normal to the working surface of the grating. The work involves not only cutting edge and blade, but also other surfaces, as they have contact with a comminuted product and lattice (Fig. 1).
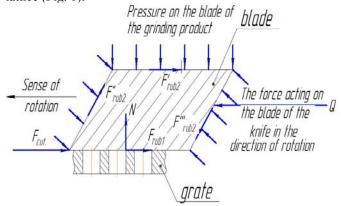
Fig. 1. The forces acting on the lobe during rotation of the knife (F_{rub1} – the friction force between the blade and the grate; F'_{rub2}, F''_{rub2}, F'''_{rub2} - friction between a blade and a comminuted product; F_{cut} – force, necessary for cutting slices from the processed product; Q- is the force acting on the blade in the direction of rotation of the knife).

Based on the foregoing, optimal from the point of view of energy efficiency, is the wedge form of the blade in all cross sections (Fig. 2). This position is tested and confirmed experimentally.
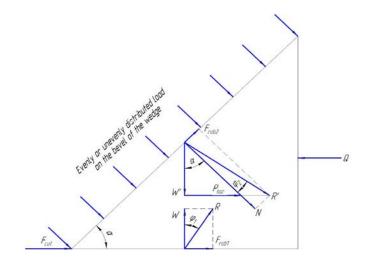
Fig.2. The forces acting on the blade of the movable knife, made in the form with one bevel wedge (F_{rub1} – the friction force between the blade and the fence; W - is the reaction force resulting from the joint action of the contact force nut grille to the movable knife and the pressure-processed product from the auger side on the blade; N- is the resultant evenly or unevenly distributed load acting normal to the inclined surface; F_{rub2} – the friction force between the processed product and the bevel of the wedge; α - angle at the vertex of the wedge; P_{hor} – the horizontal component of the resultant R'; φ1 – friction angle in the cutting plane; φ2 – friction angle on the bevel of the wedge; W' - is the vertical component of the resultant R' (note W'≠W); Q - is the force acting on the blade in the direction of movement of the knife; F_{cut} – cutting force applied to the cutting edge).

If we consider the design of the blade (feather) as with one bevel wedge, then it is subject to the forces:

- on the surface facing the grid and combined with its cutting surface, the frictional force F_{rub1} and the force W acting normal (it is formed as a result of pressure of the processed product from the auger side on the blade (feather) and pressing the nut of the grating to the movable knife);

- on an inclined surface of the wedge acting forces of F_{rub2} and the power N (the resultant evenly or unevenly distributed load) acting normal to the inclined surface;

- on the cutting edge are the cutting forces F_{cut} (cutting into portions, destroying the integrity of the product, grinding the product);

- on wedge force Q, carrying out the grinding process. This force pushes the paddle forward, rotate the movable knife.

Based on the conditions of equilibrium of the wedge, you can write

$$Q \geq F_{cut} + F_{rub_1} + P_{hor}$$

The magnitude of the cutting forces F_{cut} depends on the physico-mechanical properties of crushed product. In this case, we do not consider the ways changes in physico-mechanical properties the purpose of modifying (reducing) the required cutting forces of the processed product.

The friction force F_{rub_1} is determined by the formula

$$F_{rub_1} = W*f,$$

where f - is the coefficient of friction (steel on steel – 0,10...0,15);

W - normal reaction at the base of the wedge (it is a combination of effort N' pressure clamping nut grille to the movable knife and the vertical component W').

To reduce friction, the surface of the wedge contacting with the surface of the grating should be sharpened at a certain angle (for example, 2...30). This eliminates the contact of the movable knife (nominally) and the lattice at the sites of a certain size.

Of course really avoid contact between a movable knife and a grate is not possible. Therefore, with the purpose of reducing the frictional forces between the moving blade and grille, the actual contact may be a straight or curved form of the cutting edge on the blade of the movable knife).

The horizontal component of Phor can be determined according to the formula (for simplicity of presentation we omit the intermediate calculations)

$$P_{hor} = \frac{N}{\cos\varphi_2} \cos(\alpha + \varphi_2) * tg(\alpha + \varphi_2)$$

or

$$P_{hor} = \frac{N}{\cos\varphi_2} \sin(\alpha + \varphi_2)$$

where φ_2 – friction angle on the bevel of the wedge.

Calculations show that, for example, ceteris paribus, only a reduction of the angle of taper of the wedge α from 35 to 5o horizontal component of Phor reduced almost four times ($\approx$3.7 times).

Consequently, from the point of view of efficiency and quality of grinding of a food product, the blade (feather) of the movable knife in all cross sections must be in the form of a wedge, with the wedge angle a slightly larger friction angle φ (metal to metal), i.e. α=7…8.

The coefficient of friction «food – metal» varies widely. It should be noted that it is not dry friction. Ground products always contain moisture to some extent. Therefore, the moisture content of a comminuted product greatly affects the value of the coefficient of external friction. Were determined the coefficients of external friction of food products (meat, beet, apple, carrot), metal – 0,36…0,12.

Given that virtually no pressure from the cut off pieces on the blade of the knife, the friction force between the blades of a knife and cut pieces from the grinded product can be neglected.

As for the friction forces between a movable knife and a grate, then they can not be neglected.

Theoretically and experimentally proved, that the petals of the movable knife in all cross sections, from the point of view of energy efficiency, should only have the shape of a wedge

(not parallelogram, trapezoid, square, rhombus, segment). Moreover, the smaller the angle α at the vertex of the wedge, the lower the energy consumption of the grinding process.

One surface of the wedge contacting with the ground product must be flat and not combined (Fig. 1).

The other surface of the wedge facing towards the grille, should also be flat. But, to reduce the magnitude of the friction forces between the blades of the movable knife and a grate (metal to metal), the actual contact of the movable knife and the lattice is proposed only at the cutting edges of the blades of the movable knife, i.e. in accordance with the cutting edge shapes – straight or curved.

Determining the magnitude of the angle of taper α wedge, first of all you should consider the working conditions in the shredder.

You can consider the blade of the movable knife as odeskoy wedge with friction on two surfaces, on which side of the auger process medium exerts pressure (Fig. 3).
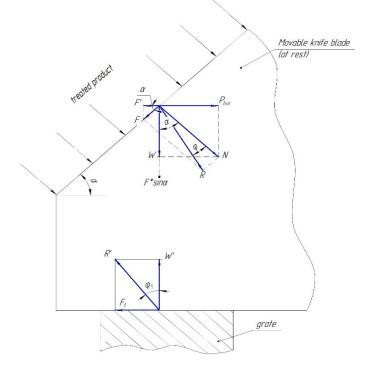
Fig.3. Scheme to clarify the conditions of self-locking of the wedge (the wedge is in the clamped state and it is subject to forces tending to push it).

At any angle of bevel α clamped wedge tends to push the reverse action Phor representing the horizontal component of the normal reaction N; W is its vertical component.

Pgor counteract the friction force F_1 on the base of the wedge and the horizontal component F' of frictional force F on an inclined surface of the wedge.

The condition of equilibrium of the wedge may be defined by the formula

$$F' + F_1 \geq Pgor$$

From Fig.3 the friction force is defined as
$$F = N*f = N*tg\ \varphi = W*tg\varphi/\cos\alpha$$
Its horizontal component
$$F' = F*\cos\alpha = tg\varphi\ W/\cos\alpha*\cos\alpha = W*tg\varphi.$$

The vertical component of the friction force F, equal to $F*\sin\alpha$, be combined with the vertical component W normal force N. Accordingly, the magnitude of the normal reaction on the base of the wedge
$$W' = W + F*\sin\alpha = W + W*tg\varphi/\cos\alpha*\sin\alpha = W + W*\sin\alpha/\cos\alpha*tg$$
$$\varphi = W + W*tg\alpha*tg\varphi = W*(1 + tg\alpha*tg\varphi),$$
and the friction force on the base of the wedge
$$F_1 = W'*tg\varphi_1 = W*(1 + tg\alpha*tg\varphi)*tg\varphi_1$$

Formula (4) for the limit case of an equality of force holding the wedge in the wedged condition and forces tending to push it in the horizontal direction, takes the form
$$P_{gor} = F' + F_1 .$$
Substituting in this formula the value of the forces, get
$$P_{gor} = W*tg\alpha = W*\ tg\varphi + W*(1 + tg\alpha*tg\varphi)*tg\varphi_1$$
or
$$tg\alpha = tg\varphi + tg\varphi_1 + tg\alpha*tg\varphi*tg\varphi_1.$$

At small angles α work $tg\alpha*tg\varphi*tg\varphi 1$ is close to zero, and the value of tangents of angles close to the magnitude of the corresponding angles in radians.

Then the condition for limiting equilibrium of the wedge is expressed by the equality
$$\alpha = \varphi + \varphi_1.$$
The blade of the movable knife on top is in contact with the processed food product (e.g. meat, vegetables, berries and other foods).

The coefficient of friction on the surface of the wedge facing to the screw, ranges from f=0.12…0.36 (food product – metal), and on the surface facing the grating f_1=0,10...0,15 (metal on metal).

If the coefficient of friction on one surface will be f=tgφ=0,12, φ=6º50', and on the other surface f_1=tgφ1=0,10, φ_1=5º43'. Then the equilibrium condition of the wedge is observed at an angle α=φ+φ_1=6º50'+5º43'=12º33'.

The results of the calculations indicate that from the point of view of efficiency of process of crushing the food product, the blades of the movable knife should be in the form of the classic wedge in all cross sections. Moreover, the angle of taper α at the apex of the wedge should be no more than 6...12º (Fig.4.).
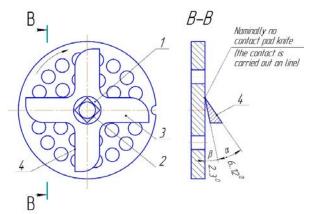
Fig.4. The scheme of interaction of the cross-shaped movable knife and a grate (1 - hub; 2 - square hole; 3 - blade knife; 4 - cutting edge blades; α- the wedge angle of the wedge; β - is the angle between the bottom surface of the blade facing towards the grille and the surface of the cutting grid).

To reduce the cost of energy to the work done by the friction forces arising between the movable knife blades and grating, it is necessary to exclude the presence of pads between them and the real contact is done only at the cutting edges movable knife. The constructive dimensions of the wedge should be determined on the basis of calculations on strength and rigidity. In addition, outdoor knives industrial shredders grinded at least three or four times during the period of their operation and this fact should be taken into account in the development of drawing.

Studies performed with moving household knives, shredders with electric adjustment, confirmed the efficiency of the moving blades of the proposed design.

Movable knives were made of steel 65G, annealed at a temperature of 790...815ºC, tempered at a temperature of 800...815ºC to a hardness of 60...62HRCэ, cooled in oil, tempered at a temperature of 160...175ºC. The energy consumption for the process of grinding meat when using the moving blades of the proposed construction on the 30...32% lower compared to the energy consumption of the grinding process with the movable knives having the form of a parallelogram.

In addition, comparative tests on energy efficiency has also been subject movable knives supplied to household electrical shredders with α=75º; β=0º and straight cutting edges and re-drilled (modified) movable knives with α=6º and β=2º, i.e. with these characteristics possessed by the design of the knife. In this case, the energy consumption with a movable knife, the proposed design, were 35% lower.

CONCLUSION

Blades movable crosswise of the knife of the food chopper must have in all cross sections the shape of a wedge (not a parallelogram, square, trapezoid, etc.) with angle α at the vertex of not more than 6...12⁰. The contact blades of the movable knife and the grating should be at the cutting edge of the blade. The angle β between the surface of the blade facing

to the surface of the cutting grid and the grid needs to be in the range $2...3^0$.

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Import Outstripping of Surgical Technologies Based on Assisted Mechatronic

S.A. Sheptunov, Nakhushev R.S.
Institute for Design-Technological Informatics RAS
Moscow, Russia
ship@ikti.ru, electronics_rn@mail.ru

D.Yu. Pushkar, K.B. Kolontarev
Moscow State University of Medicine and Dentistry
Moscow, Russia
kb80@yandex.ru

Abstract — **The given paper depicts a conducted analysis of special positions of using instruments for assisted mechatronic (robot) complex used Russia. In article it will be shown an approach, which forecasts and implements instruments, techniques and technologies, fundamentally possible during surgery, including assisting mechatronic (robotic) surgery complex. The obtained research results can be applied for further development of assisted mechatronic surgery all over the world.**

Keywords — *a robot surgery complex; a robot surgery practice, an assisted surgery; elemental surgical transitions for assisted surgery complex*

I. INTRODUCTION

First of all is performed the analysis of existing robot surgery practices and the nature of robotic surgical technologies - the analysis of used robotic technologies and instruments.

The conducted interview of experts revealed the following technologies, actively used in robot surgery in Russia.

1. Isolation of anatomical structures. Tissues prepearing.

1.1. Tissues dissection. For tissues dissection of various shapes and sizes of scissors are used.

1.2. Blunt dissection - apart of the layers of tissues. It occurs by introducing the tip of the tool between the layers. During the disclosing of the instrument, jaws are set in motion and tissue layers apart. It may be accomplished by dislocation of one instrument over to another.

1.3. Dissection of tissues with simultaneous coagulation. The use of monopolar coagulation can provide a dissection of tissues by the using of variety of tools - scissors, "hooks", "blades". Bipolar coagulation during tissues dissection is only used in tools, having two jaws – predominantly during applications of scissors.

2. Blood loss prevention and bleeding control.
2.1. Monopolar coagulation causes a local coagulation in a contact place with tissue due to the passage of high-frequency impulses between the active and neutral electrodes.

2.2. Bipolar coagulation. Using this method, the instrumental (forceps, scissors, etc.) coagulation elements have two points of contact with the tissue surface. High-frequency current, supplied to the instrument, passes between the contact points and limits the coagulation of the tissue site, which lies between these points. It's possible to use the cutting mode with coagulation. Compared to the monopolar coagulation bipolar coagulation mode is more "gentle" because it causes minimal damage of the surrounding tissues.

2.3. Argon-plasma coagulation. Argon-plasma coagulation - electrosurgical contactless hemostasis without the oxidation reaction. Unlike classical contactless (SPRAY) coagulation high-frequency electric arc passes through the tissues throw the inert gas stream. The length and power of the arc during spray coagulation can noticeably vary, what allows to adapt the method for solving the specific problems. The torch of inert gas allows to stop the bleeding easily in contrast to the classical non-contact coagulation,. The inert gas space forms a conical spark gap, which prevents uncontrolled electric arcing and its length and the power remain constant. This effect form good hemostatic effect. Coagulated surfaces regenerate faster in this case when compare with classical coagulation. Blood and other fluids that may affect coagulation result, during the using of the argon torch blown out of the surgical field. Thus it performes better control on the coagulated area. Argon also reduces the oxygen concentration in the environment, what avoids tissue carbonization.

2.4. Plasmakinetic coagulating effect. These generators use the principle of low-voltage radiofrequency energy (<200 Volts), which allows the operating surgeon to resect, vaporize, coagulate tissues, simultaneously with crossing and ligating vessels, performing dissection, mobilizing tissues. The generator operates on a feedback scheme. This scheme of work of RF surgical device scheme significantly improves the intraoperative and postoperative results. It reduces the extent of the thermal energy for the underlying tissues - reduces the degree of charring and the number of complications, related with deep-tissues dehydration.

2.5. Vessels clipping - the way for the final vessels haemostatsis, in case of difficult or impossible suturing, which consists of applying hemostatic clips. Clips could be metal or

polymeric. Clip size may be different. The most popular sizes are 5 and 10 mm.

In recent years, in urology and many other areas wide use have got the surgical clips Hem-O-Lock made from bioinert non-absorbable polymer (plastic). Latching lock of clips provides an effective and reliable closure. The design of the applicators and clips provides effective fixation of clips during the delivery to the vessels and tissues, besides the clips design makes it possible to unclip them, maintaining vessels and tissues integrity, and the presence of barbed inner surface allows to "clean" vessels and tissues before closing, that prevents slipping from them even with closed lock. Such clips are easily palpable, not R-contrasting, do not alter the picture during using MRI, CT and radiology studies.

2.6.Irrigation - a treatment method of wound or pathological center irrigation with solutions of various drugs or simply washing liquid (saline). Irrigation is using during surgery to maintain the proper visual quality. Typically, an irrigation instrument is combined with an aspirator and the surgeon, through sequential shift of modes, achieves the desired "purity" of the surgical field.

2.7. Aspiration - removal of fluid from the human body by its suction using a special instrument - aspirator There are different types of aspirators. The most popular is a vacuum aspirator, in which the level of generated vacuum can be adjusted arbitrarily. Aspirators are used to remove the irrigation fluid and "drying" the operative field while bleeding.

2.8. Tissues stitching. Curved needles are used for stitching of the skin, aponeurosis, muscles and other tissues. The size and degree of the needle curvature, the tip of the cutting or piercing needle as well as suture size, and the suture material and nature depend on the surgeon needs. Fundamental question is the choice between absorbable and nonabsorbable sutures. Special instruments - needle holders providing a reliable fixation of needles are used when suturing tissues.

2.9. Tissues fixation. An instrument for gripping, clamping and holding any object has two jaws. The shape and dimensions of the instrument may widely vary depending on the assigned task. Crocodile clips are used for secure tissue fixation, but their use entails the risk of organ damaging. Clips with flat jaws and fenestrated clips fix tissue less rigidly, but they are more safer.

TABLE 1

Methods	Operative method
Tissue dissection	Tissue incision
	Blunt dissection
	Dissection of tissues with simultaneous coagulation
Prevention of blood loss and control bleeding	Monopolar coagulation
	Bipolar coagulation
	Argon-plasma coagulation
	Plasmakinetic coagulating effect
	Vessels clipping
Irrigation	
Aspiration	
Tissues stitching	
Tissues fixation	

The existing practice of robotic surgery in Russia is mainly focused in urology. Pioneer and active mentor in this area is prof., Ph.D. D. Pushkar, with experience of almost two thousands robotic procedures.

Following instruments are used in Russia:

Fig. 1 - Instruments traditionally used in Russia

Assesment tools for efficiency of currently used robotic technologies are not found yet. Expert opinion suggests that these technologies are "imposed" by two factors:
• instruments, coming with a surgical robot «Da Vinci»;
•«transfer» the order of the traditional surgery from traditional (abdominal) surgery to robotic surgery.
From an engineering point of view, the use of surgical robots creates the fundamentally new, previously unattainable technical possibilities, that provides a basis for the creation of new, previously inaccessible, surgical technologies.

II. THE PROBLEM

The problem is to identify the patterns of forming robotic technologies in surgery.The following text is devoted to the approaches for solving this problem.

3. The basement concept of robotic technologies

3.1. Fundamental concepts (based on literature and Internet materials)
In surgery
Surgery or surgical intervention - a set of effects on tissues or organs providing by doctors for the treatment, diagnosis, correction of body functions, performed by various methods of separation, moving and connecting tissues .

Surgery (ancient greek - χειρουργική, from the ancient greek- χείρ -hand and ἔργον - action, work) - area of medicine that studies the acute and chronic diseases which are treated using surgical method. Surgical treatment consists from several sequential steps: preparing a patient for the surgery, anesthesia and surgery itself. Surgery includes: surgical approach (incision of the skin or mucous membranes), surgical treatment of the body, output from the operation (restoring tissue integrity, disturbed during the surgery).

Surgical approach - a apart of the procedure, which provides an approach to the surgical field. This step should be physiologic, anatomic and sufficient for the implementation of this goal. It is generally accepted that the surgeon should be afraid of poor analgesia and/or bad access (S.L. Libov). For an objective assessment of surgical approach is used a list of surgical activities

Operative technique - procedure technique. The operative technique, method and name of the organ, determine the name of the surgery.

Exit from the surgery. Exit from the surgery consisits of suturing and drainage
In mechatronic engineering
Robotic surgery systems are not robots, in their correct, classic definition. The essence of the new discipline in surgery is in the development and introduction of new "assisting" mechatronic devices, that extend and bring new functionality to the surgeon at the stages of preparation, implementation and exit from the surgery.

Devices, combined together, form mechatronic complex. Under the new discipline falls surgery, using assists mechatronic devices - assisting mechatronic surgery (AMS). AMS is carried out on assisting mechatronic surgical complexes (AMSC).

3.2. The basic approach to the formation of AMSC
Formulation of a service appointment of AMSC requires the full list of surgical techniques for performing which complex is created. This provision may be implemented through a statistical survey of surgeons or other means through the opening of the nature of surgical techniques.For the basis can be adopted the following position.
1. Surgery is the manufacturing process;
2. Any manufacturing process is a sequence of elementary (minimum) transitions. In the case of surgery the minimum shift is defined as an elementary surgical transitions (EST).

Various combinations of EST allow formation of various surgical techniques. Maximum full list of basic surgical conversions ensures the highest full list of surgical techniques, up to previously non-existent.

To identify the mechanism of appearance of elementary surgical transitions is necessary to clarify and define the following concepts:
• structure of the surgery;
• strategy of surgery;
• tactic of surgery;
• surgery (in a technological context);
• surgical transition (as a complete part of a surgery);
• surgical method;
• elementary surgical transition;
• principles, based on surgical transition;
• methods, based on surgical transition;
• ways, based on surgical transition.

3.3. Localization of basic surgical techniques
The principles at the base of surgery (surgical actions):
- separation of tissues;
- moving of tissues;
- connect of tissues;
- evaluation of tissues.

Subject of surgery:
- effect on the internal human organs;
- exposure to external human organs;

Surgery Methods:
Radical. The goal – to completely eliminate the cause of the pathological process. Radical surgery is not always an operation which takes organ away. There is a large number of reconstructive (plastic), radical surgery, such as plastic esophageal wiht scar structure.

Palliative. The goal – to partially eliminate the cause of the pathological process, thereby making it easier. Is performed when radical surgery is not possible (eg, Hartmann's operation with the removal of the visible portion of the tumor, creating a pocket and the imposition of single-barrel colostomy).

Symptomatic. The goal - to facilitate the patient's condition. Is performed when the radical or palliative surgery for any reasons is impossible. Symptomatic operation does not always means the impossibility and futility of the patient's cure, often symptomatic operation is performed as a stage or as a supplement for radical treatment.

Diagnostic. The goal - to get more accurate information about individual organs. For example, a diagnostic laparoscopy, hepatic biopsy, biopsy of a lymph node.

Surgical treatment methods are implemented in different ways, defined in medicine as surgical techniques.

Analysis and summary of the medical literature suggests the following classification for operative surgical techniques:
• ectomia - removal of an organ;
• tomia - dissection of an organ;
• resectio - excision of the part of an organ;
• pexia - suturing of one organ (eg, omentum) to another;
• rrhaphia - suturing;
• stomia - imposition of fistula;
• anastomosis - the imposition of anastomosis;
• punctio - puncture;
• biopsia - taking the material for in vivo morphological study, divided by a puncture, resection, plucked;
• dilatatio - expansion of the organ lumen;
• extractio - extracting from an organ lumen a foreign body or grossly altered by abnormal process formation (for example, lithoextraction, cataract extraction);
• amputatio - organ clipping. This term is most commonly used to localize the outer organs (e.g., amputation of limb, breast, penis, tongue). The exception is got accustomed in a gynecological practice the term - uterus amputation (right synonym - hysterectomy);
• replantatio - restoration of the location of the organ after it's cut-off or separation (eg, limb replantation, replantation of the renal artery in the aortic prosthesis);
• transplantatio - organ transplantation;
• implantatio - inserting the part of the body, a piece of tissue, the pharmacological drug or device (eg, implantation of an artificial pacemaker);
• reconstructio - restoration of organ structure;
• prosthetics – organ replacement to an artificial prosthesis (eg, aortic prosthesis, testis, the stump of the eye);
• bypass - a way of establishing blood and content flow in the organ to bypass existing barriers (eg, coronary artery bypass grafting, bifurcation aorto-femoral bypass, pleuro-peritoneal shunt);
• stenting - introduction into a hollow of organ lumen the special construction (stent), allowing to expand the lumen and holding it in such a state.

3.4 Allocation of surgical transitions
These classical decompositions of surgeries and traditional, stemming from many years of surgical practice, restrictions allow to propose the following procedure for the formation of elementary surgical techniques.

With all the variety of manipulations, produced by the surgeon, the first stage can be divided into the following groups (Table 1).

TABLE 2. GROUPS OF SURGICAL TRANSITIONS

Types of surgical actions			
Tissues Disconnection	*Tissues Moving*	*Tissues Connection*	*Technology (auxiliary) manipulation with tissues*
Incision*			
Dissection			
Expansion of organ lumen			
Puncture			
Separation			
Branch	Tissues holding		
	Relative displacement		
	Removing (outside the body)		
	Introduction into the body		
	Tissues tension		
		Stitching	
		Suturing	
		Closure	
		Inserting	
			Monopolar coagulation
			Bipolar coagulation
			Clipping
			Bypass
			Prosthetics
			Transplantation
			Restoration of organ

* - The list is not complete and may be extended by professional surgeons

The essence of each cited methods is represented in follows (Table 3).

TABLE 3. CONTENTS OF SURGICAL TECHNIQUES

Surgical techniques	Essence of the action
Incision	Division of mechanical or other exposure to similar and dissimilar tissues
Dissection	Isolation by mechanical or other exposure the part of the tissue or organ parts
Expansion of organ's lumen	Increase by sharp or blunt instrument into the lumen of the hollow organ tissue - apart of tissues
Puncture	Penetration by mechanical tool or other effect of explosure on the cavity formed by the tissue
Separation	Apart by a blunt instrument similar and dissimilar tissues
Branch	Widening of by blunt instrument of heterogeneous tissue. Use two or more instruments
Tissue holding	Hold tissue capture tool and holding her tissue in position a specified period of time. The power of seizure should not lead to the destruction or disruption of supply of tissues
Relative movement	Movement of the tissue after the capture of the required distance for subsequent operations on her
Removal (outside the body)	Capture the tissue or organ with followed removing the last from the trocar together with the previously separated tissue or organ (also applicable for the removal of the needle and the suture from the body)
Introuction to the body	Capture outside the body the surgical material (threads, needle, hemostatic sponge, etc.) and movement through the trocar to the body
Tissue tension	Capture of tissue in the body and holding it under tension to perform tissue manipulations (dissection, resection, etc.)
Stitching	Combining suturing and contraction to contact homogeneous tissues using suture
Suturing	Combining suturing and contraction to contact heterogeneous tissues using suture
Closure	Restore the integrity of organ of various shapes and sizes using suture
Monopolar coagulation	Use of electric current of monopolar action to stop bleeding
Bipolar coagulation	Use of electric current of the bipolar action to stop bleeding
Clipping	Application of clips, established by special tool to stop or prevent bleeding

On the basis of classification of the information gathered and according with elementary surgical types of transitions there was proposed preliminary classification of types of elementary surgical transitions (in order of release test) (Table 4).

TABLE 4. TYPES OF ELEMENTARY SURGICAL TRANSITIONS

Function of AMSC	Surgery action	Subject for impact	Surgery method	Impact area		Types of elementary surgical transitions
Surgery	Disconnection	Homogeneous tissue	Incision			1
			Dissection	Whole organ		2
				Part of organ		3
				Taking the organ material	Punctional	4
					Resection	5
					Plucked	6
			Expansion of organ's lumen			7
			Puncture			8
		Heterogeneous tissues	Branch of heterogeneous tissues and structures			9
	Displacement	Internal organs	Relative displacement	Displacement		10
				Overlay	Fistula	11
					Anastomosis	12
			Retention			13
			Removing (outside the body)			14
		Excess objects	Removing (outside the body)			15
		Inserted organs and implants	Introduction into the body			16
			Relative displacement	Diplacement of tissues		17
				Overlay of tissues		18
			Retention			19
			Removing (outside the body)			20
	Connection	Homogeneous tissue Heterogeneous tissues Inserted organs and implants	Stitching			21
			Suturing			22
			Closure			23
	Ancillary	Prevention of blood loss and control bleeding	Coagulation			24
			Clipping			25
		Irrigation				26
		Aspiration				27
Diagnostic	Examination of internal organs	Visual				28
		Instrumentation				29
	Determining the location of organs and structures					30
Therapeutic						31

[1] - The list is not complete and may be extended by professional surgeons

The result is a (particular) 31 Types of Elementary Surgical Transitions (TEST).

Each TEST may be formed by various techniques. Thus, as typically, is used instrument. For each of different techniques can be used different (up to fundamentally different) instruments.

Using the same instrument, it is possible to implement different technologies, depending mainly on the techniques and tactics of conducting the operation, the surgeon chosen.

One and the same instrument can implement several surgical techniques. Each surgical technique consists from individual actions completed. Minimum completed action in the surgical technology is defined as the surgical transition. The minimum possible part of the surgical transition is an elementary surgical transition.

Introducing of surgical elementary transitions is shown in Table 5.

TABLE 5. INSTRUMENTS, SURGICAL TECHNICS AND ELEMENTARY SURGICAL TRANSITIONS

Function of AMSC	Surgery action	TEST(conditionally)	Instrument	Surgery technique	Code EST
Surgery	Disconnection	1	1	1	1.1.1.1
					1.1.1.2
					1.1.1.3
				2	1.1.2.1
				3	1.1.3.1
			2	1	1.2.1.1
			3	1	1.3.1.1
		2	1	1	2.1.1.1
					2.1.1.2
				2	2.1.2.1
				3	2.1.3.1
			2	1	2.2.1.1
			3	1	2.3.1.1
		3	1	1	3.1.1.1
					3.1.1.2
					3.1.1.3
				2	3.1.2.1
				3	3.1.3.1
			2	1	3.2.1.1
			3	1	3.3.1.1
		4	1	1	4.1.1.1
					4.1.1.2
					4.1.1.3
				2	4.1.2.1
				3	4.1.3.1
			2	1	4.2.1.1
			3	1	4.3.1.1
		5	1	1	5.1.1.1
					5.1.1.2
					5.1.1.3
				2	5.1.2.1
				3	5.1.3.1
			2	1	5.2.1.1
			3	1	5.3.1.1
		6	1	1	6.1.1.1
					6.1.1.2
					6.1.1.3
				2	6.1.2.1

Function of AMSC	Surgery action	TEST(conditionally)	Instrument	Surgery technique	Code EST
				3	6.1.3.1
			2	1	6.2.1.1
			3	1	6.3.1.1
		7	1	1	7.1.1.1
					7.1.1.2
				2	7.1.2.1
				3	7.1.3.1
			2	1	7.2.1.1
			3	1	7.3.1.1
		8	1	1	8.1.1.1
					8.1.1.2
				2	8.1.2.1
				3	8.1.3.1
			2	1	8.2.1.1
		9	1	1	9.1.1.1
	Displacement	10	1	1	10.1.1.1
					10.1.1.2
					10.1.1.3
				2	10.1.2.1
				3	10.1.3.1
			2	1	10.2.1.1
			3	1	10.3.1.1
		11	1	1	11.1.1.1
		12	1	1	12.1.1.1
		13	1	1	13.1.1.1
					13.1.1.2
					13.1.1.3
				2	13.1.2.1
				3	13.1.3.1
			2	1	13.2.1.1
			3	1	13.3.1.1
		14	1	1	14.1.1.1
		15	1	1	15.1.1.1
		16	1	1	16.1.1.1
		17	1	1	17.1.1.1
					17.1.1.2
					17.1.1.3
				2	17.1.2.1
				3	17.1.3.1
			2	1	17.2.1.1
			3	1	17.3.1.1
		18	1	1	18.1.1.1
		19	1	1	19.1.1.1
		20	1	1	20.1.1.1
	Connection	21	1	1	21.1.1.1
					21.1.1.2
					21.1.1.3
				2	21.1.2.1
				3	21.1.3.1
			2	1	21.2.1.1
			3	1	21.3.1.1

Function of AMSC	Surgery action	TEST(conditionally)	Instrument	Surgery technique	Code EST
		22	1	1	22.1.1.1
					22.1.1.2
					22.1.1.3
				2	22.1.2.1
				3	22.1.3.1
			2	1	22.2.1.1
			3	1	22.3.1.1
		23	1	1	23.1.1.1
	Ancillary	24	1	1	24.1.1.1
		25	1	1	25.1.1.1
		26	1	1	26.1.1.
		27	1	1	27.1.1.1
Diagnostic	Examination of internal organs	28	1	1	28.1.1.1
		29	1	1	29.1.1.1
	Determining the location of organs and structures	30	1	1	30.1.1.1
Therapeutic		31	1	1	31.1.1.1

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Thus, it's developed and generally shown an approach, which, in aggregate, forecasts and implements instruments, techniques and technologies, fundamentally possible during surgery, including assisting mechatronic (robotic) surgery complex.

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Modeling Formulations Confectionery Products

Yury N. Voloshin, Musa Ts. Didanov, Murat M. Nagoev, ElsaYu. Daurova, Milana L. Huranova

Polytechnical Institute

Kabardino-Balkar state University

Nalchik, Russia

til4949@mail.ru; didan.m. 3012@ yandex.ru

*Abstract − **This paper examines the issue of designing formulations confectionery products method of fuzzy modeling in MATLAB.***

Keywords – formulation; product quality; term set; fuzzy model; MATLAB; extension

I. INTRODUCTION

The recipe is a major technological documents regulating the production of confectionery, which contains the standard layout of all types of raw materials and semi-finished products on a given volume of production in kind and recalculation on the dry matter [1]. Calculation of formulations rather time-consuming process, and there are currently a number of software products that automate the process of calculating formulations. [2] The most complete state-of-simulation of food formulations described in the literature [3].

When developing new products, if the estimate of initial experimental data is subjective and can not be represented in an explicit numerical form, and the product quality is evaluated based on the results of sensory analysis, the most promising mathematical apparatus of fuzzy inference [4]-[6]. Therefore, it is important to assess the quality of confectionery products using funktsianalnyh herbal supplements.

II. FUZZY LOGIC

For a formal description of the processes of decision-making apparatus used fuzzy set theory [7], [8]. For a description of a system of differential equations are used instead of the expert opinions that are expressed by means of linguistic variables (fuzzy initial data - fuzzy sets). In order to assess the set of admissible values of linguistic variables we introduce the concept of the term (term-set).

The basis of the formation of systems with fuzzy logic based on the following principle: the meter readings fazzifitsiruyutsya, processed, and defazzifitsiruyutsya as usual signals are fed to the actuators. Structural system circuit with fuzzy inference is presented in fig. 1.
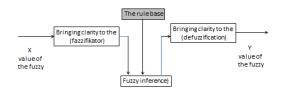
Fig.1. Fuzzy inference system

The main issue in the design of fuzzy logic is to develop the knowledge base (rules). The base may be formed by the method of generation on the basis of peer review, as well as the automatic generation method based on the observation of the actions of the operator.

At the stage of fuzzification is converted from the clear value of a parameter in a fuzzy value of a linguistic variable. To implement such a transition requires a membership function that defines a particular linguistic variable, which indicates the degree (or level) accessory element to the fuzzy sets. For continuous linguistic variable is commonly used universal membership function of Gaussian type

$$\mathrm{MF}(X) = exp\left[-\left(\frac{x-c}{\sigma}\right)^2\right] \tag{1}$$

Where c – the center of a fuzzy set; σ – parameter defining the slope function.

The purpose of the inference – derived using the specified rule base and the known values of linguistic variables, unknown values of linguistic variables. The fuzzy inference unit are most commonly used mechanisms Mamdani and Sugeno. In this paper the fuzzy inference unit used mechanism Mamdani.

The main objective of defuzzification – reduction of the value of linguistic variable back to the definition. To do this, use a variety of ways: on an average center, on the amount of points, the center of gravity method, the maximum membership function. Most often as a simple defuzzification method used by the average center.

To solve the problems of fuzzy modeling using a number of software packages, including a MATLAB environment [9]. Extension «Fuzzy Logic Toolbox» is used to implement fuzzy simulation in MATLAB. As part of this expansion, an interactive mode of graphical editing tools and visualization of

all components of the fuzzy inference systems. Use of this software is the subject of several studies [10]-[12].

III. MODELING FORMULATIONS

In this paper, the simulation of recipes, fruit and berry caramel with the addition of the stuffing extract natural adaptogen – the extract of schisandra, imparting functional properties confection [13], using the software package MATLAB.

Table presents variation recipe caramel stuffed with five intervals term sets based on the results of sensory taste analysis.

TABLE. VARIANT RECIPE CARAMEL ROLLS

Name and consumption of raw materials	Interval estimation of the term set of linguistic variables on the results of sensory analysis				
	Unsatisfactorily [0-2]	Satisfactorily [3-4]	Average [5-6]	Good [7-8]	A great [9-10]
Sugar	645,54	655,54	665,54	675,54	685,54
Syrup	378,76	368,76	358,76	348,76	338,76
Apple sauce	96,20	98,20	100,20	101,20	102,20
The extract of schisandra	14,00	12,00	10,00	9,00	8,00
Citric acid	4,79	4,69	4,59	4,49	4,39
Lactic acid	4,02	4,12	4,22	4,32	4,42
Wax	0,20	0,20	0,20	0,20	0,20
Paraffin	0,20	0,20	0,20	0,20	0,20
Coconut oil	0,40	0,40	0,40	0,40	0,40
Talc	0,50	0,50	0,50	0,50	0,50
Essence	4,00	0,50	0,50	0,50	0,50
Painting food	0,80	0,80	0,80	0,80	0,80

Membership functions for schisandra extract term are shown in fig. 2.
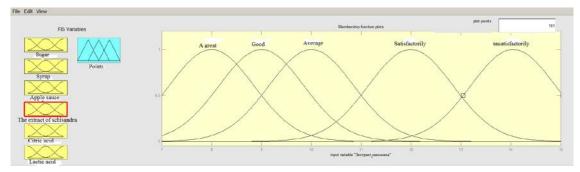
Fig. 2. The terms of linguistic variables the extract of schisandra

Fig. 3 shows a set of membership functions of the output quality according to the terms of caramel flavor sensory analysis.
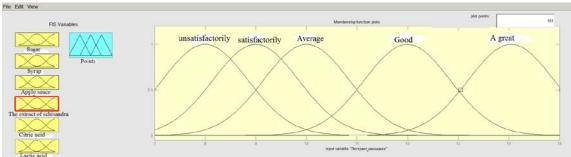
Fig. 3. The set of membership functions of output in terms of scores according to the sensory analysis

Fig. 4 illustrates one embodiment of a graphical means of expansion «Fuzzy Logic Toolbox», which allows you to interactively evaluate palatability caramel depending on the ratio of the formulation ingredients.
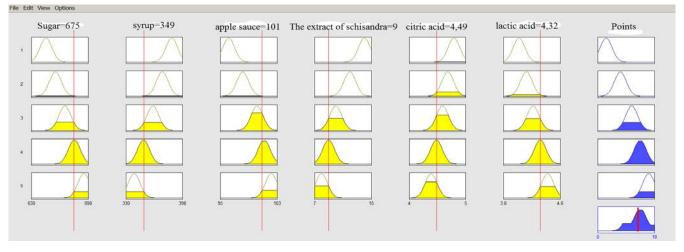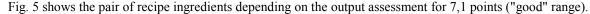
Fig. 4. Membership functions of input variables and output defazifikatsionnaya evaluation - quality candies in points according to the sensory analysis ("good" range – 7,1 points)

Fig. 5 shows the pair of recipe ingredients depending on the output assessment for 7,1 points ("good" range).

a)

v)

b)

g)
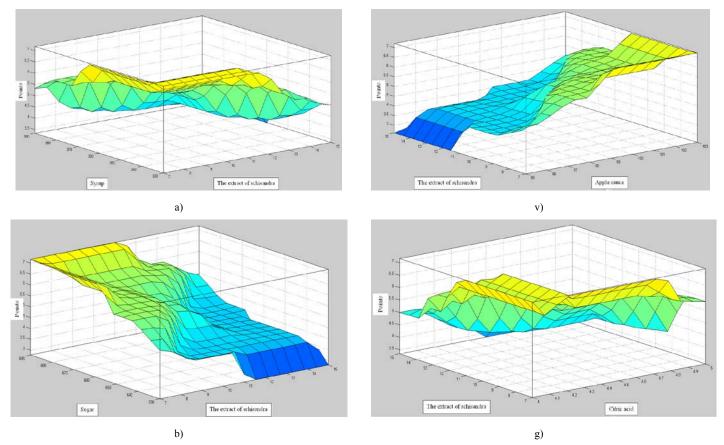
Fig. 5. Twin ingredients according to recipes off 7,1 points evaluation ("good" range): a – syrup - schisandra extract; b – sugar - schisandra extract; v – schisandra extract - apple puree; g – schisandra extract - citric acid.

IV. CONCLUSIONS

Analysis of the results shows that the use of the methodology of fuzzy inference and MATLAB software environment allow us to solve the design problem of confectionery formulations in a subjective assessment of the quality of products with the visualization of the results in the interactive mode.

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Study of the Separability of the Cereal Mixture on Velocity

Yury N. Voloshin, Musa Ts. Didanov, Murat M. Nagoev, Ramazan T. Kipov
Polytechnical Institute
Kabardino-Balkar state University
Nalchik, Russia
til4949@mail.ru, didan.m. 3012@ yandex.ru
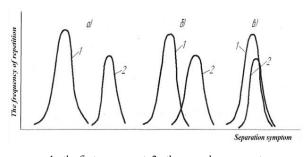
*Abstract − **The paper presents the analysis of process materials separation of grain mixes on the basis of the separation, the results of the calculation methodology and the content of impurities in the grain at withania speed***

Keywords – separation; a sign of divisibility; the var-iation curve; withania speed

I. INTRODUCTION

In industrial processes industry bread at various stages of the technology cycle is carried out the separation operation, ie, the separation of the bulk material to a more homogeneous fractions on the basis of separation. The main issue of the quality of separation is a sign of the divisibility of the cereal mixture, ie, selecting a set of characters and their use sequences [1],[2]. Signs of separation are the geometric characteristics of the particle (length, width, thickness), aerodynamic, physical and magnetic properties.

The components of the cereal mixture to form intersecting dimensional series which graphically for the case of two-component mixtures can be represented variation curves (Fig. 1).

1 - the first component; 2 - the second component
Fig. 1. Variation curves of the two-component mixture

Analysis of the curves shows that for the case of "a" may complete separation of the components, the case "b" - the separation of the grain mix on this basis is impossible and a different type of equipment you want to use, working on another division basis. For the case of "б" is necessary to make a quantitative assessment of the degree of separation. This case is the most relevant in most practical situations.

For multi-component mixtures number of curves on the basis of the division increases, therefore it is necessary to use different separation separation signs.

Fig. 2 shows the variation curves of grain heap coming from the fields after the harvest [3].

a)

b)
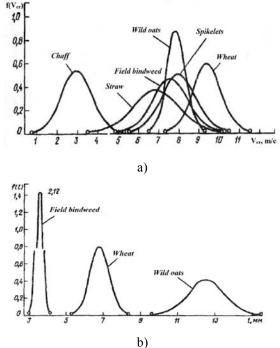
Fig. 2. Variation distribution curves of the components of the grain heap on Withania speed (a) and the length of the particles (b)

The fig. (a) that a complete separation of grain withania speed is only possible from the chaff, for all other cases is possible only partial separation, with varying degrees of probability. The fig. (b) that on the basis of the length of the wheat can be completely separated from the field bindweed and wild oats. Therefore, it is important to analyze the composition of mixtures of grain typical of the territory of the KBR [4], to work out the methodology of work and their instrumentation software.

The basis for the separation of mixtures of disperse aerodynamic properties withania put speed, which can be defined

as the air flow rate at which the fixed particle (or oscillates about a mean position). Withania speed can be determined from the formula of Newton's equation

$$V_B = \sqrt{\frac{2gm}{\rho \xi S_m}}$$

(1)

Where ξ - particle aerodynamic drag coefficient depending on the shape of the particles and the state of its surface; S_m - an area of the mid-section of the particle, ie, sectional area of the projection of the particle onto a plane perpendicular to the direction of its movement, m^2; ρ - air density, kg / m^3; m - mass of the particle, kg; g - acceleration of gravity, m/s^2.

Determination withania speed accurately analytically impossible due to changes in the values ξ and S_m for the same particle in its various orientations in the air flow. In addition, the rate of withania single particle can not match the speed of withania the same particles in a limited section pneumoseparating channel when driving aggregate particles. Therefore, the drag coefficient and rate of withania particles of different cultures and impurities are determined experimentally, and their average tabulated values are used for a preliminary assessment of the possibility of separating the granular mixture, and select the type of air separator [1], [2], [5].

II MATHEMATICAL DESCRIPTION

Considering, that most of the variation curves speeds withania grains and impurities correspond to the normal law of distribution of the random variable [6], [7] can be written in the general form

$$f(V_B) = \frac{1}{\sigma \sqrt{2\pi}} e^{-\frac{(V_{Bi} - V_{cr})^2}{2\sigma^2}}$$

(2)

Where V_{Bi} - i-th value of withania speed, V_{cr} - expectation withania speed; σ - standard deviation withania speed.

If we denote the index "1" of the distribution parameters for the grain, and the index "2" - for impurities, the graphic interpretation of the grain distribution and impurities will have the form shown in fig. 3
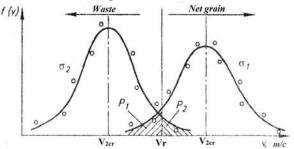
Fig. 3. Differential grain distribution function (1) and the impurity (2) withania speed: P_1 - the probability of the grain losses during separation; P_2 - the probability of hitting impurities in refined grains (at the operating flow rate V_r).

If you set the optimum for this cereal mixture of air flow rate, the probability of preserving grain in the rigging of sailing after treatment in the classifier (P') will be

$$P' = 1 - \int_{-\infty}^{Voptim} f(V_B) dV_B = 1 - F\left(\frac{V_B - V_{cr.1}}{\sigma_1}\right)$$

(3)

and the probability of survival of the impurity

$$P'' = 1 - F\left(\frac{V_B - V_{cr.2}}{\sigma_2}\right)$$

(4)

Where F - integral function of the law of the normal random variable (withania speed).

The probability in the main crop waste is defined $(1 - P')$ by the formula

$$1 - P' = F\left(\frac{V_B - V_{cr.1}}{\sigma_1}\right)$$
(5),

and the probability of impurities exit $(1 - P'')$

$$1 - P'' = F\left(\frac{V_B - V_{cr.2}}{\sigma_2}\right)$$

(6)

To determine the integral function of the law of normal distribution using the equation

$$F(V_B) = F_0\left(\frac{V_{Bi} - V_{cr}}{\sigma}\right)$$

(7)

Where F_0 - centered normalized cumulative normal distribution function ($V_{cr} = 0$, $\sigma = 1$), V_{vi} - value end of the i-th interval variation series values withania speed.

The calculations use the equation
$$F_0(-V_B) = 1 - F_0(+V_B)$$

(8)

Differential withania speeds function (smoothed variation curve) is determined by the formula

$$f(V_B) = \frac{\Delta V}{\sigma} f_0\left(\frac{V_{Bi} - V_{cr}}{\sigma}\right)$$

(9)

Where f_0 - centered normalized differential function ($V_{cr} = 0$, $\sigma = 1$), ΔV - the length of the interval withania rate of change; V_{vi} - the middle value of i-th interval variation series withania speed.

The calculations use the equation
$$f_0(V_B) \qquad\qquad = f_0(-V_B)$$

(10)

If the original content of the cereal mixture probability main culture - P_1 and impurities - P_2 and $P_1 + P_2 = 1$, the impurities in the purified grain content (3-debris) can be determined in % by the formula

$$3 = \frac{P_2 P''}{P_1 P' + P_2 P''} \cdot 100$$

(11)

III EXPERIMENTAL WORK

In this paper we study the divisibility of the cereal mixture on the basis of aerodynamic performed on designed and manufactured sailing classifier shown in fig. 4
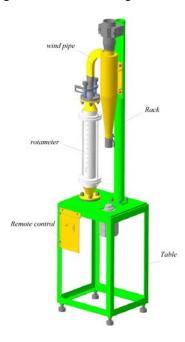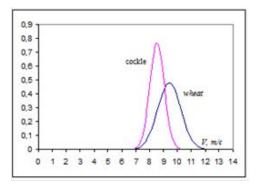
Fig. 4. Laboratory sailing qualifier

As model impurities in cockle weed seeds were used, wild oat, colza and field bindweed, and as the main culture - spring wheat [4]. Used for the experiments linkage of wheat weighing 30g and 50g weight of trash, weighing was carried out on laboratory scale, general purpose grade 4 according to GOST 24104-2001 with a weighing error of ± 0,01 g.

Experimental data were approximated by the normal distribution law of random variables in the Excel environment [8]. Fig. 5 shows the differential distribution function of wheat grains and impurities of the velocity withania.
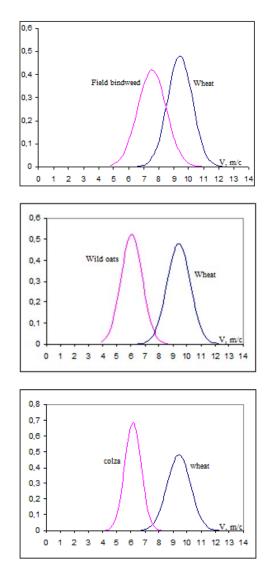
Fig. 5. Differential distribution function of wheat grains and impurities of the velocity withania

IV THE DISCUSSION OF THE RESULTS

Visual analysis of differential curves indicates that wild oats and winter cress with an acceptable result can be separated from the wheat on the basis of aerodynamic and cockle and field bindweed on aerodynamic grounds completely inseparable, and for them, it is necessary to determine the infestation at admissible norm of output of grain in the waste.
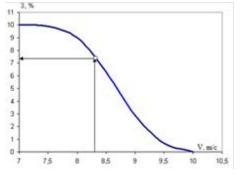
The graphs in fig. 5, you can determine the velocity of the air at the point of intersection of the curves of distribution of wheat and impurities that make systems: wheat - cockle - 9,1 m/s; wheat - wild oats - 7,7 m/s, wheat - field bindweed - 8,4 m/s, wheat - winter cress - 7,6 m/s. Calculation impurity contamination clean grain from the formula (11) was produced for the mixture model, assuming wheat content in the cereal mixture after harvest - 90% (P_1), to 10% weed (P_2) provided $P_1 + P_2 = 1$. These calculations cereal mixture composition after purification in sailing classifier by formulas (3-6)

at the operating air flow rate corresponding to the crossing point of the curves of variation, are shown in table.
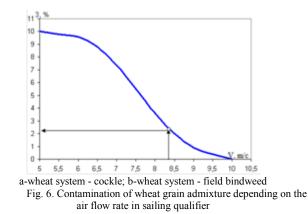
TABLE   Data for calculating the composition of the cereal mixture after treatment in sailing qualifier

Indikator	Culture Index (impurity)				
	Wheat	**Kukol**	**Wild Oats**	**Field bind-weed**	**Barbarea**
V_{cr}, m/s	9,92	8,54	6,07	7,56	6,16
σ, m/s	0,83	0,52	0,76	0,95	0,58
V_{cr}, m/s	–	9,1	7,70	8,40	7,60
P"	–	0,14	0,01	0,19	0,01
1-P"	–	0,86	0,99	0,81	0,99
P'	–	0,65	0,98	0,89	0,99
1-P'	–	0,35	0,02	0,11	0,01
3,%	–	2,33	0,11	2,30	0,10

Analysis of data in Table shows that for selected rates withania debris clean grain and field bindweed cowl is less than 3%, and wild oats and colza - less than 0,2%. At the same time when this debris in the waste together with the admixture should leave 35% of the grain on the dolls and 11% of the grain on field bindweed. Therefore, if you reduce the operating speed of the airflow classifier in sailing, you can increase the probability of survival after treatment of grain, but at the same time increase its debris. Regulatory grain loss during processing in air separators is not more than 2%. [1], sometimes grains in the waste output rate increases to 10% to improve separation efficiency of impurities. Then, the full grain in the process control operation is isolated from the treat and return it to the main stream of the processed grain.

Plotted debris (3) -working air velocity (V_r), can be determined for the desired weed working air speed in sailing qualifier and vice versa. Then, for this contamination is calculated output of the waste grain main crop. For systems wheat - cockle and wheat - field bindweed these graphs are shown in fig. 6.

a-wheat system - cockle; b-wheat system - field bindweed
Fig. 6. Contamination of wheat grain admixture depending on the air flow rate in sailing qualifier

Assuming standard grain loss during cleaning, the upper output normalized grain boundaries in a 10% deviation, the calculation formula (5) yields a value of airflow rate of 8,35 m/s while debris grains defined by formula (11) or fig. 5, will be 7,32% for dolls, for field bindweed – 2,41%.

V. Conclusions

Analysis of the results shows that the impurities can be separated from the grain mass with varying degrees of extraction of the main crop, and the methodical and hardware maintenance of process can adequately classify grain mixture aerodynamic lines.

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On Deciphering the Name of the Art of Divination "Libri Haruspicini": to the Question of Diachronic Convergent Relations in Etrusco-Adyghe Languages

A.Ch. Abazov, T.M. Tanasheva
Kabardino-Balkarian State University
Nalchik. Russia
albekabazov@yandex.ru: Tanasheva-tamara@yandex.ru

Abstract— **The article is devoted to the reconstruction of Etrusco-Adyghe parallels based on the analysis of mythology and pantheon of gods (theonyms), which has not received sufficient light in science. Decipherment of Etrusco-Adyghe lexical-semantic material based on the analysis of a pantheon of gods, their origin, genesis, the analysis of their functions, will help in the reconstruction of ancient history and culture of the peoples who inhabited the Eastern Mediterranean, Asia Minor and North Caucasus in the near past.**

Keywords— the Etruscans; the Hattians; Circassians; reconstruction; mythology; language; analysis; parallel decoding introduction

Reconstruction of Etrusco-Adyghe parallels based on the analysis of mythology and pantheon of gods (theonyms) has not yet been sufficiently investigated in science. In this article, within the available linguistic material of living Abkhazo-Adyghean languages, we are making an attempt to decipher the Etruscan language, based on internal and external renovation Etruscan theonyms compared to the pantheon of gods Hattian-Circassian area, which has become for us a scientific research platform. Deciphering of the Etruscan language, its vocabulary and semantics is in its infancy unlike the sufficiently studied Etruscan graphic system. Restoring of Etrusco-Adyghe hypothetical bilingua involving Hattian lexical parallels is based on the most authoritative point of view among scientists-comparativists of the Etruscan and Hattic languages belonging to the North Caucasian language family, proof of which are already proven hypotheses about the relationship of certain elements of the Etruscan vocabulary to the North Caucasian. The attempt to converge Circassian and Hattian root of the word is quite appropriate. Earlier S.A. Starostin told about the phonetic and semantic examples of convergence on a hypothetical Sino-Caucasian stratum. There are also I. Dyakonov's hypotheses of the structural proximity of the Etruscan language to Hurrian and Urartian (the ancestors of the Nakho-Dagestaian language family) and V. Thomsen's about the existence of parallels in Etruscan and North Caucasian languages. As part of our proposed concept Abkhazo-Adyghean mythology is considered as one of the keys to deciphering Etrusco-Adyghe lexical-semantic parallels.

Common to the Etruscans and the peoples of the east is haruspicy - the so-called science of divination by the liver of sacrificed animals. Divination by the liver originated in Babylon. Liver models, similar to Etruscan, found in Piacenza, also found during excavations in Boğazköy and Mari (Nemirovskii, Kharsekin, p. 135).

The Etruscans are tribes living in I millennium B.C. in the Northwest of the Apennine peninsula (Etruria region, modern Tuscany) and created an advanced civilization that preceded the Roman and influenced it greatly. The origin of the Etruscans is unclear. At the end of the 7th century 12 city-states were united in an alliance of around the middle of the 6th century and they have occupied the Campania region. In 5-3 centuries B.C. are conquered by Rome (New Illustrated Encyclopedia, p. 840).

Haruspices Latin haruspex from hirae (Etruscan harus) guts, entrails + shecere – watch) – in Ancient Rome - the priests, divining by the entrails of sacrificed animals and interpret natural phenomena (The dictionary of foreign words, p. 114).

Tages or Tag is an Etruscan god or hero; Tag in Etruscan mythology is a child who had the wisdom of the prophet and experienced in the art of divination. Etruscans had "Books of Tages and Vegoia". For example, Roman history by A. Martsellin tells about Taget inventor of auspice 21, 1, 10; and about Taget books 17, 10, 2 [Martsellin Ammian, p. 236]. If we talk about Tages, we should not forget that Tagos or tag (ancient Greek ταγός "leader".) is Supreme leader of ancient Thessaly. Tag or Ting – People's Assembly of the ancient Germans; Tag (Hebrew) - signs that are used to decorate the letters of the Hebrew alphabet. Tag (Tibetan) - subscription letters. Element "tag", in our opinion, is seen in the phrase "Alla tagala" (in Arabic), where Alla is the same as Allah. Name Tag on the basis of the Circassian language is read as a "Тагъ(э)" in the meaning of "gift" ("granted"). If we consider separately the name of "Тагъ(э)" in Circassian, it consists of "Та" (within the meaning of "gift" ("gift"; god) + item "агъэ" which is used by Circassians to address the baby (child) to say something like "Агъэ жегъэIэн" which is translated as "to

encourage the child to reproduce the "Агъэ"''); compared with "агу" – "агукать" in Russian. While reading the name Tag in the Circassian language basis, that is from right to left by means (technique) of palinlexia, we get the next word form as "Тіагъ" ("ГъатІ // "ГъетІ") which means "he is Hattian// Hettite". In Circassian speech there is still an appealing address in the form of "ХьетІ жегъэІэ!" which means "Be like a Hettite!" Without a doubt, we can say unequivocally that there is a divinity in the Tag name. Moreover, we believe that in fossilized (hardened) form of name-onym Tag Circassian roots are found in the form of "Тхьэ" (Та "god") + "г" in the sense of "магъуэ" prophet.

Etruscan religion was a religion of revelation. At the decline of republic the Romans knew that Etruscan priests kept the "books" like the books of Tages and Vegoia sent them from heaven by the supernatural mythical heroes - nymph Vegoia (version Begoe) and found in fresh furrow child-prophet Tag.

According to the legend, amazing boy found in the fresh furrow (Tag) was immediately surrounded by a crowd, and people wrote down from his lips unknown up to now wisdom, later called haruspicy doctrine, haruspicinae disciplina (Nemirovskii, Kharsekin, p. 131). The mythical motive of revelation in the form of a "holy book", the secret knowledge given to people by a supernatural being, was known everywhere - from Mesopotamia and Egypt to medieval India and Tibet. It became a popular scenario of the Hellenistic era. Epiphany of Tag as puer aeternus (eternal child) conjures up thoughts of Hermetism (see §209), that does not necessarily require alchemic, that is later interpretation of Etruscan tradition. For us it is important that at the beginning of the first century B.C., the Etruscans stored in their books, libri, some supernatural revelations. These books can be divided into libri fulgurates, books about lightning, libri rituales, ritual books (join with them acherontici) and libri haruspicini, haruspices books (supplemented by libri fatales, books of fate) (Eliade, §167). It is noteworthy that at the root of the word "fatales" is seen the word "fatum" - destiny, fate (The Latin language, p. 349). Similarly, attention is drawn also to the word "fulgurates". In our opinion, here we are not talking about lightning "fulmen" (The Latin language, p. 350), as some authors say. In the word "fulgurates" we believe there are two roots in the form of "fulgeo" 2. sparkle, shine (The Latin language, p. 350.) and "alo" 1. nourish, support; 2. feed, suckle; 3. develop (The Latin language, p. 335). In this case, in the first part of the word, in our opinion, there is the name of the cereal with which he carried out the process of divination. The color of cereal also attracts attention. Compare with the component "fu" in the name of the Etruscan deity Fufluns.

Fig. 1. The liver from Piacenza

A bronze model of sheep's liver, divided into sectors and signed by the names of the gods. Stored in Piacenza Municipal Museum (Palazzo Farnese). Noteworthy is the fact that this model reminds us pose of curled up dog or wolf (Our explanation A.A., T.T.), where the organs of hearing, vision, feeling and understanding are noted. We remind also that these bodies are mentioned in the Koran in the same order.

He - the One who created you hearing, and sight, and hearts, but how little are you grateful. [Koran. Sura "Believers" 23:78].

Allah has exhausted you from your mother's wombs when you knew nothing, and gave you hearing and sight and heart to you in order, perhaps, you have been grateful to him. [Koran. Sura "Bees", 16:78].

Say: "Have you ever thought, if Allah will deprive you of sight and hearing and will seal your heart, which deity except Allah is capable to return you all these again?" [Koran. Sura "Cattle", 6:46].

Verily, We created a man from a drop of mingled moisture ;We are testing him, so created him hearing and seeing. [Koran. Sura "The Man", 76:2].

It is noteworthy that the sequence of human organs development in the womb, established by embryologists only at the end of the XX century, corresponds exactly to the information sent down in the Koran verses.

The above verses of the Koran mention the senses that Allah bestowed by His gift upon the man. If you pay attention, all these bodies are mentioned in the Koran all the time in a certain sequence: hearing, seeing, feeling and understanding.

Internationally renowned Canadian embryologist Keith Moore in the article published in the "Journal of Islamic Medical Association" [Journal of Islamic Medical Association,

94] mentions that during the embryo development in the womb, the first sense that begins to form is the inner ear, and then the eyes. The brain which is the organ of feeling and understanding begins to form after the hearing and eyes.

Fig. 2. The liver from Piacenza

Apparently the tutorial on divination on the entrails of sacrificed animals is a discipline in which the Etruscans had no equal. "The etymology of the word "haruspex", as B. Raymond writes, "still remains unclear and a source of much debate since the ancient authors" (Reymond, p. 189).

Let us, based on the Circassian languages, solve the problem of etymologization of the word "haruspicina" and its derivatives. The manner or, to be more exact, typical ways of reading techniques of Etruscan words will help us. This way of reading sentences or words from right to left is called palinlexia (backward reading).

So, the original form of the word "haruspicina" is read in Kabardino-Cherkess as "а-насыпс ы-ра-хь", where "a" is an abbreviated (indefinite form (affix) - third person "ар" means "this" + "насып" means "happiness" + с//щ (suffix of assertiveness), "literally "this is happiness"+ "ырахь" let them take away. The basis of the component "Ырахь" is a derivative of Circassian "хьын" literally "let them take this with them", where morph (formant) "хь(ы)" means 1. to bear somebody/something somewhere; 2. to spend time somehow. Literally "насыпырыхь дисциплинэ" can be seen as "the discipline of happiness".

Epiphany of Tag in the form of "puer aeternus" in Circassian means "godsent to pupil", where "пIур" the "pupil", "aetern" in Kabardino-Cherkess is read as "нырита" means godsent. "ПIур" is Circassian word "baby" who was given for education to atalyk (Adygebze psalale, p. 600).

Thus, the doctrine itself in the form of Tag books "libri Tagetici" in the Russian translation is "The teaching of the Tag from Erbil". In Kabardino-Cherkess, the fractional reading sounds like "Ербыл Тагъ исыти" literally "Granted by Tag from Erbil", and the reverse reading "Исытэ ГьетI

(ХъатI) Ирбыл" is translated as "granted by Hittites from Erbil". Accordingly, "libri haruspicini" is read in Kabardino-Cherkess as "Ербыл и насыпырыхь" that is "The doctrine of luck from Erbil". This is the fractional reading. When reverse reading (that is from right to left) in the Adyghe "libri haruspicini" reads as "И(ы)" (his) + "насып" happiness + с//щ (affirmativeness suffix) + "у(ы)рахь" let them take you.

Speaking regarding the toponym Erbil, here we can talk about Erbil (Akkadian Arba-Ilu) – city in Iraq, one of the oldest cities in the world. As shown by archaeological research, it exists continuously from the IV millennium B.C. The Citadel hill reminds it, which is the remains of the former first settlements; surrounding wall, believed to be in its oldest part goes back to pre-Islamic times. The town was first mentioned in documents Shulgi, the king of the Sumerian city of Ur (XXI century B.C.) as "Urbillum" in Akkadian "Арба-илу" – "Four Gods" (that is the "City of four churches"). Remind you that in the Akkadian "Илу" is "God".

"Арба илу" in Circassian is read as "Ар (this) +Бэ (a lot)+ илу". When reverse reading at the same Circassian language, we obtain the following word form of "Илу" + Бэ (a lot) + Ар (this).

As for the self-designation of the Etruscans in the form of "Ансар" we should note the following that Tell al-Ansari, the south of the old part of the city of Aleppo (Halab), since ancient times referred to in the form of Tell al-Ansari (The Oxford encyclopedia of archaeology in the Near East, 1997). This is yet another confirmation of the version of the Asia Minor roots of Etruscans ethnogeny.

Now back to the former name of Aleppo (Halab). The first mention of this city dates back to 2500 B.C. Former names Khalpe, Beroea. Not surprisingly, Beroea reminds us of the name of a nymph and prophetess Vegoia (Begoe) in Etruscan mythology.

It was believed that Vegoia has trained some of their ritual rules and told people the principles of measurement and a way to mark the boundaries of fields. [Reymond. p. 189].

If etymologize Vegoia (Begoe) in the Circassian language, then we find in the root of this name the form of the word "(e)гъэIу" from the verb "Iуын" spread (about sounds). You can consider other versions, for example "(и)гъэуэ(у) +Iу(э)н" in the sense of "игъуэу" timely, appropriate + "Iуэн" thresh something; engaged in threshing; swear or "I(у(ы))эгъуэ" time of threshing cereals. In the old days Circassians called October month "Iуэгъуэ мазэ". There is another possible interpretation in the Kabardian language as "вагъуэ" star "вагъэ" tillage, "бэгъуа" is derived from the verb "бэгъуэн" (мэбагъуэ) 1. ripen (about harvest); 2. multiply, breed [Adygebze psalale, p. 56]. We believe that here in the name of Vegoia is seen an element of magic that is found in Kabardino-Cherkess word "тхьэгурымагъуэ", which denotes

the seer, prophet, foreteller, soothsayer. It is possible to consider other words with an element of "гъу(ы)" in the word "гъуо" herald and "игъуэ" - suitable for anything time, it is time; term (to start something). Name Vegoia can be compared with one of the sacred names of God, Jehovah, according to another reading Yahweh in the Old Testament, whose name embodies the concept of eternity and perfection. According to the Bible, God under this name for the first time opened to Moses - the founder of the Jewish religion.

Latinized Beroea also mentioned as one of the names of the city of Aleppo in Syria. Compare with the name of the city of Halab (Aleppo) (Arabic: حلب Halab, Armenian Հալէպ Халеб, Greek Αλέππο, Βέροια, Latin Beroea) - Syria's largest city and the center of the same name of the country's most popular muhafazah [UN Data, Syrian Arab republic]. From the word onym Бэлыхь when reverse reading in the Circassian language we get the city name Х(Г)алеб.

Interestingly, in palinlexia way of reading of the form of Aleppo city (Halab), we get the word form in the form of "бэлыхь" where "бэлыхь" in Kabardian II excellent, magnificent, very good (about someone or something) (Adygebze psalale, p. 35). Therein should be given another example, where it is said that the left tributaries of the Euphrates in Syria are called Balikh and Khabur, which are big rivers with headwaters in Turkey. It does not exclude the possibility of matching the words "Halab" – "бэлыхь" with the named of deity Balu, Baal (Geek). In Ugarit and Phoenicia the most widespread was cult of Balu - the god of storms, thunder and lightning, rain and fertility. We believe that hydronym "Balikh" ancient Circassians took from the Caucasus. Please note that the river Malka (Kabardino-Balkarian Republic) Circassians call in the form of "Балъкъ".

In the investigation of existence of the name Tag we must not forget that the names Yasin ياسين and Taha طه (Tages) are one of the prophet's names. "I am. Syn. I swear by the wise Koran! Truly, you are one of the messengers. "(Surah "Yasin", 1-3, Koran, 2007).

Tag onym we find in Sura 64 of the Koran, which is named "At-Taghabun // Тагъэдун // et-Tegabun (Reciprocal Loss, Deprivation, Self-deception Exposure, Mutual Disillusion)" in Kabardino-Cherkess "КъызэрыгъэпщIэжыныгъэр" godsent in Medina. Conventionally, the name (word) Taghabun in Circassian can be separated into two independent units in the form of name "Taг" + "бын" child.

The Sumerians claim that they had contact with the inhabitants of the planet Nibiru! Niburu in Circassian linguistic base means of palinlexia is read as "у" you + "ри" is (his/her) + Hattian-Circassian "бын" - a child. Form of the name Taghadun in Circassian is read as "Taг" + "дин" "Tages religion and faith". While reading the names Taghabun // Taghadun in Circassian from right to left, we obtain the following word forms in the form of "Ныбогъэт" (you pass) //

"Ныдогъэт" (we pass) // "Н(э)удыгъэ (т)" literally "нэ" - the eye(s) + "удыгъэ" witchcraft + "т" from the verb "тын" to pass.

The word "ibn" (Arabic - son) and other forms of the word in the form of a "бун", "бен" in proper name put in front of father's name (forming a "patronymic name") among the peoples using the Arabic language (e.g. Ahmed ibn Abdullah - Ahmed son of Abdullah) in Arabic means "son". So, presumably, the Koranic At-Tagh aabun can be read on the Kabardino-Circassian as "Aт-Тыг (ъ)э и бын" // "Адыгэ бын" literally "child (son) of Adyge". You can also consider other versions, whether it is "Child, son of Tages"; "Child, the son of a deity" ("Тхьэ бын")"; "Child, the son of the sun" ("Дыгъэ бын") or "Hattian child, son" ("Хь(Гъ)атI и бын").

Deciphering of Etrusco-Adyghe lexical-semantic material on the basis of pantheon of gods analysis, their origin, genesis, the analysis of their functions, will help in the reconstruction of ancient history and culture of the peoples who inhabited the Eastern Mediterranean, Asia Minor and North Caucasus in the near past.

NOTE

Compare with the name of the city of Halab (Aleppo) (Arabic: حلب Halab, Armenian Հալէպ Халеб, Greek Αλέππο, Βέροια, Latin Beroea) - Syria's largest city and the center of the same name of the country's most popular muhafazah (UN Data, Syrian Arab republic).

Гъунапкъэ - border; face (between smth.); edge, boundary (Adygebze psalale, p. 105).

nymph - in Greek mythology the deity in the form of a woman, symbolizing the different forces of nature (Ozhegov, p. 356.).

Epiphany - (Greek way out, appearance), a manifestation of the deity in the form perceived by the senses.

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Kabardino-Circassian Lexicography: Status and Prospects

M. M. Abazova*[1], M. L. Apajev, B. C. Bizhoev*[2], M. H. Tokmakova*[3]
*Kabardino-Balkarian Institute of Humanitarian Studies
Nalchik. Russia
marita.abazova@yandex.ru[1]; kbigi@mail.ru[2]; tokmak_madina_h@mail.ru[3]

Abstract— **The history of the formation of the kabardino-circassian lexicography, originating in the XVII century, includes several stages. The subject of this research are the dictionaries of kabardino-circassian language, published in the 1950-ies–2000–ies. That is since the 1950s, begins a new milestone in the development of the kabardino-circassian lexicography. Objective: to characterize the existing dictionaries of this period, to determine their achievements and shortcomings, therefore used descriptive and analytical research methods. In the study of this question revealed that thanks to the efforts of scientists and linguists have managed to create at a high professional level the most important types of bills, explanatory and other dictionaries, and the lexicography currently has become one of the leading areas of adygueya. The materials in this study can be used by professors in the courses of lexicology and lexicography, on the development of the kabardino-cherkess literary language and its norms. The results obtained will also be useful for future lexicographical developments in kabardino-circassian language.**

Keywords— dictionary; kabardian-circassian language; lexicography; translation; interpretation; phraseology

1950-ies was the beginning of a new stage of kabardino-circassian lexicography. Due to the significant intensification of political, ideological and cultural life and a closer communion of the masses of workers to the modern Russian and world culture, increasing the number of kabardian and circassian students in universities and pupils in the secondary specialized educational institutions, as well as with a large scale translation business in KBASSR raises the question about necessity of creation of bilingual dictionaries, more or less fully reflect the basic vocabulary of the Russian and Kabardino-Circassian languages.

The first was published in Moscow "the Russian-Kabardian-Circassian dictionary (30,000 words) with a brief grammatical sketch of the Kabardino-Circassian language B. M. Kardanova [1]. The appearance of this dictionary has become a significant event in the cultural life of the Republic and marked a qualitatively new stage in the Kabardino-Circassian lexicography. The dictionary was intended to some extent to serve as a guide when studying the Kabardians and Circassians lexical richness of the Russian language, Handbook for translators of Russian language at the Kabardino-Circassian and for teachers of the Russian language in Kabardian schools. None of the previously published dictionaries in the Kabardino-Circassian language does not meet those requirements. It was further decided to create a "Kabardian-Russian dictionary" in volume 20 000 Kabardian words. This work of life done in an extremely short time, and the dictionary was published in Moscow in June 1957 with the same grammatical sketch by B. M. Kardanova [2].

The data dictionaries was a major bilingual lexicographical AIDS. The compilers were faced with some very difficult problems associated in particular with the formation of words and interpretation of lexical units in the first major Circassian-Russian dictionary, which was the Kabardian-Russian. From the printed responses to his special attention deserves a most thorough and reasoned review of M. A. kumakhova, according to which we have before us "a major achievement of the Kabardian lexicography", "the first national-Russian dictionary in the Adyghe dictionary science, the first experience, which collected and processed most common vocabulary of modern Kabardino-Cherkess literary language" [3]. The dictionary has not escaped certain shortcomings. Not everywhere has managed to clearly distinguish between verb forms and derived words, complex verbs and phrases. Lexicographic work, which are, as objectively observed M. A. Chumakovym [3], "first experience in the Adyghe linguistics". Despite the known disadvantages, explain the objective reasons, the Russian-Kabardian-Circassian and Kabardian-Russian dictionaries still remain outstanding lexicographical works, important monuments, Kabardino-Circassian language, it continues to serve the objectives of studying native and Russian languages.

Not to mention the minor training, a bilingual Russian-Kabardian dictionary, which had in the late 50s and the 60s are known to spread among students Kabardians, especially rural areas. We are talking about the Russian-Kabardian dictionaries to readers for 5 th grade (1,400 words) [4], for 6-class (1,400 words) [5] , as well as "Russian-Kabardian dictionary" to reading books for 6th class national schools (1000 words 70 phrases) [6].

In the postwar years the big attention is given to improving spelling and, in close connection with this, the compilation of the spelling dictionary. In 1946 a reform of the Kabardino-Circassian orthography, which had an important social

significance and updated the spelling. Published manual "Kabardino-Circassian orthography" ed. by X. U. Albegova and A. P. Keshokova [7]. Significant work to streamline and further improve the spelling done brilliantly Urusov S. X. and L. G. Zaharovym - authors the most complete set of spelling and punctuation rules Kabardino-Circassian language and where the included spelling dictionary 13 000 words [8]. They made up the largest spelling dictionary of the Kabardino-Circassian language, covering 90 000 words and forms [9].

In 1967 published the work of L. G. Zaharova School spelling dictionary of the Kabardino-Cherkess language" [10]. In 1989, he held the fourth, revised edition of this manual to which is annexed, lists of geographical names, Kabardian male and female names [11]. A family of short, bi - and multilingual dictionaries for educational purposes was increased due to "Russian-Kabardian-Balkar dictionary Karmakova X. G. and S. Gurtuev [12], "School of Russian-кабардинского dictionary" X. 3. Georgieva and X. X. Acunova [13], Kabardino-Circassian-Russian-English-Turkish dictionary illustrations" X. X. I. X. Acunova and Sokolovoi [14].

Remarkable not only in Kabardino-Cherkessia, North Caucasus but also in lexicography is the Dictionary of the language of Ali Shogentsukova, compiled by one of the enthusiasts vocabulary of the country's L. G. Zaharovym. The dictionary contains all the primordial and borrowed lexicon of the poet-a classic that is 7,200 words [15].

Kabardino-Circassian lexicography has achieved undoubted success in the development of phraseological and other aphoristic material.

The most comprehensive and significant publication aphoristic material is a two-volume collection of "Kabardian Proverbs" [16], registered more than 5,000 Proverbs and sayings in the Kabardian language. The second edition carried out in 1994 in a book [17].

Collecting and theoretical study of the phraseology of the Kabardian-Circassian language has devoted many years of B. M. Kardanov. As a result of years of training this problem he created two phraseological dictionary [18, 19] and one monograph [20]. These works received high praise in the literature. To the type of multilingual phraseological dictionaries is the work of A. G. Emuzova [21].

In 1971 in Circassia created the first dictionary of synonyms Kabardino-Circassian language [22], which covers 545 synonymic rows. In 1989 he published "a Brief dictionary of antonyms Kabardino-Circassian language" I. X. Psybaba [23].

As you know, in the Autonomous republics very poorly conducted, or almost never conducted the work on creation of encyclopedic dictionaries. To a certain extent this also applies to terminological dictionaries. It is gratifying to note that the Kabardino-Circassian linguistics has made a new step in this direction. Circassian scholar B. Yu. Hakunov amounted to "a Dictionary of the Kabardino-Circassian names of the plants, with Russian and Latin indexes [24].

S. X. Shhagapsoev . and L. H. Elephants in the distance "Kabardian names of plants", which includes about 700 names [25]. In 1999 the publishing house "Elbrus" N. N. Zekoreev released Russko-Kabardino-Cherkess explanatory terminological dictionary" of a General nature [26].

A new page in Circassian lexicography was the two-volume work of A. K. Shagirova "Etymological dictionary of the Adyghe (Circassian) languages" [27]. The work is done on the basis of the whole of the Abkhaz-Adyghe language group with the broad involvement of material and other Caucasian languages of Dagestan, Nakh, Kartvelian. It is a generalization of previous research studies of domestic and foreign caucasologists in the comparative-historical study of the vocabulary of material Adyghe languages.

In the late 50-ies of the 20th century was begun the compilation of the fundamental work — explanatory dictionary of the Kabardino-Circassian language", which is interpreted around 31 000 words [28]. Its first version was completed in the mid 70-ies. Dictionary after several long completions published in Moscow only in 1999 In its creation involved a large team of authors. The dictionary is the first ever dictionary of the Kabardino-Circassian language and includes mostly common vocabulary and phraseology. This work acts as a bilingual - Kabardian-Russian dictionary. To expand the circle using a dictionary headword it is translated into Russian language (through the selection of equivalent or descriptive). It is important to pay attention to the fact that the explanatory "Dictionary of the Kabardino-Circassian language", among other things, has become a solid Foundation as a launching pad for many new in the Adyghe linguistics types of lexicographic works - thematic, ideographic, word-formation, valentnosti, antonymy, homonymic, paralimini and other dictionaries are not developed in linguistic adigonidon [29, 30, 31, 32, 33, 34].

In 2008 published in the Kabardino-Circassian-Russian dictionary, M. L. Apazheva and D. N. Kokova, including about 27,000 words [35]. This dictionary differs from its predecessors as the composition of the dictionary and lexicographical interpretation. So, tightened the principles of selection of lexical units at the expense of involved forms, of verbal formations in –Hye, causative forms, when they do not form an independent lexical units, forms version and potentialise borrowed words that are not included in the active vocabulary. Stricter distinction between a compound word entered into the dictionary, and attribute complexes.

It should be noted that the vast majority of existing dictionaries Kabardino-Circassian language was developed in

the walls CBHI sector of the Kabardino-Circassian language. There are two the most productive in this plan period in the history of the sector is 50-60 –ies of the last century, when appeared the first professionally written and the most complete Kabardino-Circassian-Russian, Russian-Kabardian-Circassian, and Kabardino-Cherkess Russian phraseological dictionaries. At the same time work began on the first sensible, synonymic and phraseological dictionaries.

The second period began in the 90-ies of XX century, during the so-called perestroika, the most important task which was overcome stagnation in society, which lasted many years. Unfortunately, this stagnation is noticeably reflected in lexicographical work. In a number of objective and subjective reasons, was abandoned in an incomplete form several dictionaries. Since they started work updated collective sector. On the basis of the achievements of modern linguistics, and given the rapid changes in the socio-political system of the country is actually new was developed dictionary of the Kabardino-Circassian language, which was published in Moscow in 1999 [28]. Using the accumulated material by members of the group were compiled and published two high school dictionary. The first of these - School phraseological dictionary of the Kabardino-Circassian language [36], which is the first sensible phraseological dictionary of the Kabardino-Circassian language and covers more than 2300 phraseological units designed for students in secondary schools; also it will be useful to all who wish to learn the depths of their native language and make the speech shaped and the label. The second School dictionary of synonyms, where the reader will find more than 750 synonymic rows [37]. They are placed in the dictionary by alphabet "uppercase" words, i.e. those words that come first in each group of synonyms. Description of specific synonyms given in comparison with other synonyms belonging to the group.

Special attention to the sector of the Kabardino-Circassian language CBHI training school-academic dictionaries because students in greatest need in such directories and their presence is of great importance for successful acquisition of the wealth of the native language by the younger generation. Therefore, for the above-mentioned dictionaries, it was followed by the Training of Russian-Kabardian-Circassian dictionary [38], a School dictionary of the Kabardino-Circassian language [39].

Russko-Kabardino-Cherkess dictionaries intended for learners, was published repeatedly since the 1920's. The first such work belongs to B. L. Juranova [40]. In subsequent years, the practiced preparation of concise dictionaries for school textbooks in Russian language and literature for national schools. They are all actively used in the learning process and has brought many benefits, although, if you look at them from the perspective of our days, they were still largely imperfect, since their authors have not had sufficient experience to lexicographic activities.

In this respect from their predecessors favorably School Russian-Kabardian dictionary Georgieva H. Z. and H. H. Acunova [41]. First, it covers significantly more words (about 12 thousand), and secondly, the translations here are more than adequate, thirdly, all Russian words are provided, in addition to translations for Kabardino-Circassian, a variety of additional information, ie, received widespread grammatical feature. Here is the third decade of this dictionary is a reference book for many teachers-philologists KBR and KCHR.

A special pride of workers is the language Dictionary Alim Keshokova, which was completed to the 100th anniversary since the birth of the classic of the Kabardian literature (2014). This dictionary was first compiled on the basis of card files, consisting of painted all the creative heritage of the classic of the Kabardian literature. He will actually dictionary of modern Kabardino-Cherkess literary language, which in many ways complement and clarify Dictionary 1999 Unfortunately, due to lack of funds its publication was delayed, but we hope that this unique work, unique in all the world only one, soon will see the light. In the final stage of the Big academic Russian-Kabardian-Circassian dictionary, which covers the main lexical richness of the Russian language. In the active stage of the academic dictionary of synonyms Kabardino-Circassian language. Plans for the coming years of academic explanatory dictionary.

As you can see, one listing the names of dictionaries looks solid and takes a lot of space. We have no way deployed to characterize each of them – you've got to devote special articles and entire monographs. Here we can confidently conclude that the Kabardino-Circassian lexicography has now become a highly developed direction Adyghe linguistics, which has made significant progress in compiling various types of dictionaries and which, in future, shoulder the realization of more complex tasks.

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Communicative Function of Interjections in Dialogue Discourse
(Based on the Materials of Kabardin-Chircassian Language)

Andzhela A. Afaunova
Kabardino-Balkar Institute of Humanitarian Studies
Nalchik, Russia
martazei@mail.ru

Abstract— **Language is the primary means of communication. The most important role in this process belongs to interjections. The subject of this research is the text-forming, contact-establishing function of interjections Kabardino-Circassian language and their referativnye opportunities. Objective: to analyze the discursive significance of interjections, their text-forming potential and thereby to refute the established opinion about their isolation. The considered material allows to conclude that with interjections in the discourse, provides a wide set of semantic nuances, which are superimposed on the common semantics of the utterance. Interjections addressed to a specific communicative partner and actualize the subsequent speech act. Studies have shown that Dialogic interaction is impossible without verbal participation listening: communicative intent of the words, particularly interjections cannot be realized without the direct communication of interlocutors. The author uses descriptive, comparative and analytical research methods. The obtained results can be used to further the study of interjections in the Kabardino-Circassian language.**

Keywords— interjections, discourse, discourse formation, multifunctionality, text-forming potential

Since the fast development of anthropocentric approach to language studies took place, the linguists have recently been showing interest in the language sections that are directly related to emotional and expressive aspects. The reason is that no linguistic phenomenon takes place without that factor. It is related to the ability to act upon emotional state of a person through the expressive speech, thus generating certain feelings. Emotional intensity of speech is built exclusively upon psychological features of a person.

Emotions and feelings are a psychic process that defines the state of a person reflected in his/her overliving of certain important life events (joy, sadness, exaltation, fear, pleasure, content, protest, resentment).

Interjections are known to be expressing the emotional state of a person, his/her attitude to the social realm, or his/her feelings and emotions.

Interjections do not require any speech chain to express emotions. The sentences that follow them commonly reveal and describe the exact emotional state that the author is in. Interjections act as operators of a person's discourse activity and because of that they are ignored by linguists compared to other parts of speech. Their function is to reflect various, often absolutely opposite, emotions, such as disappointment and admiration, happiness and grief, fear and astonishment. Important role is given to the context, the situations in which the interjections are used.

− Бэтал, − жиӀащ Мухьид… − ИкӀэ къихуамэ, дапщэрэ укъыдэкӀагъэн мы ЛъагъуэзакъуэмкӀэ? Уи гъащӀэ псом къриубыдэу?

− Уоу-уэхь, − къызэщӀэувыӀыкӀащ иджы Бэтал. – Уэлэхьи, ар куэд мэхъум, куэд дыдэ!.. [1].

[− Betal − Mukhid said… - In extreme case, how many times did you cross the Lonely path? Ever in your life?

− Oh-my, − Betal stopped. – God, many times, so many times!..]

Ар [Къасым] япэплъэрт абыхэм, жьы дыдэу къызэрымыкӀуэхэм иризэгуэпу.

− Пу, алаурсын, сыту фыгулыцӀыншэ фэ къомыр! – жеӀэ Къасым къэкӀуа щӀалэхэм япожьэри. [2].

[He [Kasseem] was waiting for them, angry for not having come early.

− Holy moly, you are all heartless people! – Kasseem says meeting the walking guys].

Based on the above, one could formulate the objective of the article, which is to analyze the communicative functions of interjections in Kabardin-Chircassian language, to define how they affect the structure of sentences describing the thoughts and feelings of a person.

The research of text formation and text-forming units has become topical relatively recently. Text is made up of

complex lexical, stylistic and logical interrelations between language units. Every word and every syntactic structure is important in transfer. Combined with the emotional contents they all influence the formation of a text. They carry the information that an addressee needs. Its completeness is ensured with the words used to transfer the meaning and emotional state of the author. Interjections also influence the formation of a text.

Example:

– Сэ ар фIыуэ солъагъу, – жеIэ Аслъэн.

– ХьыI, – мэдыхьэшх Хьэмид, и щхьэр игъэкIэрахъуэурэ. – ХуэIуа щыIэкъым, дахэщ! ФIыуэ плъагъу хъунущ. [3]. – Interjection хьыI denotes sarcasm. To reveal this emotion the author makes another statement, although it is clear what his thoughts are in his minds.

[– I love her, – Aslan says.

– Hm, – Khamid laughs and twists his head. – No wonder, she's beautiful! One could fall in love].

Щэралыкъуэ Iэ ижькIэ и пащIэшхуэр ирилъэщIэкIри, бысымым зыхуигъэзащ:

– Алоу-уэхь, Хъуншэр, уи щIалитIыр къэкIуэжа жызоIэ! «Зи цIэ ираIуэ бжэщхьэIу тетщ», – жыхуаIэракъэ? Мыдэ фыкъакIуэт, щIалэфIхэ. Пу, мэшэллыхь, мы тIум я теплъэр, мы тIур зэрыхъуа! [4]. – Interjection алоу-уэхь denotes surprise, exaltation; пу, мэшэллыхь – is used to show exalation and to prevent basilisk-glance.

[Sharaliko trimmed his moustache with his right hand and turned to the hosts:

– How come, Khunshar, both your sons are back, I said! «Whoever you call by name, he will come» – they say. Come here, good boys. Pooh pooh, look at them, who they have become.].

It is undeniable that interjections plan an important role in communicative behavior of a person, in his everyday speech. The use of interjections is regulated by feelings and emotions as well as the author's personality and his addressee, their relationship, social status. They can have good, friendly relations, or negative ones, they can be in the same social status or they can belong to different age groups. These criteria influence the way the speakers express their emotions and the way they receive the message.

[Юрий Иванович:] – СлIожь, пэрымыхьэ укъэкIуауэ ара? Мыр сыт атIэ, зэхэпIуэтэжаи къыпыпча пэрымэр!

– Пу алаурсын, мыр дауэ хъуа! – Мусэбий и щхьэр къеIэтри Юрий Иванович къыхудоплъей къэуцIыплъауэ. А пэрымэр къыщыIыпичам Юрий Иванович гу лъитэмэ, и напэр текIакъэ» [5].

[[Yuriy Ivanovich:] – Are you here for the flowers? What now, messed all the ripped flowers!

– Holy moly, how come!! – Musabi raises his head and looks at Yuriy Ivanovich, blushing. If Yuriy Ivanovich understands why Musabi ripped the flowers, it will be a disgrace.].

In this sentence the interjection «пу алаурсын» is not meant for the addressee but rather the author himself, as an expression of annoyance and shyness for having let the situation out of control in front of the respected Yuriy Ivanovich.

– Тхьэ фатэмэ! Уимыгъэбауэт и мэм!

– Мэ зимыIэ кхъуей щыIэ, зиунагъууэрэ! Дэнэ зыщипкIутар?

– Псыунэм.

– Пу алаурсын, уэ пхуэдэ цIыху! Дапщэщу пIэрэ фэ цIыху фыщыхъунур? [6].

[– By God, they are rotten! One couldn't breathe the air!

– Cheese always has a smell! Where did you pour it?

– In the toilet.

– I'll be damned, what kind of a person are you! Are you planning to become a real person, guys?].

Here the interjection «пу алаусын» is used as a disapproval of a listener, in this case, of a family member.

Хьэщауэ: Уа, Жанзилэт, а псори зыгуэр хъунщ, ауэ апхуэдизу ууакIытэхрэ пэт, мы Хьамзэт уэрэ дауэ фызэрыугъуэт, дауэрэ фызэрыушэ?

Жэнзилэт: (мэдыхьэшхри). IукI, кхъа, иджы… Тхьэ дуней мылъыкукIэ абы?..

Хьэщауэ: Сыт, зиунагъуэрэ, апхуэдизу ар…

Жэнзилэт: АIэ, тхьэ. Сыт жысIэжми, ар… ЯIэлыхь, сыту утхьэщыхьэ уэ… [7].

[Khashao: Hey, Zhanzilat, it's all fine but how come you, such a shy lady, have met this Khamzat, how did you get married?

Zhanzilat: (laughing). Quit it... No way …

Khashao: What, on earth, is there…

Zhanzilat: No, by God. Whatever could I tell, but this... God, you are so persistent …].

In the given example, interjections зиунагъуэрэ, яIэлыхь, тхьэ, ya reflect the fact that the partners are very close to each other. «Зиунагъуэрэ» – expression of surprise; «яIэлыхь», «тхьэ» is confirmation; «уа» – calls for attention.

Naturally, the closer the relations between the speaker and listener, the more sincere, more lively and expressive the

dialogue is, the more expressive words are used without the fear of misinterpretation. It is clear that it is improper to words with negative connotation or emotions or disrespect when addressing to a person who is higher in social status.

The choice of interjections causes response. In this sense, one could trace the way interjections influence the formation of dialogue speech, the way the speakers arrange their phrases:

[ХьэпащIэ:] – СоIуэ, Къанщауэ, тIэкIу деIубамэ… Къытхуэгъэгъу. Дэнэ щыIэ Назир?

– ТхьэгуIэ, Назир жеижакIэ. И гугъу умыщI, къыпхуищIэн щыIэкъым.

– Iэгъу, моуэ щхьэщIыжу зы бжьэ демыфэу дауэ хъун? Къэгъэуш!

– ТхьэгуIэ, зы фадэ ткIуэпси ди унэ щIэмыт. [8].

[[Khapasha:] – I swear, Kanshao, we hardly touched a drop … Forgive us. Where is Nazir?

– Word, Nazir is already asleep. Don't disturb him, he can't help you.

– How can we not take a sip to cool our coppers? Wake him up!

– Word, there is no single drop of alcohol at home].

The attitude to interjections in linguistic studies of Kabardin-Chircassian language has always been complex: some thought that interjections shouldn't be considered as parts of speech [9]; others attributed them to auxiliary parts of speech since they had neither semantic nor grammatical features [10; 11]; the rest would refer to them as a separate part of speech since they thought that the interjections were a "special class of words that differs from content and auxiliary parts of speech as well as from the sound effects» [12; 13; 14; 15; 16].

All linguists, meanwhile, emphasize the role of interjections in oral everyday speech as well as in the origin of a language. Many scientists consider them to be the oldest elements of the language activities: "Interjections… are considerably amended remains of the older stages of the development of the human speech" [17]. According to Kh.Sh. Urusov, interjections are the remains of the amorphous language of the ancient past [18].

Since interjections are polysemic, they are also multifunctional. The author, in his attempt to influence his companion through his speech, carries out a phatic function when starting a conversation. The speaker may put the exact connotation into a certain interjection that is needed for that certain communicative act. This phenomenon is characteristic of the author, and that is often used in the fiction literature for a better understanding of the characters' inner world and emotional condition.

Хьэсэн и цIыху щIыкIэкIэ укIытэх гуэрти плъыжь къэхъуащ, зыкъыфIэщIыныгъэ жыхуаIэми хуэхейти идакъым:

– Уэ суригъусэу сэ хэт къызэплъын. Уэлэхьи, уэрам псоми я нэр зытенар.

– Ей-й, жумыIэ, къуэш, дэ къыщыдэплъынур икIащ. [19].

[Khassan blushed as he was a shy guy and he never got above himself, and he did not agree:

– Who will be looking at me when I'm with you. I swear everyone is staring at you.

– Well, you said it, bro. The time when people were staring at us has passed].

– СиукI пэтаи, Алыхьым иукIыным… Си насыпыжьти, мэлщ, уэлэхьи былымыбгъуэрауэ щытамэ, си нитIыр упIэрапIэрэ си лъакъуитIыр пIэтIауэу сыкъриудатэмэ, – и щхьэ дэгушыIэжащ ар, узыр нэхъ хэкIа нэужь. – ХьыI, «хьэм къупщхьэкIэ уеуэкIэ гъыркъым» – жаIэ итIани. – Уэлэхьи, пщIэупIэ имыхуэу, иукIынмэ. [20].

[– Almost killed me, … Fortunately, it was a sheep, I swear, if it was a heavy beast with blinking eyes and twitching legs, it would have killed me, - he laughed at himself when pain faded. – Hm, they say "a dog does not get hurt if you through a bone at it". I swear I would kill it before it yelped].

To summarize, one can conclude that interjections are a specific part of speech which is very tightly related to the emotional state of a human being. The communicative potential of interjections expresses both the emotional state of the speaking subject and perlocutionary (communicative) effect that influences the addressee and his/her discourse behavior. The use of interjections in an informal dialogue is characterized by the ethnic and cultural peculiarities as they are used in the free, instinctive speech.

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On the Characterization of the Circassian Diaspora (on Materials of the Russian Caucasian Studies)

S.I. Akkieva, K.F. Dzamikhov
Kabardino-Balkar Institute of Humanitarian Studies
Nalchik, Russia
siak2000@mail.ru; Casbolat2013@yandex.ru

Abstract— **Article is devoted to history of formation and present state of Circassian diaspora. The main stages of institutionalization of Circassian (Adyghe) diaspora in Turkey, Syria and Jordan are investigated and factors defining this process are brought to light. The authors analyze activity of the Circassian (Adyghe) public organizations of the Russian Federation and of foreign diaspora in solution of problems of the Circassian (Adyghe) nation in linguistic, ethnic and ethno-political spheres and problems of repatriation to the historical homeland. The problem of politicization of the Circassian problem and its conceptual basis are investigated. The conclusion is made that the Circassian diaspora is capable to resist modern challenges, to promote its interests and to act as the non-governmental actor. The authors note that at the present time repatriation of Circassians neither meets expectations of its supporters, nor justifies the fears of repatriation opponents.**

Keywords— Circassian diaspora; public organizations; "Circassian problem"; historical homeland; repatriation

Circassian[1] (Adyghe) diaspora was formed as a result of a mass exodus of the peoples of the North and Northwest Caucasus to the territory of the Ottoman Empire in the course and after the Caucasian war of the 19th century for political reasons. It was caused by rejection by their leaders of active penetration of the Russian influence on the Caucasus and an active foreign policy position of Great Britain and the Ottoman Empire, and also by counteraction to strengthening of Russia in the Caucasus. As a result of this war all lands inhabited by Circassians became a part of the Russian Empire, and the Circassian population has suffered essential losses. According to official figures of the tsarist military authorities, the number of the deported Adyghes reached 493000. Special scientific researches (domestic, European and Turkish) estimate the number of exiles over 1.5 million people [1]. For the Ottoman Empire that was growing decrepit and torn apart by contradictions, the Circassians (Adyghes) became a valuable source of the human capital. Circassians were settled generally in those regions of the empire where strong centrifugal forces against the central power existed, in regions with prevalence of Kurds, Arabs and on the Balkans [2].

After disintegration of the Ottoman Empire descendants of muhajirs (the name that became common for immigrants from the Caucasus) have been dispersed through the territory of Turkey, Jordan, Syria, Palestine and Serbia. Civil war in Russia has caused the second wave of emigration from Russia to foreign countries in which representatives of Circassians (Adyghes) who have emigrated to France, Germany and USA have also been involved.

After the victory of the Soviet power the process of national-territorial construction has begun on outskirts of the Russian Empire with the autochthonic population, as a result of which the peoples have acquired the right for creation of statehood in the form of the national district, the autonomous region, the autonomous and union republics. This form of statehood conditionally was based on two principles: demographic (ethnic population number) and geographical (compactness of accommodation of ethnos in a certain territory). These principles promoted creation of three Russian autonomies (subjects) in which Circassians (Adyghes) acted as title nationalities. Now it is the Adygeya Republic (the title people - Adygheys), Kabardino-Balkarian Republic (the title people - Kabardins and Balkars (the second of these two speak Turkic language) and the Karachay-Cherkess Republic (the title people – Karachays and Circassians (the first being also Turkic)[2]. Opinion that became widespread during the last decades that "the Soviet authorities has purposefully and "artificially" divided "a single ethnos" into three national and state formations has no convincing confirmations and is based on extrapolation into the past of modern ethno-ideological ideas.

Territorially and administratively the Circassians have been divided long ago - during the Caucasian war of the 19th century, and such problem (i.e. "the Circassian question")

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[1] In the countries of Europe and Asia representatives of all nations of the North Caucasus were called Circassians. In recent years in historical literature the term Circassian is assigned to representatives of the people of the Adyghe language group (Adygheys, Circassians, Kabardins, Shapsugs) .

[2] During the Soviet period sub-ethnic groups of Circassians (Adyghes): Kabardins, Adygeys and Circassians acted as the separate nations each with its own territory. Therefore in 1921-1922 three national and territorial autonomies have been created: Adygey Autonomous Region, Circassian Autonomous Region and Kabardin Autonomous Region. In the territory of the Black Sea district 3.4 thousand Shapsugs (a sub-ethnic group of Adyghes) lived compactly. Shapsug national area was formed in 1924. It existed until the end of the 1930th.

simply did not arise during the Soviet power", noted one of the famous Adyghe historians A.Kh. Borov [3].

The Soviet state has forbidden and practically stopped personal and other contacts and ties between Circassians (Adyghes) of the North Caucasus and diaspora. Foreign Circassians were denied the right of repatriation, they could not visit the historical homeland [4] and that promoted isolation of diaspora from the mainland of ethnos. Such isolationism led to erosion of ethnic culture, both in diaspora, and on the historical homeland. The diaspora was exposed to influence of the Arab and Turkish cultures and languages, and the mainland part of the nation was under pressure of policy of russification pursued in the USSR. Facing the danger of possible loss of ethno-cultural originality in an alien ethnic environment, the Circassian elite at the beginning of the 20th century makes rather successful attempts of creation of public charitable and cultural- educational associations. The first such organization has been created in 1908 in Istanbul – the Circassian Society of Unification and Mutual Aid (CSUMA).Its ideologists set three main objectives for the society: strengthening of traditional culture and moral and ethical values; national education of broad masses of the population; strengthening of economic positions of the diaspora. To fulfill the last task the members of diaspora were urged to develop agriculture, to arrange production, to create the enterprises founded on the joint capital [5].

In 1928 the Circassian Society on Training and Cooperation was created in Damascus. In October, 1932 the Circassian Charitable Association was organized in Amman. These organizations certainly helped to promote the crystallization and strengthening of ethno-national identity of Circassians (Adyghes) and formation of ideological and political traditions of diaspora [6]. The first thirty years of the 20th century were the time of institutionalization of Circassian (Adyghe) diaspora since by the opinion of the researchers one of the major signs allowing to consider this or that ethnic community to be a diaspora is the "presence in an ethnic community of certain organizational forms of existence, beginning from such form as a fellowship of countrymen, and finishing by emergence of the social, national culture and political movements" [7]. Process of an institutionalization of the Circassian diaspora has been disrupted with Kemalists coming to power, when Turkey adopted the policy of assimilation, which was discriminatory towards minorities. This policy has proclaimed the thesis that in Turkey all are Turks. In 1927 the law forbidding citizens of the country to talk any language except Turkish in public places has been adopted in Turkey. After disintegration of the Ottoman Empire, Syria, Palestine and Jordan fall under the mandate of Great Britain and France that made both formation and activity of societies of an ethnic orientation rather problematic . The Circassian societies of that period weren't numerous and their activities were short-term, except for the Circassian Charitable Society in Jordan. This society has been organized on October 25, 1932 and at the first constituent assembly the following purposes and tasks were formulated:

1) to carry out charity actions;
2) to organize various events, friendship meetings for unification of Circassians;
3) to care for moral and physical training of youth;
4) to enhance friendship and mutual aid between members of the organization [8].

After the end of World War II begins the process of formation of the independent Arab states in which representatives of the Circassian (Adyghe) diaspora play an important role in military and political structures. In the second half of the 20th century the process of an institutionalization of the Circassian (Adyghe) diaspora continued.

From the middle of the 20th century the international labor migration from the Arab countries and Turkey to countries of Western Europe – mainly to Germany, and later to the USA became more active. The descendants of muhajirs also joined in this process and that was followed by formation of diasporas in the countries of the West. After disintegration of the Soviet Union economic migration of Circassians (Adyghes) to the western countries and replenishment of foreign Adyghe diaspora at the expense of the mainland ethnos was notable.

At present time the representatives of the Circassian (Adyghe) diaspora live in more than 50 countries of the world. Turkey, Syria, Jordan, Israel, Libya remain places of compact accommodation of Circassians (Adyghes). The approximate number of the Circassian (Adyghe) diaspora in Turkey, according to the Turkish newspaper "Yeni Şafak" reaches 7 million people [9]. In Syria live about 100 thousand Circassians (Adyghes), in Jordan - 90 thousand, in Israel – more than 3,5 thousand and in Libya – 30 thousand. In the Western countries the most numerous Circassian (Adyghe) diaspora exists in Germany – 40 thousand, in the USA – 15 thousand, in the Netherlands (Holland) – 500 persons [10]. Main part of the Circassian diaspora lives in modern Turkey. On the basis of the numerous Circassian cultural centers and associations a united Caucasian Society of Turkey (KAFDER) has been formed. After 10 years in Ankara the "Federation of Caucasian Societies" (KAFFED) and "Federation of Societies of the United Caucasus" were organized. Since 2009 KAFFED unites in its ranks about 65 Circassian societies (khase) and is a member of the International Circassian Association. According to the estimates of experts studying the Circassian diaspora in Turkey for the last 25-30 years over 100 Circassian public organizations – cultural societies, funds, committees, clubs which are included into various federations are active. 20 of them are operating in Istanbul, the majority of which are engaged in cultural and educational activities. Besides KAFFED a noticeable role is played in Turkey by the "Council of the United Caucasus" created in due time by former members of Parliament, retired military and prominent businessmen of the Circassian origin for lobbying North

Caucasian interests. The Fund of Education and Culture named in honor of Shamil financing a great number of cultural and educational actions proves to be rather active. At the beginning of 1990s, when the situation in the North Caucasus aggravated ("the Chechen crisis" and the Georgian-Abkhazian war), a Committee of solidarity with Abkhazia and Committee of support of Chechnya were created in Turkey [11].

The Circassian diaspora in modern Turkey represented by its public organizations has no uniform political platform in definition of its program of actions: some of them see the future of ethnos in return to the historical homeland; others believe that the present reality in Turkey and the Russian Federation doesn't allow a mass return to the Caucasus and therefore it is necessary to strive to achieve favorable conditions for preservation of ethnic identity in the country of accommodation; the third consider actions through the international organizations and political institutes as more effective for the solution of the Circassian problem.

Finding themselves out of their homeland, Circassians (Adyghes) have managed to adapt to life in the countries of accommodation and to create compact ethno-demographic segments. Despite all negative processes happening in political life and ideology of the countries of accommodation (Turkey and the countries of the Middle East), the Circassian diaspora was considered as a reliable support of the state everywhere and won a reputation as a loyal part of the population, capable of military and administrative service. Numerous are the facts of appointment of Adyghes to high posts in government, their election to the supreme legislative bodies of the countries of accommodation. The Circassian (Adyghe) diaspora occupies the most prominent and strong positions in Jordan since formation of the ruling (and considerably military) elite of the Jordanian kingdom happened with the assistance of the natives of diasporas [12], (out of which the Adyghe one was the most numerous). In the Great National Assembly of the Republic of Turkey not less than 30 members - ethnic Circassians are traditionally elected from various political parties. According to experts there are much more parliament members having the Circassian origin, but they, as well as many prominent military ranks or officials of high government institutions, don't declare their ethnic origin for career reasons. In Libya representatives of the Adyghe diaspora in 2011 were active participants of opposition and were active against Muammar Gaddafi [13]. A certain part of Circassians, migrating to Europe, USA and other countries of the Western world in the 20th century, integrated into their political culture and standards of life. But wherever the representatives of the Circassian diaspora would live they realize their ethnic and cultural unity and consider themselves a part of the whole Circassian ethnos.

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System of Altruistic Motifs in North Caucasian Tale

Burkhan A. Berberov
Kabardino-Balkarian Institute of Humanitarian Researches
Nalchik, Russia
burhan_berberov@mail.ru

Zukhra A. Kuchukova, Liana B. Berberova
Kabardino-Balkarian State University named after Kh.M. Berbekov
Nalchik, Russia
kuchuk60@list.ru; berberova.liana@yandex.ru

Abstract— **The subject of research in the article is the educational potential of the North Caucasian folk tales, thematically focused on the development of altruistic personality traits. The main goal is to explore the array of Adygei, Balkar, Dagestan, Ingushetia, Karachay, Ossetian, Chechen tales, to identify and interpret the scientific basic of altruistic motives contained therein. A complex method of research, combining the comparative-historical, systemic, structural and semiotic methods is used in the work. As a result of the study it should be noted that the value of altruism in the world picture of the North Caucasian folklore is one of the leading and performs an ideological function. Among altruistic motives predominate reciprocal, environmental and transfinite motives. Application of the results is in folklore theory, literary studies, Caucasian studies, comparative study of fairy tales of Russian peoples and peoples of the world. Actual material can be applied in a practical pedagogy in order to increase students' altruistic culture.**

Keywords— folklore; North Caucasian tale; altruism; motive; reciprocal altruism; environmental altruism; transfinite altruism; educational potential

The present stage of social development is characterized by an abrupt change of the life's value foundations, the unprecedented growth of aggression, crime, extremism and terrorism. The concentration of selfish feelings in society implicitly becomes invisible source and root cause of numerous local and international wars. Under these conditions, the problem of altruistic qualities upbringing as essential components of humanity among the younger generation is of key importance. Unlikely someone will object to the primary importance of altruism in the educational process, considering that altruism is the core of the fundamental basis of morality, its mechanism and the driving force.

The term «altruism» was first introduced in the scientific sphere by French philosopher, the founder of positivism, Auguste Comte (1798-1857), who proclaimed the slogan «Live for others» (revile pour autre) as a basic principle of human society. The scientist needed an innovative term to consolidate the authentic concept, exactly the opposite to the concept of «selfishness». In other words, the system of moral and ethical philosophy felt the need for a binary opposition «egoism-altruism» for the expression of the dialectical unity of the world. For nearly two centuries distinctive ability of «altruism» term contributes to a deeper comprehension of the moral foundations of human and humanity. «Altruism»

category takes its rightful place in folklore, outlining the educational field where interests of pedagogy, ethics and literature intersect.

The greatest contribution to the altruism theory development, contributed the Russian geneticist of XX century V.P. Efroimson, proving on broad evidence basis the availability of vital, biological foundation in the altruism phenomenon. Through numerous examples, associated with the process of stadial human development (from Australopithecus to homo sapiens) the scientist leads the reader to the conclusion that «there is something in hereditary human nature that always draws him to justice, to deeds, to the selflessness» [1]. Underscoring the dependence of tribe viability on the presence of altruism gene, the scientist writes: «Herds of pre-human beings and hordes, clans, tribes of people could some time live without any collectivist and altruistic instincts. They could temporarily win and be fruitful. But they were rarely able to grow their offspring and rarely pass on their genes. And without leaving offspring or carelessly dooming it to death, these hordes, no matter how they were numerous and victorious, had to become endangered countless dead ends of evolution, its dried up branches» [2].

Justifying the «logic of good», V.P. Efroimson specifically examines the situations of the strengths of the tribe relationships to the more physically weak - children, women, old people. Offending younger leads to deprivation yourself of the future, offending women to deprivation of offspring, disrespectful attitude toward the elderly turns into a deficit of inherited experience. We can say, that the «reasonable altruism» principle makes a strong part of the team kindly refer to the «outsiders» of the tribe on a subconscious, instinctive level. The phrase «long-term altruism» can characterize the behavior that is not associated with immediate direct benefit, but with fruitful historical perspective.

The whole progressive world culture, including folklore, literature, painting, music, was initially focused on the development of high altruistic culture in a person, on the victory of good over evil. In this article, we discussed tales of the peoples of the North Caucasus as didactic texts, containing an enormous educational potential of altruistic content. Studied array of Adygei, Balkar, Dagestan, Ingush, Karachay, Ossetian, Chechen and other tales allowed to identify «index

of kindness» which contains in them, mainly realizing through reciprocal, environmental and transfinite altruism motives.

Reciprocal (mutual) altruism, having emphasized bipolar character (you to me, I to you), can be called an initial «alphabet» of doing good, later rising to complex variants of altruistic relations, including such options as a reasonable or transfinite (infinite, boundless) altruism .

The classical form of reciprocal altruism embodiment can be considered Karachay-Balkar tale «Black Eagle». Here is just the exposition of the text, where the eagle, seeing the hunter aiming at him, said: «Do not kill me, good man! You will see how I thank you!» [3]. Of course, in the final of the tale the hunter, who passed the most difficult trials of life gets «gold and flock» by «the receipt of good» [4]. A similar version of reciprocal altruism is found in the Chechen folk tale «Hunter». In the story the hunter on an irrational level shows mercy towards the bear, fox and vulture. For human generosity nature repays good: the grateful animals gave the young man one hair from their skin, and a vulture gave a feather. In an extreme situation, these magical objects played a pivotal role in the life of the hero, giving him a happy family life [5]. A similar story related to reciprocal altruism is in Kumyk tale «Friends of a shepherd», where the fish, deer and fox appreciated the young man's good deed [6].

Tales with the description of reciprocal altruism are of great educational value, because of them the child learns about the interconnectedness of all elements of the universe, of the resonant chain of good, that sooner or later any plausible action will cause an adequate response. Reciprocal tales educate in a child such qualities as historicism of thinking, trust to a partner, the ability to be grateful, to distinguish momentary benefit from long-term (and, ideally, dateless) benefit.

In a separate conceptual group can be identified tales, where altruism is set in family-related discourse, adding up to a specific pair of «I am and my mother», «I am and my father». We note at once, in Karachay-Balkar performance parental altruism is far from the «tender and pink realism», it is harsh and courage matching the harsh life among the snow-capped mountains. Another feature of parental altruism of mountaineers is its being veiled: it is manifested indirectly, not «here and now», but as in a chess game in a few moves. An initial phase of such altruism is usually harsh and rigid in relation to the child, but in the future the result of the initial tears and complaints of the child emerges a certain living benefit.

In the expanded form this model of the «visionary» altruism is found in Karachay-Balkar tale «Father and Son». Father was dying and called his only son, and said: «I hid a lot of gold under the ground if you dug it up, you will live rich and happy!». After the funeral, the son dug all around the house, but found nothing. Frustrated, he came to the sage for an explanation. Aqsaqal explained the father's will: the cultivation of the ground is an honest work it is the main source of wealth, human happiness [7]. At first, it seems that the father brutally deceived expectations of hapless treasure hunt, made him sweat shed in vain, but in the end the reader realizes that the spiritual and moral attainment of boy, the happiness of being Person, a hard worker is the most important treasure in the world.

People's imagination always seek in mysterious phenomena of nature a causal relationship of spiritual and moral order. Where from does cuckoos' custom to leave the eggs in another's nest without parent supervision go? In the Ingush fairy tale «The Cuckoo» the root cause of the «family crisis» is seen in the original selfishness of chicks, which at their time showed callousness towards his mother [8]. This kind of fairy tale in its own way interpreting the intricate biological law, is typical to the mentality of the Caucasian peoples with their mother pronounced cult.

Balkarian altruism so you can call the following tale «The Adoration to the wool», where the philosophical core is a far-sighted mother's altruism towards young daughter. According to the plot of a fairy tale, a dying woman turned to her husband with the last monologue: «When I die, be sure to marry a second time. My only request is let your new wife hit my daughter with a hand wrapped in wool, never hit my daughter with his bare hands! [9]. Word of the deceased is a law and the family has acquired pets. Thus, meat, milk and wool appeared at home. The girl learned to keep house, to spin yarn, to knit. So, the mother with her, at first glance, weird, convoluted and hard request («beat my daughter with a hand wrapped in wool») has programmed a happy future to her beloved daughter, did everything that her daughter grow skillful, hard-working, business, obedient and ultimately happy.

The world folklore repertoire is full of tales where the cult of the parents and elders, the altruistic attitude of children to parents is approved as a social standard. «How people stop discharge old people of the mountain» is one of the most constant transnational motives in this or that artistic refraction occurring in the folklore of all peoples of the world. Kabardian version of this tale is called the «Father's pieces of advice». It tells about a young man who contrary to custom didn't discharge of a mountain his old father and hid him in a cave.

Due to the secret advices of his father, the young highlander managed to avoid many problems that constantly his fellow villagers suffered. When the secret was out, the rural toastmaster honorably restored an old man home and permanently eradicated an evil custom [10].

The above tale remarkably demonstrates the intrinsic value of the spiritual and the practical experience of elders, which is beneficial «breeding ground» for the younger generation. The tale «Father's pieces of advice» is a direct illustration of

theoretical positions of V.P. Efroimson, who proves that «to be an altruist is profitable». The scientist writes: «The fact is that even at the beginning of human communities organization with the development of speech more and more, and perhaps crucial importance in the tribe's struggle for existence accumulated and transmitted experience began to play. The volume of knowledge and skills necessary for the tribe survival in the struggle with nature and enemies was steadily increasing. The main transmitters of all this experience, especially before the advent of writing, were first of all, old people with their life experience and amount of knowledge reserved by memory [11].

The relationships «I am and Nature» relate to actual issues of our time. Currently, the declared and undeclared war of a «civilized man» to nature actualized the problem of «ecological altruism» development among children. Exactifing today's ecological catastrophe, Yu. A. Andreev writes: «One of the striking contradictions of the scientific and technological revolution is a mismatch between the huge opportunities that gets a man armed with technique, and his morality» [12].

The direct opposite to rational, pragmatic, predatory consciousness of a civilized human is an archaic natural philosophy, embodied in the tales of the peoples of the world. They are imbued with the idea of a pantheistic deification of nature, the perception of it as animate organism where all parts are interconnected and interdependent. Among the fundamental precepts careful «brotherly» attitude to the flora and fauna is prescribed to a man as a rational being. «Do not kill the fowl during hunting more than you need for food», «do not pour hot water on the ground», «do not pluck unripe fruit», «do not to ruin the bird's nest» - these and numerous other taboos are registered in the «environmental code» of all peoples of the world without exception.

Acquaintance with Karachay-Balkar folklore texts can detect the motive of self-sacrifice of the human for the salvation of his four-legged friend. So, in Karachay-Balkar epic song «Bijneger» a hero, trapped in rock trap, cuts off chunks of his flesh by a hunting knife and feeds his dog which is dying of hunger [13].

Investigating this problem, theoretical propositions of V.S. Solovyov about pity, as an ethical category that is «psychological support of altruism» are very important [14]. His opinion is shared by modern educators E.Yu. Ermakov and V.A. Ermakova, which call factor of pity and empathy «one of the triggers that creates an indicative basis for altruistic behavior» [15]. The task of the educator is in system and consistent form to bring up in the child a feeling of pity and compassion towards all those who needs assistance. Among them is the world of animals, which by its proximity to the world of a child may be the first school of altruism.

Representatives of moral philosophy entered into a scientific turn the term «transfinite altruism» implying the spiritual selftranscendence of yourself in a world in which the subject experiences himself and the world as a part of a whole, and transmits to the world inner love and contentment as to himself. At the same time psychological borders between the subject and the world are becoming permeable, and he begins to perceive the world as a part of himself, and himself as a part of the world [16].

Quite vivid in this context is the fairy tale «The Ant and the Flea», where in order to save a little insect stuck in a puddle, global kindness resonantly transmitted from flea to wild boar, from wild boar to the apple tree, from the apple tree to the eagle, from the eagle to the chicken, from the chicken to the hen, from the hen to the mouse, from the mouse to the cat, from the cat to the old woman is required [17].

We found typologically similar tale in the system of Russian folk tales, entitled «Death of Cockerel». Cockerel choked seed. Hen, wanting to save a friend, ran to the river for some water, but the river has demanded in exchange a leaf, a linden - thread, a girl - milk cow, hay mowers – scythe, smiths - coal. «Colliers gave embers, chicken laid coal to blacksmiths, farriers chained scythe, etc. Finally she carried water to the cockerel: but he is lying without breathing, choked by beanstalk» [18]. Sad, touching end of this tale causes not only a child's sense of compassion for the cockerel, who died because of the slowness of others, but teach the manifestation of «emergency altruism» where appropriate. Often human passivity, laziness, artificial rigmarole in solving simple problems in life can cause great social tragedy. That is morality of a Russian fairy tale «Death of Cockerel».

Interestingly is described a model of transfinite altruism in Dagestan (Lak) tale-parable «Three friends» [19]. The concise text tells about the desire of three friends (shell, lump of oatmeal and fly) to cross the creek. Shell was out of luck, the stream began to carry it away. Oatmeal has rushed to help to its friend, but softened in water. But a fly successfully flown on the right bank and began to laugh at its hapless friends. Her abdomen burst from laughter and she died, too. The essence of mortal motive here is in the actualization of the universal humanistic idea that «being happy alone is impossible». A similar motive of transfinite altruism is found in Adyghei tale «Who is stronger» [20], Ingush tale «Falcon and raven» [21], Ossetian tale «How the poor girl was saved from Aldar» [22], Tat tale «Happiness for young is joy for old») [23], Chechen tale «The wolf, the fox and the cock» [24] and others. By law of folklore and literary relationships marked altruistic motives in art refracted form are reproduced in the works of both classical and contemporary authors of the Northern Caucasus, including Kajsyn Kuliev, Alim Keshokov, Rasul Gamzatov, Idris Bazorkin, Musa Batchaev and others.

Our analysis of the North Caucasian tales shows that altruism plays one of the major roles among the approved and cultivated fundamental human values. From the typological

varieties of altruism in the national folklore of Balkars, Karachays, Kabardians, Chechens, Ingushes, Kumyks, Circassians, Adygeis, Tats, Dagestans prevalence of reciprocal, environmental and transfinite is observed. Judging by this triad, folk culture, with its planetary thinking focuses a human on altruistic attitude towards one's neighbor, to natural objects and to the universe as a whole, where everything is subjected to the «logic of good». Tales encompass huge didactic possibilities of spiritual and moral self-identity, increasing the «human in man».

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The Monuments of Antiquity and the Middle Ages as a Factor Sustainable Development of the Cultural Landscape Nalchik and Its Vicinities

Barasbi H. Bgazhnokov, Vladimir A. Fomenko
Kabardino-Balkarian Institute of Humanitarian Studies
Nalchik, Russia
bbarasbi@yandex.ru, fva2005@gmail.com

Abstract— Ancient and medieval settlements, burial grounds and some other archaeological sites of the city of Nalchik and its surroundings are seen as an important factor for sustainable development of the cultural landscape of the Kabardino-Balkarian republic's capital. Particular attention is paid to the preservation of monuments of ancient and medieval times, the prospects for their further scientific study and museification, scientific and methodological problems of the use of historical and cultural heritage in the process of spiritual and moral improvement of the residents and guests of the republic, in the development of event-driven and scientific tourism. We used materials of the scientific archive of the Kabardino-Balkarian Institute of Humanitarian Studies, monographs, publications of Soviet and contemporary authors.

Keywords— *North Caucasus; Kabardino-Balkar Republic; Nalchik and its surroundings; cultural heritage; a factor of sustainable development of society; archaeological sites; barrow burial rites* **introduction**

City Nalchik - the capital of Kabardino-Balkaria, one of the largest and most beautiful cities of the North Caucasus, developed industrial and cultural center of the South of Russia.

According to the publications of the last decades the residents of Kabardino-Balkaria, know that the first documentary mention in Nalchik as a settlement referred to in 1745, and this year is considered and celebrated as the date of founding of the city [1]. In the eighteenth and the first half of the nineteenth century. Nalchik developed as the administrative center of Kabarda. In 1862, Nalchik was founded settlement, which later became the center of Kabarda, and then the Nalchik District Terek region [2]. In 1921, Nalchik was granted city status and at the same time - the capital of the autonomous Kabardinian region [3], and then - the capital of Kabardino-Balkarian Autonomous Republic. At the present time - is a modern city, the number of residents whose 258 thousand people.

However, the population of the city and the country as a whole are poorly informed about the ancient and medieval monuments in the territory and in the surrounding area of Nalchik. This is a big gap, which does not give a complete,

integrated picture of the cultural history of the area, use a rich artifacts antiquity and the Middle Ages as a starting point of centuries of progressive, sustainable development of the local population, as a base and a factor in the modern, sustainable development of the Kabardino-Balkarian society.

It should be noted in this regard that the development of land and the construction of settlements in the territories and in the vicinity of the town began in the Chalcolithic period and the Early Bronze Age. This is evidenced by dated IV millennium BC. Agubekovskoe settlement in the area of the current lull and Dolinskoe selishte IV millennium BC. [4]. The settlement consisted of scattered at a considerable distance from each other turluchnyh homes. By type, these structures resembled the dwellings that remained in the Circassians and other Caucasian peoples to this day [5]. Free spaces between the houses were used, probably, for agriculture.

Of particular note is that along the river. Nalchik between the city center and Dolinsky in the prewar years, has a huge mound field. Mixed in there were mounds of famous North Caucasian and Maikop cultures and medieval Kabardinian mounds. During the construction of the city center buildings (hospital, House of Soviets, etc.). Many of them have been excavated [6]. It has hundreds of scientists were the richest artifacts spanning a long period of history - from the IV-III century BC to the XVII century BC [7]. Among them are unique pieces of the early and middle Bronze Age, and objects typical of late medieval culture Kabardian.

But Nalchik ancient monuments are not only scientific but also a wider cultural significance. Studied in the pre-war years in the mounds "Kabardinsky Park" and "Sadko" become an important source for the history of the population of the North Caucasus of the early, middle and late medieval bronze. From these mounds, for example, it is widely used in the book of a prominent Caucasianist Eugene Ignatievitch Krupnova "The ancient history and culture of Kabarda" [8]. These materials, indicating the constant and never interrupts the presence adygskih settlements around Nalchik, currently under

consideration in the context of close cooperation between the peoples of the Caucasus with the peoples of Europe and Asia.

Interestingly, when huge amounts of development of the city in the prewar and postwar years, especially, some ancient burial mounds fields "Kabardinsky Park" and "Sadko" survived. In the autumn of 2015 we had inspected the mound mound height of about 3 m in the courtyard houses 7 and 7 and on Lenin Avenue in the south-western part of the city of Nalchik. Barrow has an almost hemispherical shape correct, in terms of close to a circle. Dimensions of the mound (diameter and height) is quite common in ancient burial mounds in the Middle Pritereche. The sections of the south-eastern and eastern embankment floors are the ruins of stone structures of river cobbles, also typical of the burial mounds of the Early or Middle Bronze Age (IV-II millennium BC.).

To save the embankment mound and prevent it from accidental or deliberate destruction, you must install it on a billboard or a column with a sign, which says that the mound is an ancient burial mound "Sadko" (the object of cultural heritage) and protected by the state.

It is also important to say that according to the Department for Protection of Cultural Monuments of the Ministry of the CBD this mound is not in the state register of cultural heritage sites. However, in the "Objects of Cultural Heritage of the CBD," recently published book states that burial mound on the main avenue in the city of Nalchik, entitled "Nalchik mounds" protected by the state in accordance with the decree of the Council of Ministers KBASSR from 06/16/1971 number 276 and has the status of a cultural heritage federal [9]. However, this publication is not clear where exactly the individual mounds are located on the main avenue, and whether the attitude towards them in the yard of the mound houses 7 and 7a. Office of the Ministry of Culture of the Kabardino-Balkarian republic should prepare appropriate documentation at the detected object of cultural heritage.

Nalchik mounds on the main avenue are the most valuable monuments of the ancient history of the peoples of the CBD. As to the mound in the yard of houses 7 and 7 a, then it could be to explore and create there a small archaeological museum.

In the same attentive and caring for others in need all the archaeological sites in the capital of Kabardino-Balkaria and in the regions of the republic. It is necessary to certify and document to establish their boundaries, set inscription informing local residents and guests of the republic that is the historical and cultural monuments, which are protected by the state. But work in this direction is not conducted at all in the country. In particular, for nearly half a century, it addressed the issue of reconstruction of the tomb beneath barrows in Nalchik, which is one of the unique monuments of the IV millennium BC. Maikop archaeological culture The tomb was discovered in 1966 during the construction of the Palace of Trade Unions in the area of "Mountain". At the construction site was a mound about 10 meters high. If you try to take down the mound builders stumbled upon a monumental tomb stone. In 1968-1969 years, archaeologists examined a crumbling mound and unique burial in the tomb. In all likelihood, the rich tomb belonged to the leader of an ancient tribe. Some of the stone slabs that made up the walls of the tomb are t. N. anthropomorphic steles. Some of the plates is covered with geometric patterns [10]. The finds from the tomb beneath barrows, including anthropomorphic stone stelae of which it was composed, came to the National Museum of the CBD to restore the unique tomb in its original form, which, however, was not done.

Meanwhile, the interest in this unique monument only increases. In 2011, researchers visited Nalchik Svend Hansen and Sabine Reinhold from the German Archaeological Institute. German archaeologists have got acquainted with the materials of the National Museum of the CBD and plan to publish in Germany the full catalog of finds from the tomb beneath barrows in Nalchik. But appropriate measures to perpetuate the monument must take, and authorities responsible for this in the republic. To get started on the "Mountain" location location of the mound with Nalchik beneath barrows tomb at the Palace of Culture in the area could be to establish a shield with a brief, but meaningful information about this unique monument. Practice of this type of communication is well known. For example, in the city of Maikop in the place where before there was the famous Maikop Barrow, installed in Soviet times stele-monument with an appropriate inscription. It is known to all residents of the city, about her talk to all the guests of the republic, as one of the most important attractions, glorified the city of Maikop.

In Nalchik and its surroundings there are other famous monuments of antiquity and the Middle Ages. For example, a large mound, probably referring to the Maikop culture, is situated near the village of Urvan. This mound is called Oshhatsa - Wooded mound. Shore Nogmov wrote that during the reign of Justinian, Greek clergy (priests - and bishops shogeny shehniki infiltrated "in the Caucasus Mountains ... Tradition has preserved even the name of the place where lived the first bishop, who came from Greece; it is located four miles from the castle and Nalchik called "wooded mound" and now this mound is very high Here's a song that mentions about him and praised the bishop, to dwell there:... "shehnik our protector and educator, shehnik our light educator talked about the law of God from the top of a wooded mound and. on a wooded mound bound him a house made of tin with doors made of cast silver, and there is a divine spirit dwelt light. and the angels spoke with the wise old man" [11]. Unfortunately, in recent decades this monument is destroyed by looters, trying to find the treasure. Therefore, there is also need to install the shield with the legal nature of the information (about the responsibility for the destruction of cultural heritage).

Numerous groups of mounds of different epochs are located not only in the vicinity of Nalchik (near the village of Urvan, Nartan, Shalushka, Chegem I and II), but also throughout the territory of Kabardino-Balkaria. Construction of gravestone monuments - mounds are extremely characteristic of culture in general and Circassians Kabardians in particular. Were formed in the Early Bronze age, this tradition has existed and was maintained up to the turn of the XIX - XX centuries.

The photograph of the materials of ethnographic expeditions Hungarian explorer Count Eugene Zichy seen that small burial mounds typical for older and larger mounds lining the cobblestone ring (cromlechs) Kabardinians were built in the late XIX century. These mounds called Iuaschhe byn - "family of mounds" have survived in villages Zayukovo, Dugulubgei in many other areas of Kabardino-Balkaria and the North Caucasus. But many of them, unfortunately, were completely destroyed or partially and no one cares about their preservation.

The same applies to a plurality of sites in the tract Mahuegeps in the space between the rivers Baksan and Chegem. There remained several groups of impressive size settlements, which, in our opinion in the Middle Ages could be fortified city of Magas - Alan capital [12]. In addition, in this area can be found the remains of the crypts and tombstones XVIII-XIX centuries.

Perhaps the tomb, known under the name in Kabardians khe legune or cheschane / keschane (funeral home) are a continuation of the tradition of dolmen. Such an assumption is expressed earlier. We note in this regard that some mausoleums Kabardian-cheschane repeat structure of a multi-faceted dome dolmen on the river. Farce in Zakubanye. To this we must add that around inlets keshane allocated sometimes relief likeness of the portal resembling pattern on the front plate zapadnokavkazskih dolmens.

For Kabardia end of XVII - XVIII century. characterized by monuments of Islamic culture in particular gravestones stele - synyzh and more complex stone structures cheschane, including tombs and various forms of [13]. Traces of such mausoleums preserved in Kenzhe (mausoleum with the ashes Andemira - educator legendary Andemirkana)., Mausoleums groups in villages Chegem II and Lechinkay mausoleum on an old graveyard in Baksanenke etc. For little explored and unexplored monuments of the late period are "khan cemetery" in Chegem and the burial mound of Beslan and Nalchik between obese Kenzhe, mound on the outskirts of villages. Aushiger in which, according to legend, lie the remains of the famous hero and knight Andemyrkana and others.

Poorly researched and are not marked properly monuments related to outstanding philosopher Kabardian Zhabagi cauldron. Among them are the remains of the fortifications and Kalezh Pschyune near the modern village Zaragizh. According to local residents, they were built under the direction of Zhabagi in 1720 to protect the 40-thousand army of the Crimean Khan Saadat Giray, invading in Kabarda for the purpose of revenge for a crushing defeat in the Battle Kanzhalskoy 1708.

Not known to many, and not recorded properly even places where Zhabagi lived. According to our information, first he lived in the village Hamgorukay on the right bank of the river above the present village of Baksan Atazhukino. Then, climbing up the river founded the village of Lower Kazanukay and then - the upper Kazanukay. The second period of life associated with the village Zhabagi Kazanukay Aushiger in the tract. Valley, where there was this village and is now called the "Valley of Kazanukay". The last period of his life spent in Zhabagi Kazanukay village on the right bank of the river Shalushka, in the western part of modern Nalchik. Hence at the end of the nineteenth century. his tombstone with tombstone of his wife was transferred to the city of Nalchik and installed at the entrance to the garden Atazhukinsky. Currently, no one and settlements based Zhabagi, did not survive. Is not stored in connection with the Caucasian war, many other villages, is located on the territory of Nalchik and its surroundings. According to the archive data of the first half of the XVIII century, they were here about three dozen: Village Taov, Bagyrsov, Vykov, Tokulanov (Toglanov) Tlostanakov, Agzagov, Kazanokov, Koshrokov, Beev, Karabov, Mekenev, Klishbiev, Kozhokov et al [14].

There is also compiled by the Secretary Kabardinsky temporary court YM Shardanovym list of land, which owned the Kabardian princes and nobles to 1818: "In the gorge of the river in the direction of Nalchik land belonged to Prince Kilchukinu. Below, in the direction of Nalchik who fled the land belonged Uzdenov Hadji Sholokh Elkabanovu. From the fortress of Nalchik - Uzdenov Bagirsovym, fled beyond the Kuban. On the left side of Nalchik river from the fortress of Nalchik up - Uzdenov Tlostanokov, fled beyond the Kuban. Up Nalchik - Prince Bekmurza Kaytukin. Ferried Nalchik White River - Uzdenov, fled beyond the Kuban. Above - the deceased prince, Colonel Haji Hamurzin and the prince died Salatgeriev. On the left side of Nalchik between the add-on, and white river - Uzdenov shackles. Below the fortress on the left side of Nalchik to Shaluhi river - Uzdenov Toglanov". According to the beginning of XIX century. Ie, to build a fortress, there were "villages Kudaev, Gukezhev, Toglanov, Atlaskirov, Klishpiev" [15].

According to archive data, which results in AD Gugov, at the beginning of the XIX century. in the village Tokulanov the residence of the chief prince of Kabarda Kuchuk Dzhanhotov. Referring to the document signed Kuchuk Dzhanhotovym March 13, 1809 and marked a record that he made in "Ur. Nalchik "[16], R.H. Gugov concludes: village Tokulanov (Toglanov) was for a long time the official administrative and political center of Kabarda. The same opinion was held by H.M. Dumanov and R.U. Tuganov [17].

CONCLUSIONS

We have seen that in the territory and in the city of Nalchik neighborhood is full of unique archaeological and other cultural monuments, different in their appearance, the spiritual and moral content of his scientific and practical significance. Some of them survived. Another more significant part is destroyed, it disappeared and disappearing before our eyes. But fortunately, much preserved in the archives, in the memory of the local population, in the records of archeology, ethnography, local history enthusiasts.

The total number of sites is extremely high and reaches many hundreds, even thousands of pieces. Therefore, we present in this report are only a few examples that allow a general picture of the cultural layer and draw attention to its conservation, integrated, comprehensive study and use in the practice of interaction between the urban community with its own existential space.

There is no need to prove that the specificity of ancient and medieval monuments of culture in the city and in the surrounding area needs special deployed surveys and descriptions involving archaeologists, ethnographers, experts on landscape design, event tourism.

It is important to bear in mind that the results of this work can be an important tool in establishing the necessary connection times and the continuity of culture in Nalchik, in Kabardino-Balkaria in general. Ultimately, this will allow to develop the population liable to the territory of a rich past, a correct concept and guidelines for sustainable development of the cultural landscape of the capital.

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Islam in Balkarian Culture and Modern Religious Situation

Tamara Sh. Bittirova, Gulfiya D. Bazieva
Kabardino-Balkarian Institute of Humanitarian Studies
Nalchik, Russia
tbittir@mail.ru, gbaz@mail.ru

Abstract— **In the article the processes of interaction of national and moslem traditions in a balkarian culture are analysed. The adaptiveness of «normative» islam to the local terms taking into account the spiritual features of regional culture is marked.**

Keywords— customary law; Sharia; Balkarian culture; Muslim education; religious identity; spiritual culture **introduction**

Islam as universal ideological system covers all aspects of life of society including ethical standards of society as systems of the interpersonal relations. Ethical fundamentals of Islam are based on centuries-old experience of mankind and reflect, first of all, a level of development of the Arab society in the period of the early Middle Ages, during Sharia formation era – the set of rules, regulating everyday life of the believing person. Tribal Arab society of this period was characterized by existence of two communities – citizens and nomads above whom there were monarchs and priests. It is quite natural that the norms of communication between estates and layers of the Arab society subsequently painted by ideas of Islam have made a basis of Sharia [1].

A moslem faith brought with itself to life of late medieval Balkaria a sheriat that determined every step true believer not only in sending of religious ceremonies but also his behavior in the circle of family, friends, colleagues, casual fellow-travellers, attitude toward ancestors and descendants. A sharia right in highlander society, certainly, ran into the system of адата – «Ezden adet» and, wider, is «Tau-adet», that also applied on universality.

Which were requirements of «Tau-adet» and as they were correlated with new ideology and her establishments in a sheriats right? This very difficult and multidimensional question the decision of that requires the detailed comparisons and analysis. In this article we are interested by the processes of interpenetration of two systems, in both the past and present.

One of basic principles of coexistence of nomads of the deserts and habitants of oases (townspeople) was hospitality. It needed to the nomads for stability of distilling ways of removement, as well as to the townspeople, nomads always concerned by predatory raids. In similar terms there were highlanders in the epoch of feudalism and slavery, true, taking into account a that circumstance, that highlander people in swingeing majority conducted the settled way of life. Highlanders forced to come running to the different forms of unblooded cognation (such as twinning, kunachestvo, atalychestvo) for maintenance of both the property (earth, cattle, agricultural inventory) and personal freedom.

A native difference of sheriat from a highlander ethic code was and in that a religious constituent prevailed in first case. Driving the mass home of basic postulates of faith («iman islam») and was one of key tasks of figures of moslem missionary work and inlightening, that were armed with not only philosophy of islam but also richest culture accumulated by arabs from all regions of influence of caliphate. Sunni Islam in traditions of hanafitsky madhhab assumed flexible adaptation to the different ethnocultural environment and wide use a local ordinary right. As a result balkars had the local form of бытования islam, known in religious studies as a «domestic», «folk» islam. Modern researchers have noted a close relationship of Muslim culture with the spiritual substratum of the Islamized peoples, their religious and cultural traditions, which testifies to the adaptability of «normative» Islam to local conditions, taking into account the spiritual peculiarities of the regional culture [2].

Formation of norms of the sharia right and its interaction with national ethical representations in the North Caucasus took place in conditions of toughening of the feudal relations what the European authors of the XVII-XVIII centuries testify to, emphasizing that the new religion was apprehended by representatives of the highest estates. [3].A mark complex of problems, related to the theistic dynamics and ethic norms, was obvious to the first society well-educated representatives of karachays and balkars people. It is «needed to notice that our best customs, the best lines of karachays, as, for example, hospitality, honouring of elders, modesty, began to be eradicated, and meantime, in parallel with this sad phenomenon there is a height of immorality and cynicism. It is therefore necessary to draw up a draft of fight against ignorance by an exchange by ideas in printing» [4], wrote Islam Hubiev at the beginning the XX century, calling rural effendi to render the influence on the revival of morality corresponding to the islam and adats of highlanders.

Balkars and Karachays sincerely believed in essence of Creator, but were not religious fanatics, easily enough behaved to the external displays of faith. In a folk environment there is a large class of the jokes related to religion, with moslem ceremonies and servants of faith. Attempts to give the personal faith holiness are frequently ridiculed. So, when at Budaev Husej, poet and dogma, a fellow-villager asked: «Husej! I sleep with Koran under a pillow. How do you look at it»?, that, not long thinking, answered: «I think that your headboard will become higher» [5].

In this genre of Karachay- Balkarian folklore, related to the genre of «hilikgyalyk-zhyrlaa», ridiculing identically mercilessly both nonbelievers and zealous servants of faith, it is possible to meet some details of expulsing of paganism an islam. In Baksans canyon an anecdote is written in about a Karachays dogma from the aul of Uskhauat (Hasauut) studying to bases of islam far outside Karachay. To him appealed with a request to give the name new-born. He began to sort out the moslem names, but none pleased to the parents of kid. And then effendi said: "To my arrival you had the names of Teke (Goat), Ulak (Kid), Koyan (Hare), Gylyu (Rat), Tana (Calf). It I converted you in Muhammats, Ahmats, Fatimats» [6].

The same anecdote existed and in other version, in obedience to that in the aul of Uskhauat was invited by a dogma known teacher Barasbiev Salih-hadzhi from Kendelen. Many years he taught children to bases of islam. The young generation of connoisseurs of moslem faith appeared, and the villagers in course of time began to him to hint, that he would come home and to yield the position to anybody from Uskhauat. And then, allegedly, the above-mentioned sacramental phrase was pronounced.

An islam in life of highlanders, besides the theology basis, introduced and substantial components cultures, the value of that it is impossible neither to belittle nor ignore. So, for example, karachays-balkars spiritual literature rendered noticeable influence on a society poetry, on becoming of her genres, on the structure of verse. Even value of concept of «nazmu» transformed from religious in society with borrowing of term. The formal components of society poetry, since a XVIII century, began to equal on the standards of religiously-didactic poetry. It is thus necessary to underline that maintenance of society poetry practically was not subject to transformation. In this cut it is possible to say about the mutual enriching of different, ideological mismatched, components of culture of ethnos. To it religious poems testify about a prophet Muhammad and his associates that was perceived in national consciousness of balkars along with the heroes of historical poems and ballads. Sicily religious and folklore songs from different positions covered the relevant facts of national life.

«Zikirs in Karachay and Balkaria were part of cultural process, everyday, rather ordinary phenomenon, when they were carried out at home, in the clock of leisure, and sitting on a zavalinka in the circle of worthy old men or friends, and during work, even such workaday, conservative, not prepossessing, so to say, to the high state of spirit, as, say, care of live-stock, even cleaning up after a cattle. It goes to show that, perceiving an islam as sacred religion on the whole, nevertheless - karachays and balkars saved freedom of spirit, that allowed to them cleanly religious essence of motets . to carry out conformable to the concrete momentary state, but not following only to the canons, strict binding overs of taking them studies» [7].

Thus, by the end of XIX of century on territory of modern Kabardino-Balkaria an islam got wide distribution, influencing on different parties of both domestic and spiritual culture. «In a soviet period, in spite of destruction of bases of faith, some perceptible unrealized supports were saved at the level of subconsciousness and at stopping of ideological pressure reconstructed and proved in visible forms» [8]. At the end of the 20th century the period of revival both national (ethnic), and religious traditions begins. In the context of modern culture interest in religion is defined by a number of factors: a sharpening of religious feelings in society and at the same time growth of the tolerant relation to dissent. These phenomena create a basis for return to spiritual life of society of the religious monuments, customs and ceremonies opening mentality of various faiths, and also promoting growth of ethnic consciousness of the people inhabiting the Russian Federation.

In 1994, on the basis of two-year courses for the training of imams in Kabardino-Balkaria opened Islamic Institute, which the best graduates got the opportunity to continue their education in the countries of the Arab East. But absence of professional shots, and also the systems of primary and middle education in a republic were braked by the receipt of quality religious education. The general fund of library of Institute was completed from literature in Arabic language, while moslem foreign literature in translation in Russian language uses large demand, but was inaccessible from high prices at the book market. In 2007 for the improvement of quality of religious education the Islam institute was fastened on the Kuban state university and renamed in «North-Caucasian Islam university the name of Abu Hanif». A collaboration in the field of society and moslem education was called to assist the improvement of quality of education in a religious sphere. In 2008 at an university establishment of primary religious education - madrasah of «Nur» («Light») was open. For the theology faculty of the Pyatigorsk linguistic university diplomas, both graduating students and teachers of the Islam university, secure annually. With 2015 in an university free child's camp is annually opened for educating of children 8-13 years to bases of islam and Arabic. Building of the Islam center was begun in 2010, however, from a sharp polemic in society, building of center was eventually passed to the Child's house of work. Problems in the field of religious spiritual education determine appearance of different nationalistic

flows leaning against the doctrines of one or another religion, and also on conception of maintenance of ethnic unicity that is understood from cardinally opposite positions.

Problems in the field of religious theological education determines the emergence of different currents, based on the doctrine of the Muslim religion and the concept of maintaining ethnic uniqueness is based on paganism. Adherents of formation of Islamic culture don't accept some folk customs and traditions which «are perceived by them as violation of «pure» Islam, distortion of initial shape of Moslem doctrine» [9]. Babich I.L marks: «In Kabardino-Balkaria a dancing culture, wide spectrum of dances and musical instruments, is saved until now. According to islam canons, dances of men with women are not settled. Young Muslims of KBR allow only those dances where one men, under a drum and a fancy riding participate. So, one young man when has begun to go to mosque, has been forced to leave national ensemble in which he worked before» [10].

To beginning of XXI of century the new generation of moslems, perceiving folk customs and traditions as violation of «clean» islam, distortion of primordial look of muslim religion, was formed. A conflict arose up between a senior generation and so-called «young Muslims», first of all, on soil of disagreements in the field of spiritual culture (relationship to funeral and wedding rites, and the secular side of Muslim life). It seems, that a mark conflict is not taken off and today and will remind about itself repeatedly and in different forms. And meantime, for his decision it was possible to take advantage of experience of our ancestors that found harmony between an adat and sheriat, remaining veritable moslems here. Every people, without depending on a faith, value own ethnic values, an islam got wide distribution on North Caucasus by virtue of that a sheriat did not abolish an ordinary right for highlander people, that allowed to accept or not accept one or another norms of islam. It is as an example possible to bring attitude over toward polygamy. Under any circumstances the people of North Caucasus did not adopt this phenomenon.

But, in our opinion, calling for the return to pagan principles also are extreme. Paganism, as the longest stage in the history of the ethnic group, of course, have developed a rich spiritual culture, which we are proud, sometimes forgetting about what kept many idealized pantheism. It was the bloody rites of human sacrifice, it was the cult of power (remember the song about the raids, which the vast majority was composed in pre-Islamic period), it was the disrespect for private property and the worship of natural elements.World religions got wide distribution by virtue of claim of high ethic and moral values, ideas of predominating of the spiritual beginning above material life. «Outliving cruel persecutions in the totalitarian state,. an islam in Russia regenerates foremost as a culture and morality, as a system of the traditional domestic and community relations based on authority of elders, on a high moral, guarding society from a drunkenness, drug addiction, from the negative consequences of «sexual

revolution» of the second half of XX of century» [11]. In a real period not only representatives of religious philosophy of neothomism, theology existentialism, moslem fundamentalism etc., but also irreligiously philosophers, in particular culturologists, assert quite often, that religion an important role belongs to in forming of fundamental cultural values. In fact bases of morality, respects to the laws, principles of service to the general blessing, are stopped up in religious manoeuvres.

In the context of modern culture interest in religion is determined by the row of factors : intensifying of the religious feelings in society and at the same time by the height of tolerant attitude toward a dissidence. These phenomena provide a basis for a return in spiritual life of society of religious monuments, customs and ceremonies, exposing mentality of different confessions, and also assisting the height of ethnic consciousness of people, inhabiting Russian Federation. There is activation of different religious confessions on this background, including in area of education and culture. In this connection an enormous value is acquired by the researches related to the study of role and place of religious traditions in spiritual life of society.

In the XXI century the religion representing a clot of experience of spiritual and moral culture of mankind becomes one of forces forming consciousness of the people. «The religion – art – culture – spirituality» – close interrelation of components of this chain is the most obvious today. At the beginning of the 90th the academician D.S. Likhachev wrote: «It was nowadays made extremely important in our spiritual life. Already nobody opposes religion to culture. The culture was born in a subsoil of religion and has been connected by the millennia with her. The culture never becomes outdated and is always modern – is modern in a broad sense this word as also beauty is modern. Also that culture which lives in religions is modern. And this is irrespective of believer or unbeliever person, claiming to be the cultural» [12].

In a modern period religious tradition is understood not only as a mechanism of fixing and transmission of concrete religiously-confessional values but also as a method of national self-definition, social self-expression and self-affirmation. In the collective consciousness of the Balkars, the Muslim creed is not opposed to traditional culture, but is not as orthodox dogma. Contradictions in a religious environment must decide at the level of structural dialogue in all spheres of spiritual life of society. In this connection the role of humanitarian science in research of problems of development of national cultures in wide historical, social and religious contexts is increased.

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Features of the Man's and Women's Speech
in Kabardino-Circassian Language: Emotive's Aspect

Zareta V. Cherkesova
Kabardino-Balkarian Institute of Humanitarian Researches
Nalchik, Russia
zara7belle@mail.ru

Abstract— **The article is devoted to the peculiarities of male and female speech in kabardino-circassian language. The research center – lexical and phraseological units, enclosing a different kind of emotion and interjections that are used exclusively in women's speech. If you try to analyze gender differences in kabardino-circassian language found that women in their speech more often than men use lexical and phraseological units expressing emotive.**

Keywords— kabardino-circassian language; man's speech; women's speech; emotivness; expressivity; lexical unit; phraseological unit; interjections

The emotivness is one of main (the second for the importance, after informational content) components of communicative function of language and is shown in the speech in the form of emotionally painted language units. At the same time their emotivness and estimation are fixed in semantics of these language signs. The emotivness allows speaking to express the feelings, the relations, impressions in language signs for which informational content (denotative, rationality) isn't dominating, and is directed, first of all, to transfer of emotional experiences of the person. According to the famous psychologist K.E. Izard, emotion it is possible to consider not only as the main motivating system, but also as the personal processes attaching sense and significance to human existence [1]. Penetrating all speech activity, emotionality is fixed in semantics of words, forming emotive's lexicon.

Due to the ability of human consciousness to create certain associations, and also to use already ready associations (communications, images) created on the basis of the previous experience for the nomination something again created a human body not just perceives the events around, but also experiences certain emotions, feelings, experiences about it. Thus, in language the special set of means – from phonologic to structural – capable to transfer all scale of feelings and experiences is formed. It is accepted to call such set of means «an emotive's code».

In our opinion the emotivness and estimation need to be considered in a complex as the emotivness is the main transmission medium of the relation of the person by the way, and also a word lever on the person. And the relation always means an assessment of the transmitted information.

By the nature the concept «emotivness» is a complex entity. For example, the kabardian phraseological units (further FU) «I schedzhyzh(ir) egjeiuezhyn» – «to force someone to be spent»; «to go broke»; literally «to force someone to thrash an old stack of bread» [2] and «mykhyyr egjekhyyn» – literally «to force to take down not taken down, to bear intolerable» somewhat corresponds to the russian FU «show (someone) Kuzkina mother». To her also there corresponds the kabardian FU «bzhynem igepschyn» – literally «to force to creep through a horn». That is FU given above mean that a certain subject has made a bad act in relation to another that is negatively estimated by the third subject. There is also FU where one subject makes ill effect in relation to other subject or to any object, however in these FU there is no specific subject of an assessment (third person). Such, for example, the kabardian FU «teiushchiykiypie shchiyn» – literally «to make someone by object of continuous oppressions, a whipping boy» or «to mill to someone bones»; «herekjuakie dykhyezhyn (degjekhyezhyn)» – literally "to disappear", «to force someone or something to disappear, break (about a subject)». Thus, the emotive's macrocomponent is the culmination of some semantic information which introduces a subjective factor – specifically emotional and estimated relation that gives to FU expressional coloring.

At perception and knowledge of world around each person defines for himself concrete valuable reference points. Around it he estimates all events through a prism of dichotomies: the good – the evil, is good – badly, beautifully – ugly, the truth – lie, possible – impossible, etc.

In our opinion, an important role is played by an emotive-estimated modality which is to the main components of an emotional component of a connotation and expresses the emotive-estimated attitude of the subject of the speech towards object of the statement.

In the kabardino-circassian language of an assessment of the person can express as the all-estimated relations (positive and negative), and partial-estimated (psychological, social, moral, esthetic, etc.). The emotional component of a connotation expresses the relation to a subject and transfers the whole set of feelings – from discontent and grief to pleasure.

Some scientists suggest not to be limited to two-digit system of an assessment (positive and negative). So, G.G. Sokolova considers it expedient to allocate three types of an assessment – positive, negative and situational as in a circle even of one society various aspects of an assessment of the phenomena are possible [3]. So, the kabardian FU «gum imykiyzhyn» – «unforgettable»; literally. «do not forget whom - something» – a striking example of situational type of an assessment. This FU can't have unambiguous interpretation out of a context of her use. For example, in the offer «Madinere Marinere Iuashchkhyemakhue ljape shchagjekiua makhuekher iyagu ikiyzhyrkjym: hauar kabzat, uas huzhyym nar shidjilt, tsiykhukher najagujat» – «Madina and Marina have spent unforgettable days at the bottom of Elbrus: air was pure, white snow has stuck together eyes, people were joyful» positive value of this FU comes to light. In other offer – «Murat a makhuehem zekhikha psalahar igu ikiyzhyrkjym – idzhyr zheshchkie abiham kjadoskie» «That day Murat has heard unforgettable words from which he still shudders at the nights» – obviously negative value of FU given above is observed. In the third offer «Shchiale ne tsiu tsiykiu Lu kjyshchaljkhu makhuem kjuazhem yagu imykiyzhyn iedzhi kjyshchykhjuashch» [4] – «That day when Liu was born, the boy with brilliant eyes, in the village there were unforgettable events» it is necessary to consider situational type of an assessment as from this offer aren't absolutely clear what events (good or bad) have taken place in the village. On the other hand, that the birth of the person could symbolize change of life of the village to the best it is possible to assume the FU «gum imykiyzhyn» positive value («unforgettable») in this offer.

In the kabardino-circassian language the variety of lexical and phraseological units «female subject» meets. On the basis of the principle of the emotive-estimated attitude towards the woman it is possible to allocate:

– emotive-positive – the containing positive emotions of respect, a worship, approval, admiration, etc.: kupschhe guasche – a doll, the beauty, keshen – the bride, the beloved (litarally «that which I am going to marry»), mazer zi nekiu – lunoliky, Iekiuetsiyr zibg – harmonous, liy i fiz – the balanced woman, the good wife etc.;

– emotive-negative – with a negative assessment, with scornful perception, contempt: bzi – a female individual (comprises neglect), kieude – the coquette trying to draw attention of men, канzhe kiakie – talkative as forty; quarrelsome; the gossip, kjydenezha, hydzhebzyzh – the old maid, kehpe, kuepech, psezh, hebz – the loose woman, the prostitute, liygjezh – cruel in relation to the husband [5], quarrelsome (litarally forcing the man to throw up, pull out), almesta mazhe (tsiykhubz zhy) – the angry (slanderous) woman, liyne-liypse – amorous, litarally loving, adoring men, meskietiine – provocatively elegant (about the girl), nysemyde (nysemyde schIyn) – non-recognition of the daughter-in-law (to refuse the daughter-in-law, to declare non-recognition of the daughter-in-law by the family of her husband), nerybgy – the ill-natured person, phuzh – divorced (or the widow –

fyzabe), pschydeguel – (obsolete) the concubine of the prince, pieshchkhyagjey – the unaccomodating spouse, fyzey nepsyrylesch – at the angry wife is many tears, fyzykhja, liyiueliyfe, shygurykh – the virago, the boorish woman, hjyryg (obsolete) – the quarrelsome, capricious woman, Iuitibziti – hypocritical, double-faced; gossip, etc.;

– emotive-neutral – designating a female with a neutral assessment: ade shypkh – the aunt on the father, ane – mother, ane shypkh – the aunt on mother, aneshhue – the grandmother, bzylhuge, , tsiykhubz – the woman, nysashchie – the daughter-in-law, newly married, nyseg – the wife of the brother-in-law, nerybge - daughter, in general, any woman in the family, uneguasche - hostess, homemakers, fyzgalhue - midwife (midwife), hydzhebz tsIykIu – girl, hydzhebz, pschasche - girl shyphu – sister, schuIege (obsolete.) - wife, husband, schhelaschIe - a woman of letters. "Wearing a headscarf", etc;

– emotive-balanced – situational (depending on a context); polysemous; bearing in themselves both a positive and negative assessment (depending on a context), contradictory emotions: guasche – the mother-in-law (it can be used both with neutral, and with an assessment negative (in most cases)), Guasche – the princess; in folklore and literary works meet both positive, and negative (the last are more often) images of the princess, niise – the daughter-in-law, the daughter-in-law, fizizh – the old woman (with neutral value), ud – the witch, the sorcerer. The initial perception, value of this word – negative, but in the kabardino-circassian language is expressions «ud shchiezh» and «ud shyr» («Iushchytse»), used in «very wise» value.

Also in the kabardino-circassian language the lexical and phraseological units which on the semantics don't have relations to the woman, but characterizing the man through the «female» elements which are present at them meet: fyz zimyie shchialere shhue zypshchiekhemyl shire – the guy without wife – that a horse without bridle, fyz keshegue – time of marriage, the age of marriage; letters. time to the importation of his wife, fyz keshen – get married, get married; letters. bring his wife, fyzdeubze – characterless man, henpecked; letters. curry favor with his wife, fyzkym, bynkym – no wife, no children (alone), bostei kuaschIer Iygyn – cowardly hiding behind his mother (his wife) man.

The use of the interjections expressing the subjective relation speaking to told, is the most widespread way of creation of an emotivnost in the kabardino-circassian language. Interjections, along with a mimicry and other expressional painted words, are one of the most important means of expression of emotions. As I.A. Pushkina notes, «emotions not only do life bright and expressional, but also regulate relationship of people with each other and the subject world, allow to adapt in this interaction. They are the main estimated contents practically of any transmitted data as in the course of communication not only information, but also the attitude towards her, her assessment, emotional interpretation is transferred» [6].

In the kabardino-circassian language gender distinction of interjections is observed. Some scientists (H.Sh. Urusov, M.L. Apazhev, A.K. Shagirov, G.A. Klimov, etc.) distinguish the so-called "female" and "male" interjections. By specifically female interjections are an-a (na-a), a-na gusche, a-na mygue, adydyd (mygue / gusche) guIeguezh mygue, asymygue, sermygue gusche, aIey mygue etc. "Women's" interjection usually begin with the sound "a" [7]. en and interjection (an-a) – oh, well, really, really was surprised, and, in some cases, discontent:– An-na-aaa, ezym psem fIefIyr kebgasherke uperymyueu. Alyh, di Iuehum fIekI kuazhem hybar zyri demylyzh [8]. – Can not you let him marry the one he likes. Honestly, in a village only about our history and talk.

In the above example, an interjection, and complains, even though most of it is surprised: – An-at-a, lIyzh, situ Ieyue ukeguva yu myhabzeu? – SchIoupschIe zeryschIyhezhyhheu Guaschenehu [9]. – About (well), my grandfather, how do you delayed, which is unusual to you? - He asks Guashanoh as soon as he entered.

"Women's" interjection in kabardino-circassian language can express many different emotions: surprise, fear, fear, fear, regret, etc. For example, an interjection guIeguezh mygue –– oh, sorrow can simultaneously express the fear, the horror, frustration, anger and surprise – GuIeguezh mygueti! LIy udokIue – zhiIeri Hebibe i kuafitIym euezhasch [10]. – Oh, woe what! You're getting married! - Habib said and slapped his thigh (as a sign of frustration - cr).

In kabardino-circassian language there are interjections-oath (alyh, azalyh, alyh dysche, alyh dyde, alyh zakue, alyh lesch, tha, tha dyde), which often function as introductory words: - Tha dyde, myr dane deji schylezhefynum, aue, khyIe a yapem schysam huede komygetIys, pkygueher zegedzekIaue, phenzhu zerigeubydu ... [11]. – Honestly (I swear Tha), it can work anywhere, but please do not put someone here, similar to the previous one, the fastening parts on the contrary ...

Interjection ua [ue] Iey (wa-ah, wa-ei) in the kabardino-circassian language is found only in female speech and expresses different emotions – fear, fear, surprise, delight, joy, etc .: – Ua Iey , sykeflyhuezhynu fi guschhi kekIyrkymi – kyschIohezh Mazize. – Phi nybera neh Iuehur, hemere ... [12]. - About (horror), do not even think to look for me - comes Maziza. – Important for you to stomach, or ...

«Men's» interjection «I» often begin with the sound. Scientists distinguish such «male» interjections as: Iag, Iagu, Ieg, Iau, ziunaguere, uelehi [13], ei lIeun, thar sogeptsI, zgeptsIai, tha dygyIe, kurIenkIe soIue [14], theguIe (tha guIe): – Tha dygyIe, Denehu i tsIer kipIuaue, uezgafem! ItIane ... Si nybzhegur symadzheschi abi syschIeupschIenusch. – Hat zi gugu pschIyr? – Astemyrsch, Ieu! Situ uschygupscheh .. – LIo keuzyr? – Uelehi, symyschIe. SschIame, schIeupschIakIue sykIueret? Povestke kyhuekIuaue zigehezyr hunsch a ue pschIem – gushyIeure zhiIasch Zhansehui [15]. I swear (I swear Tha), pronounced the name Danoh, I will not give you a drink! And yet ... My friend was ill, go to see him. – Who are

you talking about? – On Astemir, also (of course)! What are you forgetful. – How sick? - Honestly (I swear), I do not know. If I knew, I would visit? Probably, I received a summons and prepares our mutual friend – joking said Dzhansoh.

As illustrate the examples given above, interjections in the kabardino-circassian language at the same time can belong to different (including opposite) to semantic groups that is explained by their polysemous therefore concrete value of interjections is defined only in a context. At the same time it is important to note that in the kabardino-circassian language gender distinction in the use of interjections is observed.
Summing up the result, we will note that in the speech of women the most frequent use of lexical and phraseological units, characteristic only of them, expressing emotive and also the interjections used only in the female speech is observed.

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Megafolinic about the Origins of the Kabardian Literature (1920-1930-ies)

Liana S. Hagozheeva

FSBES Institute of Humanitarian Research of KBSC Russian Academy of Sciences

Nalchik, Russia

Zalina hagozheeva@mail.ru

Abstract— **The paper investigates the role megafolinic origins in the rise of the Kabardian literature of 1920-1930 – ies.**

The analysis is based on the fiction and critical works of young writers. Deals with the questions of folklore and mifoepichesk motifs in the Kabardian literature of the studied period is determined by the specificity of the impact of traditions in the work of novice writers.

Keywords— folklore; literary tradition; genre; literary character; story; essay introduction

Mifofolklornye origins Kabardian literature - one of the most pressing problems in literary criticism . On scrutiny it can say the following : none of the researchers of national literature did not remain indifferent to this problem , treating it in different ways. We say that only the main works: HI Tanks . National originality and creative individuality in adygskoj poetry (1994); LA Bekizova . Literature in the time stream: literary circassians - Circassians (2008);

From heroic epic to the novel (1974); VA Biguaa. Abkhazian literature and literature of the peoples of the North Caucasus (Historical and cultural context of the Diaspora.) (2011); AM Gutov. Artistic tradition Adygeyan epic (2000); UB Dalgat. Literature and Folklore; historical aspects. (1981); IA Kazharova. The man and the history of poetry in adygskoj 1970-1990-ies Artistic and philosophical aspect. (2009); OH. Musukaeva. The North romance. Artistic and ethno-cultural typology (1993); OH. Musukaeva, YM Thagazitov. The evolution of the novel genre in Kabardian literature 50-80-ies (2010); KN Paranuk Mifopoehtika and artistic image of the world in the modern novel Adygeyan (2006); YM Thagazitov evolution of artistic consciousness Circassians (2006); KG Shazzo Art conflict and evolution of genres in the Adyghe literature (1978) and others. In modern literary actively pursuing the issue of the results of folklore influence on literature and its modern use in the works of poets and writers, typological transformation of its traditions, etc. The tradition of folk culture in the literature - one of the faces of specific appearance of works of art, one of the productive ways to enrich their poetics. This is always important to see their humanistic sense to understand why in all difficult life collisions dominated persons: "Questions and folklorism

mifopoeticheskogo consciousness particularly intensively studied in young literatures , where their influence is most strongly. These problems are analyzed in the theoretical aspect and in the historical and literary perspective.

This interest is natural, since it lies attention to the artistic traditions as a whole, to genetic spiritual origins of artistic expression in all its diversity and richness" [1]

It is known that the emergence and further development of the Adyghe literature researchers associated with folklore, emphasizing its importance as artistic and aesthetic framework, without which was the formation of a national literature is impossible. Folk traditions are often carried a double meaning. The first folk art - the source of the transformation of literature "talking" in written literature. Mifofolklornye tradition of giving aspiring writers a platform to jump to a specific image in fact, the characters of events to fill their authenticity and realism imagery.

LA Bekizova said: "People's pedagogy, philosophy, morality, expressed and stored in literary treatments of folklore, have been placed at the service of human education. Found and discovered a gold mine of native writers of poetic literature contributed to the penetration of the views of people in the world [2]. And the second - in the early stages of folklore influence on the developing literature can be seen crossing a mechanical folk motifs, themes and colors, which often leads to naturalistic declarative, descriptive.

As a rule, the product, being constructed under the scheme is characterized by a statement of facts, inertia, but not internal traffic collisions, development and depth of character. This could be explained only by the inability of the authors fruitfully use folk tradition, whose wealth is inexhaustible.

Occurring in many of the same plot points, folk typing methods of positive and negative characters led to the template, significantly prevented the birth of a new hero living man with all the difficulties of his life and character. Illegally it could be argued that mifofolklornye traditions contain negative beginnings. Only inefficient, inept use of them is the source of rare works and subjects.

On kabarda literature of the early period was influenced by works of national poets - storytellers (dzheguako) - . B.Pacheva , A.Havpacheva, P.Keshokova , P.Shekihacheva etc. They preserved monuments of oral- poetic literature - one of a kind artistic level indicator thinking of the people in those days.

In Kabardian literature of the period of 1920-1930 the main works appeared as a hero, as a rule, as some political scheme in his artistic decision were equally strong and folklore and journalistic elements, as a result, this led to a contrast the romantic embodiment of the character. But over time the hero has gained not only real, but also typical features: instead of a predetermined circuit to the reader appeared as a living man of today, with all the complexity of his personal qualities, embodies the different time lines, actions of the hero has not beenone-sided.

To those heroes should include first Kabardian literary collections " Yape lebaku" (first step), "Karuusch1e" (New Force), "Nybzhysch1e karu" (Young Power), as well as stories S.Kozhaeva "Sch1e" (Virgin Soil) Dzh.Naloeva "Home " and others. There is no doubt that the intensive development of the genre forms in the national literature would be impossible apart from the spiritual values that were created Kabardian people for many centuries.

Kabardian folklore - a remarkable testimony to the level of aesthetic perception of the world people are trying to master the art world and to convey his understanding of it, and to establish certain stable genre forms in the process of poetic creation. Since young literature in the first period of its formation are closely related to the folk basis, poetic genres in them for a long time occupied the dominant position, ahead in its development of prose.

The poetry of this period was able to outline the most significant trends in the development of artistic minds of the people at a new historical turn and reflect the most characteristic qualities of the new hero on a new historical turn. If the other literatures of the region 1930 are characterized by the almost simultaneous appearance of the major works of the epic form ("Chamboulive" T.Kerasheva - in Adygea, "Black box" H.Appaeva - in Karachai, "Glow" H.Abukova - Cherkessk) in Kabardian literature, prose, there were a number of stories and several novels.

National prose only mastered the way to great genres and seeks to capture a new life and new characters available in her forms. The first works of prose writers Kabardinian - newspaper articles, essays, reviews, short stories. If you try to identify the distinguishing feature of these works, it is worth noting their relevance, direct reference to the topic of the day pronounced agitation In 1932, in the magazine "Revolution and beyond" (No. 1) emphasized the importance of literature in public life: "the Works of the mountain of the poets and writers made heritage of the broad masses of workers, farmers, poor and middle peasants. We can say that this type of literature in the mountains enjoys a particularly successful and it has a great educative influence on the masses" [3]. In this period of life is not able to obtain adequate implementation in the literature. Criticism of the 30-ies, wrote: "Neither in Kabardinian or Balkarian prose have not created great works. Writers, moreover, had not yet mastered the subject of today, not mastered the vast abundance of those offered by Kabardino-Balkar reality" [4].

In difficult historical conditions of development of the whole national art has acquired great importance to literary criticism that national reality had not so much to see of the artwork, how much, theoretically, to direct the development path of literature in General, closer in some ways to sketch and journalistic genres. A special place in Kabardian criticism of the 1930s years was taken Janah Naloev, whose articles and still attract the attention of researchers. In the article "From the dead to the living" (1933), noting significant successes of Republic in economic and cultural development, he wrote that literature and life are inextricably linked, that the writer, who is on the side of the "Affairs of the working class" voluntarily or involuntarily "politically kill herself..." under the influence proletkultists concepts, Lectern has not escaped some errors and the call to learn from M. Gorky and V. Mayakovsky, critic, unlike So Borukaev, denied the value of folklore for "proletarian literature": "the pre-revolutionary creativity of the formless. It may have value for the historian and linguist, but not for the proletarian national writer, because it is characterized by national– political system of a certain age" - we read in the article John.Naloev. If we set aside the criticism of perfectionism, we see that he was right in one thing: the folklore and literature of qualitatively different ways of artistic vision and embodiment of life, different aesthetic system. In the same article, highlighting a complete lack of Kabardian literature, of any heritage, called "borrow the more happy in this respect, people something, i.e. to find out from him the law by which the literature, which can be built and our. Discovery, study and development of this law in the lab those that best owned it is the goal and world classics, and especially of contemporaries." [5]. As the researchers note, in the Circassian heroic epos protagonists tend to be heroes and fighters. They have long depicted life-philosophical concepts of the nation that rejects oppression in any form. This poetic world, filled with pathos and inspiration, became the main source of literature for the reconstruction of the past of the people. Heroic situation, the richness and diversity of those great spiritual energy caused by the artistic originality of the young national literature: "the Increasing trend in modern prose attention to the dialectic of the tribal, national and social brings a new quality, which is broader and more substantive popular in the national prose admiring spontaneous organic unity of a kind, timeless pathos and mandatory poetizatsii" [6]. Mittelklasse origins is one of the fruitful ways of recreating the specificities of the national facility, the national reality, it is the most important factor in the formation of the historical and philosophical worldview of the writer. Using traditions of

the past, artfully transforming the best of them, n the early stages of the development of Kabardian literature, writers and poets in a new approach to the solution of artistic problems, improving and deepening the difficult art of the word.

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Biblical Motifs in the Works of Contemporary Art Adygskih Writers

Madina A. Hakuasheva

Kabardino-Balkarian Institute of Humanitarian Studies

Nalchik, Russia

dinaarma@mail.ru

Abstract— The main purpose of the article is to study the phenomenon of modern Adyghe (Circassian) literature as a dynamic cultural phenomena in the era of globalization. The author focuses on some of the most typical of its aspects, one of which is mifofolklornoe borrowing, which is treated by means of the comparative method. Cultural determinants of global mainstream can not influence on modern literature Adyg, causing a marked tendency of borrowing biblical images and motifs - an aspect that is being considered for the first time. Results of the study may be of interest to specialists, philologists, culture experts, religious scholars, graduate students, as well as a wide range of fans.

Keywords— bilingualism; folklore; myth; biblical motives; biblical images; borrowing; the sacrifice; the archetype

INTRODUCTION

In some Russian regions, including the republics of the North Caucasus, a situation bi- and multilingualism, significant cultural transmission, which together is difficult and ambiguous impact on the artistic consciousness, causing, in addition to the accelerated development of literature, significant modification and inversion of its traditional artistic structures and genres. Therefore, special interest folklorism the problem of so-called "newly created written" literature, in particular, the Adyghe (Circassian).

The interaction of folklore and literature emerged as a versatile and relatively stable even in antiquity, and the process of folklore and literary collaboration in the development of the immense diachronic coordinate (until today) - a mirror image, adjusted for the changing features of episteme.

Modern interest in folklorism and mythologism remains high and rising steadily. The reason, obviously, is not only a great extent a variety of forms and methods of drawing folklore characteristic of modern literature. It turns out unusually extensive and complicated sphere itself is borrowing, within which there are certain regularities.

Artistic consciousness Circassians type is characterized by mythological perception. This circumstance explains the rich heritage mifofolklornym and chronologically a small distance from the folk era (in comparison to the development of literature). Considering the myth and folklore as a basis, the cradle of every culture, it can be argued that the degree of manifestation of national identity, literature, depends primarily on the degree of conjugation with them.

Circassian literature is strongly influenced by mythological and folk poetics, although the dynamics of complexity borrowing mifofolklornyh elements and structures does not always depend on the extent of borrowing. On the other hand, it is difficult to assert a direct impact on literary folklore tradition, as well as its direct continuity; more likely this relationship can be considered indirect; at the same time it is more complicated, and literary forms of artistic expression are increasingly degree of transformation. This is due, primarily, the fact that the phenomenon Adygeyan artistic consciousness is complex and peculiar to the same extent as any other, and tend to evolve non-linear model.

Significantly deepened artistic angle view of Scripture. The Bible has significantly expanded its perennial moral and instructive, regulatory functions, it saw the most comprehensive, universal embodiment of «typical, always human, ever recurring, timeless» (Thomas Mann). The biblical myth was able to embrace all the universal category of human morality, philosophy, while remaining a living reflection of the empirical life of each person. Faulkner once said that reading the Bible every day, always laughing, «The same thing happened with my neighbors yesterday».

The same socio-cultural determinants are likely to cause a marked tendency of borrowing biblical images and motifs in the Adyghe literature.

With the advent of «Myve lehane 'first novel-myth "Stone Age» (1985) Kabardian poet H. Beshtokova in Kabardian literature originates a new trend - neomifologizm. In the war of Dore and Emineev no winners, but losers are all that people of both tribes are killed, except by accident survivor boys Anu. Typical inter-tribal conflict can be seen as mimetic or sacrificial crisis, which was resolved by military confrontation. The period of «Stone Age» in the context of the novel's

chronotope can be regarded as the era that has not yet adopted the ritualized sacrifice - the ritual, warning the total bloodshed.

The central motif of the novel «Night of Qadar, or who is right» modern Kabardian writer M. Emkuzhev becomes sacrifice motif associated with the crucifixion of Christ. Despite the "stylized" nature of the crucifixion, for such a conclusion can be reached through the specific composition of the novel, which is based on the introduction of multi-feature sections. So, throughout the narrative, the author introduces fragments of the scene of the crucifixion of Jesus Christ, sent by one of the three sentenced, which was to the left of the Messiah.

The reader can not help wondering relatively strange at first glance, the name «Night of Qadar» Which novel or the right». In fact the name carries the hint. Kadar night - the only night during the holy month of uraza when Almighty descends to earth, listens and grants wishes. The token «who» by chance marked with capital letters as an indication of the presence of God. According adygskoj tradition, the right is a senior, in this case, the father. But if Jesus Christ combines, according to Christian tradition, the trinity (Father, Son, Holy Spirit), then Jesus, who is to the right of the crucified - an emanation of God the Father. In another case, a similar allusion to the crucifixion associated with the long-bearded Nasrenom - Circassian analogue mythological Greek god Prometheus. In the context of the theme of the novel is chained to a rock god to be seen as a variant of the theme of Christ's crucifixion. Characteristically, the crucifixion motif varies, it breaks into a local 'sub-theme, "repeating it several times archetypal option. Thus, it achieved some polyphonic sound of the motive.

Adyghe world (codenamed Hakuzh - old homeland) before the next World Flood becomes the central theme of a small novel M. Emkuzhev "Flood." In the work of M. Emkuzhev combined two types mifofolklornogo borrowing: in the first case the author uses mifofolklorny national component, the other - the universal, and this combination is one of the important features of the individual style of the writer.

Approximately the same semantics and form-the myth of the novel become decisive for the novel Adygei writer Yu Chuyako "Legend of the Iron Wolf". Ominous Iron Wolf image in the space of the novel is subject to endless transformations, he mimics, changing countless masks, behind which hides the evil. Properties and features of the Iron Wolf scattered everywhere, invisible seep into all areas of life, condensed, compressed with the development of novelistic narrative, defining state predapokalipsisa times. The evil in the modern world put indistinguishable, Proteaceae. It acquires the image of the werewolf, which occupies a central place in the new Adyghe literature.

The symbol of the evil acts and Black Mountain from the novel-parable N. pupa Adygei writer. It is able to endless metamorphoses as well as Iron Wolf and Psomordy.

The apocalyptic motif laid the basis for the novel "Abraham" of another Russian-speaking author J. Adygeyan. Koshubaeva. The etymology of the ethnonym A. Gadagatl explains: "The motive of the punishment of people by God, - failure through the earth for their daring passes in many legends of the Circassians, and storytellers, they are usually timed to coincide with the famous lakes of them. In addition, among the Circassians there are many proverbs and curses ... In Adygea, near the left bank of the Kuban River, near Kazanukay and Edepsykuay 1 there was a lake "Humedzhy", the origin of which is due to sink into the ground the village, who was once here: their behavior inhabitants of the village We incurred the wrath of god, for which he punished them severely "[1, 185]. A similar tradition is contained Crimea Giray: near Ts1emeza (Tsemez now - Novorossiysk) has a lake 1ebragu (Abraham) [1], surrounded by mountains. Adyg According to legend, in the words of Crimea Giray, before this place was located aul Abraham. Its inhabitants were extraordinarily rich, like the inhabitants of Sybaris, just the same as they are soon forgotten abragtsy bans god during merrymaking began using stones instead of bread, and instead of clay used by the test. (Characteristically, the same motif is used in the novel M. Emkuzhev "Flood). God told Abraham: all the wicked people of the village at dawn were buried under the ground razverzsheysya: survived only a righteous man and his family, an angel descended into another canyon. In place of the lake was formed village. Circassian legend performs a function of plot for a novel George. Koshubaeva. But given the plot has direct analogies with the biblical destruction of Sodom and Gomorrah, Lot fleeing with his family. On the other hand, appeared the lake is associated with the "Flood."

This phenomenon borrowing biblical motifs and images becomes a common manifestation of the modern trend in modern Kabardian literature, which in turn is part of a global trend: the biblical myths embodied in poetry, prose, drama firmly established in the life of the world literature. This is understandable, since the turning of the twentieth - the beginning HH1 centuries, exacerbated all the potential for conflict in the first place, those who one way or another come to the moral and ethical foundations, the quintessence of which is embedded in religion.

The most popular biblical character of Russian and Soviet literature is Jesus Christ; his image as timeless relevance, as the search for absolute truth, the struggle between good and evil, the understanding of the laws of the universe, and climbing steadily striving for perfection. Artists will inevitably come to the necessity of comprehending eternally mysterious image of the Messiah: each new era began with a new perception of the image of the Savior. Not surprisingly, it has undergone a tremendous evolution in the minds of not only humanity, but also in displaying it in the monuments.

The whole epoch is characterized by the words of NA Nekrasov on Chernyshevsky: "God sent His anger and grief the kings of the earth recall Christ." FI Tiutchev binds

suffering "crestfallen" weight of the cross of Jesus with "nudity humble peasant Russia" ("These poor villages"). In FM Dostoevsky, he appears as a prisoner in a dungeon of the Grand Inquisitor ("The Brothers Karamazov"). The image of the Messiah in the novel "The Idiot" is embodied in the image of Prince Myshkin. Search correct interpretation, complication and deepening of the image of Christ did not stop and in the twentieth century. The tradition was continued by MA Bulgakov's novel "Master and Margarita". A brilliant interpretation of the Savior in the way of Yeshua Ha-continued Aitmatov ("scaffold"). In complex dialectical countering presented images of Christ and Judas Iscariot in the story Andreeva "Judas Iscariot" (1906), which was published only in 1990.

Poetry BP Pasternak brings torment of Jesus Christ with the tragic vulnerability of Hamlet. Of special note is the figure of Jesus Christ "in a white crown of roses" march across zavyuzhennomu Petrograd led 12 Red (12 apostles in the poem A. "Twelve" Blok).

Biblical images and motifs are widespread in foreign literature. The name of the novel E. Hemingway's "Fiesta", an alternative to having "The Sun Also Rises" - a phrase from "Ecclesiastes", one of the books of the Old Testament of Solomon. Meanwhile, the heroes of the novel Hemingway - representatives of the "lost generation". Reading the novel, it achieved a sense of meaninglessness, emptiness of what is happening. But, guided by the key to understanding the novel, resort to "Ecclesiastes" the text: "Gender and race comes out, but the earth remains forever." The projection for eternity novel paints the background in bright optimistic colors. The young man Pedro Romero exacerbates this feeling, because it is - a symbol of new life.

Of the various hoaxes folk, pagan beliefs, biblical images built wonderful fabric of the narrative unique Marquez novel "One Hundred Years of Solitude." Not only this, but also in the future his novel "Autumn of the Patriarch," the writer relies extensively on Latin American folklore, supplementing it with ancient and biblical motifs and episodes of historical legends.

The plot legend of Cain and Abel was the basis for the novel Faulkner's "Absalom! Absalom! "Fratricide, as the author believes, was due to the limited, narrow view of people on the foundations of the universe. Heroes led by false representation, unknown true values remain.
Another interpretation of the same scene gives Lars Yullensten. The basis of the "Memoirs of Cain" novel (1963), a stylized under the ancient didactic prose, modern conflict laid. In Yullenstena ethical confrontation between Cain and Abel are facing two polar positions, two world-view, two faiths. Cain kills his brother because Abel thinks, feels, acts not as he, Cain, who believes his way of being indispensable. Such a reading of literary legend with all its conventions and external remoteness from the present, contains a clear allusion to the historical events of the twentieth century, primarily on the origins of fascist ideology.

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Recreational Resources of the Kabardino-Balkaria as a Key Factor in the Socio-Economic and Cultural Development of the Country

Zarema M. Kesheva, Natalia V.Varivoda, Marina H.Gugova, Ruben G Oshroev.

Federal State Budget Institution "Institute of Humanitarian Studies" of KBSC of the Russian Academy of Sciences

Nalchik, Russia

kesheva10@gmail.com; Variks1@yandex.ru; gugowa@mail.ru; ruben.kbr@mail.ru

Abstract— The purpose of the article was to study the prospects of development of the recreational sphere, peculiarities of its formation and functioning in the life of modern society on the example of the Kabardino-Balkarian Republic.Scientific methods used in the work, make it possible to determine the degree of influence on the achievement of national reconciliation and peace, establishing friendly relations between the Russian people. The main conclusion is seen in the fact that the entry of the KBR in the tourism cluster of the North Caucasus region, the presence of other promising projects will help to increase the number of tourists and holidaymakers, as well as the further development of related industries and the creation of new jobs, which is the most favorable impact on the economic and cultural republic climate.

Keywords— *tourism sector; recreation; globalization; North Caucasus; Kabardino-Balkarian Republic; tourism cluster; cultural tourism; investment passport*

Historical mark the end of XX - beginning of XXI century is characterized by dynamic changes in the global political, economic, cultural and social life. When considering the related issues with these changes it has become customary to use the key term «globalization», under which eminent sociologist Anthony Giddens proposes to understand the investigation together political cooperation, economic, cultural and social factors [1].The processes of modernization, globalization, the internationalization of all spheres and domains of life have an increasing influence on the course of historical development [2]. An increasing number of philosophers, sociologists, historians are inclined to think that at the present stage of human development is formed by a single civilization on the planet. Rooting this idea in science and public consciousness of globalization promotes awareness of social and cultural processes in the modern world.

The experience of advanced countries and local communities suggests that the search for a constructive model of economic and cultural development of one of the key tourism sector occupies. The development of tourism promotes the peaceful coexistence of countries, enhance mutual understanding between peoples, expanding socio-economic and cultural cooperation. Strategy of development of tourism in Russia is a system of evidence-based views on the nature, character and ways of development of tourism in the regions, on the requirements for the improvement of tourist infrastructure, resources, their diversity and quality.

In light of the current at the moment of the geopolitical situation in the world, the time has come when the reorientation must take place in tourist flow from the external to the internal tourism. This all-round development of domestic tourism can and should be a factor that will acquaint its people together, strengthen horizontal links between people and thus contribute to the unity of the country. And when you consider the fact that the main ideological and practical tasks in the sphere of interethnic relations is to maintain and strengthen a united and indivisible state - the Russian Federation, the role of tourism in general will be invaluable. Moreover, tourism is inseparable and can not be outside the scope of national reconciliation and peace, it can play an invaluable role in the process of establishing friendly relations between the Russian people [3].

The Russian government is taking all possible measures to promote tourism. At a meeting of the Government Presidium, which took place on 28 July 2011 chaired by Vladimir Putin, approved the federal target program «Development of domestic tourism in the Russian Federation (2011-2018)». The Program allows you to increase the competitiveness of the domestic tourism market, to create conditions for the development of tourist infrastructure, attract investment into the sector. Programe activities are also aimed at improving the efficiency of promotion of the national tourist product in the domestic and international markets, the improvement of the training system. But the most productive, the program began to work after the popular foreign destinations were closed for a number of reasons for the Russians.

Today tourism strategy defines priority directions of development of individual regions, which include the North Caucasus. The unique natural and climatic, relief, historical and socio-cultural conditions of the region determine the role and importance of tourism for the prospects for its further

social and economic development [4]. In the North Caucasus tourism cluster started the construction, by 2025 it is planned to build a network of world-class ski resorts. In the North Caucasus turklaster, which is engaged in the development of the management company JSC «Resorts of the North Caucasus», entered decyat sites. This mountain resorts «Lagonaki», «Arkhyz», «Elbrus-Bezengi», «Mamison», «Matlas», «Tsori», «Armkhi», «Veduchi», Caspian coastal cluster and spa resorts in the Stavropol region. However, the unstable economic situation in the country may prevent the realization of this ambitious project. Among other risk factors, it should be noted a low level of production and transport infrastructure in the region of the North Caucasus, a complex labor market, local administrative barriers [5].

However, analysts note that the private capital ready to invest in such capital-intensive projects mainly provided state guarantees and subsidies, they have on public-private partnership (PPP). The financial crisis of 2008 caused a debate on the paradigm of economic development and the role of government in the development of the national economy as a whole, and in its capacity to promote the formation of high-quality social infrastructure and alternative financing traditionally budgetary sectors [6]. In this regard, the role of PPPs in the development of tourism industry can not be overestimated. According to the JSC «Resorts of the North Caucasus» tourist cluster will be developed in two phases. In the first place, it will be set up in terms of growth in the development of the most promising areas «Arkhyz» in Karachay-Cherkessia, «Elbrus-Bezengi» in Kabardino-Balkaria and «Veduchi» in Chechnya. In the second phase of the project it is planned to set up a consistent development of resorts and implementation of other projects.

At a meeting of the RF Minister for the North Caucasus L.V. Kuznetsova with Russian President Vladimir Putin August 1, 2016 was set out a strategic task of development of the North Caucasus region in the near future. «Given the nature of the Caucasian Mineral Waters, our unique climate, we understand that we can be competitive both on the map Russia, and to attract more foreign tourists. At the same time we have a niche not the sea, where beach tourism, and in the first place health. We and «Elbrus» and «Arkhyz», and now we begin to «Veduchi». And the projects themselves create jobs, so it is very important that they have a large indirect effect», - said V.V. Putin L.V. Kuznetsov [7].

After starting third cableway «Elbrus-3» in the framework of the project turklaster «Elbrus-Bezengi» length of 1 thousand metres from the station «Mir» to the station «Gara-Bashi» tourists can climb to an altitude of 3780 m above sea level. Member of the Board of Directors of JSC «Resorts of the North Caucasus», Jean-Pierre Sonu says: «Elbrus - the highest point in Europe, and there is already infrastructure. It is very attractive for foreigners, because every European wants at least once in life to climb to the highest point of the continent. Therefore, we recommend building lifts as high as

possible, so that each European can rise to the height of a T-shirt on which is written, «I ride on Elbrus». I believe that we need to include this resort on a tour of the Caucasus, Elbrus visit should be for everyone it is a necessity» [8].

According to experts, the development of the tourist cluster in the North Caucasus in the medium term can help stabilize regional labor markets by increasing employment and generally make a significant contribution to the socio-economic development of the district. The key to attracting real flow of tourists should be a new and unique experience. Investors can invest in the development of the tourism cluster in the North Caucasus project about 2.2 billion rubles in 2016, which is 16% more than last year, said the JSC «Resorts of the North Caucasus» [9].

However, for Russia with its multinational and vast territory of the most important strategic objective is the development of the North Caucasus region, not only economic but also cultural component, and there may be mentioned in this context, the indirect effect of tourism development, which referred to a meeting with Russian President Vladimir Putin, the RF Minister for the North Caucasus L.V. Kuznetsov. In the KBR, with the implementation of «Elbrus-Bezengi» project, as part of the North turklaster, especially important to develop cultural tourism and ethnographic tourism. Here a crucial role is played by regional authorities: they can make it a key area for the development of regions with significant historical, cultural and natural potential.

The obvious brand of Kabardino-Balkaria is to find here the highest peak in Europe - Mount Elbrus biceps (5642 m.), which is on the border with Karachaevo-Cherkessia. The KBR is focused resort and recreational complex of federal significance. Elbrus, Chegem waterfalls, blue lakes – it is well-known brands which attract many tourists to the republic. Now ethnographic tourism development in the KBR as a separate stream, which could generate a separate flow of tourists, is inefficient. The initial task is to create display objects that could be a complement to the main types of recreation in the Kabardino-Balkaria: alpine skiing, mountaineering, treatment in sanatoriums. Kabardino-Balkaria is actively working on the development of ethnographic tourism industry. Ethnographic tourism, based on ethnographic traditions, customs, folklore and recreational potential of natural areas, can be an effective means of developing regional economies of subjects traditionally inhabited by indigenous peoples of the Russian Federation to preserve their national and cultural identity [10].

An important factor for the development of ethnographic tourism in modern Kabardino-Balkaria is a need to preserve and restore the identity of a natural landscape, and national and cultural characteristics with the use of architecture and design. To date, the country operates an ethnographic area, established in 2008, Elbrus owner of one of the local hotels on the book by Bernstein's «Architecture of the Balkar people's homes».

Among the projects to be implemented in the KBR, it should be noted tourist ethnographic complex «Zaragizh» in Cherek district. It is located at the entrance to the future location of the object of the tourism cluster «Resorts of the North Caucasus» and will be included in the road map as a place of rest. Ethnographic Complex is situated on the territory equal to 7.1 hectares. Half of this area is occupied by the lake. Also in the complex is a small hotel and 13 national houses. The decoration of buildings consistent with the proposed kitchen peoples of the republic and the world, including the Kabardian, Balkar, Abkhaz, Korean.

The investment KBR passport identifies a number of objects, which in the future will contribute to the development of cultural tourism, because in addition to recreational holidays, tourists should bring an interesting cultural program. In 2018 on the territory of camp sites and alplagerey «Bashil», «Chegem», «Valley of Narzan» assumed the organization of extreme leisure activities: mountain biking, bike tours, fishing tourism, unique hunting tours, rafting, jeep tours. The project will help to increase the capacity and area of the license, as well as the creation of modern tourist infrastructure of the complex, corresponding to the European standards, which must surely enter ethnocultural display objects.

From this point of view, and very promising are other objects specified in the investment KBR passport. Creation in 2016-2018 years tourist water-entertainment complex «Thermal cup» includes the construction of accommodation facilities for 50 beds, the VIP-zone food items, SPA-zone, Aqua-zone with thermal pools and water slides, the zone for recreation, planting and accomplishment of the object. Construction of the entertainment complex «The Big Kizilovka» in 2017 year assumes the organization of alpine skiing for beginners in walking distance from the spa facilities of the complex. The project will contribute to the quality, availability and competitiveness, provided on the KBR spa services, which will increase the number of tourists and holidaymakers in the resort «Nalchik», as well as the further development of related industries and the creation of new jobs. The project «Malkinskiy stables» 2017-2019 years it will help to promote a healthy lifestyle through the provision of various services (horse riding lessons, show jumping, dressage, fancy riding, riding and romantic walks in the park, hippotherapy, gymnastics on horseback for children from 4 to 10 years), including horse tourism [11].

The construction of tourist and recreational complexes in the area of the waterfall Gedmishh Zolsky District in 2019 year involves the construction of ethnographic and entertainment complex for active recreation with swimming pools and sports fields. The project will promote a positive image of the region as the territory of the prospective development of tourism by means of ethnographic, adventure, ecological and gastronomic tourism.

Thus, today the tourism strategy defines priority directions of development of individual regions, which include the Northern Caucasus, and in particular the KBR. The entry of «Elbrus-Bezengi» in the tourism cluster of the North Caucasus region, the presence of other promising projects will help to increase the number of tourists and holidaymakers in the KBR, as well as the further development of related industries and the creation of new jobs, which is the most favorable impact on the country's economic climate. Create a display of places for tourists to encourage the conservation of sites, for respect them. The financial infusion into the sphere of cultural tourism is not confined to the old traditions, many of which exist only in reconstruction. Especially interesting for tourists is the modern history of small nations put before the fact of globalization. Our country - a small piece of the North Caucasus, but on its territory a large number of archaeological sites, cultural heritage and natural attractions. All this creates preconditions for successful development of ethnographic tourism.

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Karachay-Balkar Legendary Tales of the Prophets

Hamid H. Malkonduev, Leila S. Gergokova, Farizat H. Guliyev (Zanukoeva)

FGBUN Institute of Humanitarian Studies of RAS KBSC

Nalchik, Russia

kbigi@mail.ru; Leylagergokova79@mail.ru; gfariza37@mail.ru

Abstract— **The article discusses the feature of existence, the narrative, composition, as well as the problem of borrowing motifs and story elements from the sacred books ("Bible" and "Koran"): Joseph Fine, Moses, Solomon, Noah, Jesus Christ, known in folklore as the legendary tales. The authors in their judgments largely based on the pre-revolutionary recording (P. Ostryakov E. Baranova), publications and materials folklorists 1970-1980.**

We consider the divergent features of some texts, especially the language, as well as a fabulous character of Christian motifs, bearing the legendary character.

Keywords— Christianity; Islam; Joseph; caravan; Pharaoh; Moses; Solomon; the prophet; the motive; the monologue; Elbrus

This topic is in the Karachai-Balkar folk prose in content and narrative features is one of the most interesting and complex phenomena, as their spatial and temporal vestiges of it absorbed both local and glubokomasshtabnye, biblical and Christian motifs, which is obviously connected with the spiritual history of the ethnic group.

The term "legendary tales" on the nature of the content is very suitable to the disclosure of his narrative features. The system elements vnutrizhanrovyh Karachay-Balkar household tales, a group of biblical prophets, texts, historical figures and sages, making a special background of folk prose. "Legends of the people sometimes come together with household tales. Famous Soviet scientist VI Chicherov referred to such legends tales, legends "[1] - wrote VP Anikin.

Exploring the structure of Russian fairy epic, the writing group reflects: "The Christian legend set forth in the form of a fairy tale, a group made up of legendary tales. Life in the form of fairy tales, they are subjected to the laws of his narrative poetic fairy "[2]. By studying the legends in the Christian stray motives, as says a famous Russian folklorist JM Sokolov [3].

Legends, the contents of which brought significant elements of fairy-tale motifs - is the story of Yusuf-faygambare (Prophet Joseph) Syulemen-faygambare (Prophet Solomon), Nuh-faygambare (Prophet Noah), Musa faygambare (Prophet Moses), Isa faygambare (prophet Jesus), which is known to be devoted and significant motives in surah "Koran."

When and how could they be and remain in people's memory? This issue is quite complicated, but requires your response. In our view, this is connected with the history of the Karachai-Balkar ethnic group. As is known, the Alans, who played a big role in the final formation of our people, adhere to the early Middle Ages, the Christian religion, as evidenced by the ruins of many churches, preserved stone crosses of great size, toponyms on the territory of modern Balkaria and Karachai.

Basically they are a short story about some episode or significant events in the life of the prophets.

The most popular in the Karachai-Balkar ethnic environment is the tale of Joseph the Beautiful. It was first published in a collection of folklore texts in 1987 [4] and again on the Karachai-Balkar language in 1999 [5].

This work we have heard and recorded in 1970-1980 in oral prose and verse, prose tradition, as well as in an author's work, what back later.

There is no doubt that the motive of this text comes from the Biblical-Quranic story elements that are wandering in the mouths of the people, in their formation fazisnom enriched with new content ', obtained the legendary fairy-tale character of the national color. Consider this work in comparative terms, variability of our texts with recordings from the mouth of folk media in 1978-1981.

Entry text is traditionally a fabulous character inherent to the composition of Karachai-Balkar folk tales, which begins: "Once upon a time one of Khan had twelve sons." Next it continues, ten sons were the first, and Yusuf and his brother Buniyamin (Viniamin) were born from the second wife of the monarch.

The narrative immediately goes to the motive of the content of a dream of Yusuf, full of mystery and mystique, he tells his father. In the dream, he circled around the sun and moon and eleven stars. Khan's father explained to the Sun and the Moon - it's his parents, and eleven stars, it was his brothers that he expects a great future and they will be obedient and dependent on him. But he warns that he did not share his dream with his brothers, because they did not forgive him.

One day, trusting the brothers, Yusuf goes with them to the mountains to graze their family herd. Noticing that his father loved him more than the other sons, brothers resolved to destroy him and thrown into a well. At this time the caravan passed by, and people are noticing it, pull out Yusup. Seeing this picture, the brothers take a small ransom and sell Yusup traders.

Khan, the father of his brothers are in advance of the bloody shirt and say that the wolf ate Yusuf. I do not believe it, my father cursed them and expresses his anger. Travelers give Yusup one of childless provincial governors, who adopts him. In this part of the composition, which we would call the exposure or the first element of the action, as the multiple of the episode takes place the script when after some time, the wife of the house owner shows their care towards the young handsome Yusup. When a woman of her acquaintances call for morality, it gives him one apple and a knife and orders as soon as enters the room Yusup, cut and eat the fruit. Blinded by its beauty, they hurt your fingers, for which she blames them, whether they would in her place, would be able to hold back his emotions ?!

Having been refused by the handsome, she convinces her husband that Yusup molested her. Believing the words of the treacherous wife, he puts him in prison. Here he unravels the dream of a close sultan that he will be released tomorrow, and he will return to his old job. And so it happens.

The second element of the action of the story of how Sultan dreaming associated with cows, a fairly well-known motif of the fate of the Prophet Joseph, where he solves the sleep of the monarch, exposes the lie woman who betrayed him, it is an approximate Khan and occupies a high position in his palace.

Interestingly the third and final element in the legend-tale - the climax, when the old man with the old woman and eleven of their sons begging, turn to for help Yusup. He recognizes them as their brothers and causes to tell you how they did in the past with him. Father and mother, he leaves the host and runs the brothers. Then they turn to him in prayer, forgive them for their past and leave with him, to which he concedes and agrees.

Ends product traditional ending for most folk tales of any genre, "Ana kërmegen Kibik, aura-Tala kërmey kalayyk" - "What we have not seen it, so let us not experience disease-leprosy."

In the language of the product meets a number of archaisms, "kuyu" - well, "zharym padchah" - Sultan (ruler) province, "kara catfish" - penny, "charlaydy" - outraged, "bale" - grass, etc.

In another version of the legend "Yusyup faygambar" - "The Prophet Joseph," which we recorded in 1979 by an elderly woman Shavaeva Maryam Hasanovna more widely and clearly presents the narrative elements of the two traditional varieties motives worthy of attention: Biblical-Quranic and later, eastern literary standards, which greatly complement each other [6].

Here, the most colorful designated composition, plot and narrative elements and fairytale motifs along the following lines: to learn about the dream of Yusuf (Joseph), a prisoner of jealousy, the brothers want to kill him, but the older ones Yahud (Judah) persuades them not to do it, and reset it the well that they make; after returning home, his father Okubo (Jacob) are in tears tell us that Yusuf ate wolf (which later proves to human language that she did not commit, and brothers lie); snakes and crocodiles do not touch it, and with the bottom of the well comes up the stone on which he sits and rests; each Yusuf, an elderly Arab dreaming and realize that a friend is in trouble and saves him; Soon he arrives from heaven Zhabrail angel (Gabriel), she brings clothes and food, and lets you know about a particular location to him of God and that he has in his life to go through many difficulties and trials, what will turn their attention to the Creator. Seeing him alive, the brothers of Yusuf sold to the merchant by the name of Malik and weep bitterly, saying goodbye to him, reproaching each other in deed; on the way he approaches the grave of his mother Rahildy where from it to pronounce full of sadness maternal monologue about the fate of his son; Yusuf, to the surprise of all, it is possible to stop a storm, clouds disperse and dissipate the hostile army, which pursues them with the purpose of robbery, (when he undressed, beauty emanating from its rays blinded the eyes of soldiers, and they fell on the ground); Soon the caravan reaches the shores of the Nile, and night to him here again arrives Zhabrail angel (Gabriel), and reports the news that at the behest of the Great God, he is now a prophet in the world and a favorite of the Most High. According to well-known events, he is in prison, and guesses Pharaoh's dream, about the occurrence of famines in Misir, for that honors the monarch of his office the Grand Vizier of the state.

Ends the text of meeting him had come from far Falstin (Palestine) on horses and donkeys millet brothers. Hiding himself from all through native Abunyamina younger brother (Benjamin), which he reveals the truth to his father sends Okubo (Jacob) his shirt, which he wore as a child. As the smell of clothes the old man finds out that his son was alive, he tells the other children to follow him in Misir.

The meeting is touching: Joseph forgives his brothers the past, and the father takes to live with him at the palace.

It is well-known motifs from sacred books. However, this work is much interspersed motives of passionate love between Yusuf and Zulaikha, not related to the biblical-Quranic tales of Joseph the Beautiful, bringing the outstanding poets of the late Middle Ages of the East of Ferdowsi, Nizami, Navoi, etc.

It is easy to notice that there is significantly dominated by fairy-tale motifs on possible events, which are expressed in the

following scene elements: Yusuf has a dream, and then falls in love with a beautiful girl named Zulaikha; in turn, Zulaikha dreamer who falls for the handsome Yusuf.

As is customary in the tradition of oriental poetry, in the tradition of powerful place given to "keriuanu" - "caravan" as a substantive art-object, which is constantly in motion, overcoming great distances in space and time.

A comparative analysis of the two texts shows their variability, where the second significant development of fairy-tale motifs, later complemented by the introduction into the story elements of oriental literature.

On this topic wrote his poem "Yusuf and Zulaikha" a master of the poetic word of the XIX century Shavaev (Abayhanov) Dauud- Haji [7], which clearly stated all the popular elements of the story of the life and fate of Joseph, supplementing them with known motives of his love with Zulaikha. In our opinion, this work holds the copyright individual bringing something which, even minor episodes that complement not only the artistic works of the imagery, where the canons of Eastern poetics of one and the same motif can be created tens and hundreds of works of different people.

The language of the poem there is a number of religious terms-Arabisms, historical place names and personal names, as well as archaisms, released today obsolete.

There are several legends legendary, fabulous nature and of the Prophets Musa (Moses), Nuh (Noah) and Issa (Issa), which are prevalent in the Karachai-Balkar oral tradition to the present. They express, in general, any one episode in the life of the prophets, and in terms of plot and narrative of the known motifs from the sacred books (the exception is the text of Moses). The artistic and stylistic the plan, these texts are not of great interest.

Tales of Nuh (Noah) encountered in several variants, where more popular is the motive that he during the global flood in the world, sailed past Mingi Tau (Elbrus), in his ship (ark), and it is supposedly not deigned to say hello to prophet. Offended for this blow his nose Noah destructional ship shared the top of the mountain in two parts, from which Elbrus, and became a two-headed. This motif is the basis of the works of eminent poets Karachay-Balkar Shavaeva (Abayhanova) Dauud Hadji "Sad thoughts" and Ismail Semenov "Assy Tau."

His original interpretation of these works of professor ZA Kuchukov results in the article "Semiotics of the two-headed Elbrus" [8], which stops at the interesting arguments famous collector of Karachai-Balkar folklore P. Ostryakova "Highlanders positively convinced that Noah's ark came to rest on Mount Elbrus. They point to the cavity between the burning peaks as a place through which was the ark, and the other more thoroughly refer to the fact that one of the

mountaineers, dates back to the summit, it was possible to find a stump, as though fashioned tree, and the stump that still kept them as a shrine "[9].

Interestingly Karachay-Balkar tale of Noah wise, cunning of his wife, who tried to seduce his students and his knowledge of the language of birds has been published in the XIX century. EZ Baranov [10]. This behavior helps to expose his wife owl who overhears her dialogue with the young priest.

Fairy-tale motifs Issa (Jesus) exist in brief, episodic narratives about any event in his life. On one of these tales of the legendary character says that one day the Prophet, being in a cave, was for a long time and you will see a big pile of gold and a number of jug.

Surprised by the prophet begins to pour into the jug pieces of metal and it is not filled. But he had to dial into the palm of several mounds of clay as instantly filled her pitcher, and then the prophet came to the conclusion that man in your life will not be sated wealth, while not be sated (covered) ground.

As published in the Karachai-Balkar language poetic text "O Prophet Jesus" [11], which again terminantnaya main role is given to the pitcher as artistic and substantive object. It tells the story of how Drinkers water flow in the river and saw the Prophet near the ancient manufacturing pitcher. The water seemed to him unpleasant, bitter.

Then he climbed a little higher from the place and again drank the water from the river. It was delicious, enjoyable. Surprised by this, the prophet appealed to God, to jar spoke and explained to him what had happened. Please Issa Almighty has been executed, and the pitcher told him in human language, that five hundred years ago, he was a man, he had the soul, lived and walked the earth, and then he died and was buried.

But the years passed, and these places are settled other people, other people. They dug my grave, taken from her clay, molded from her pitchers, they produced weapons. Later in the monologue pitcher explained that the bitter water in the river because during his life he had a heavy, unbearable and that the clay from which the pitcher prepared, absorbed in itself, a bad thing that he had in life.

A number of episodic motifs of it borrowed from various verses of "Koran" and is well accustomed to the oral archeographical story about the prophets.

As can be seen from the content of the text, here lies the philosophy of Sufism on the essence of human life on Earth and its place in the other world, which is given important place in traditional Arabic and Persian philosophy.

On the role and place of Sufism in the development of our kindred language Nogai literature Ph.D. OH. Kurmanseitova thinks as follows: "Sufism has had a significant focus on the formation of world-Nogai ... Staronogayskaya poetry XIV -

early XX centuries, formed under the influence of Sufism, should be the subject of a special study of literature, owning Arabic and Persian" [12].

After analyzing the publication of Karachai-Balkar folklore records Baranova, Ph.D. known folklorist A. Aliyev says that "a special place [in them - JM] is a legend" Cain "- a well-known biblical story of fratricide," [13]. Indeed, Cain murders his brother Abel motif, found widespread in oral religious traditions. Again, there is no doubt that the ministers of the clergy, who knew to what extent the Arabic language could express in their own language the content of "Koran", where some of the motifs became popular among the people .

In the tradition of Moses-faygambare (Moses) [14] briefly tells the story of his magic staff, had a fantastic power that the prophet could, if desired, to cause such severe flooding and storm that the water could be towns and villages Misir etc.

Both he and his tribe, leaving Misir, reached the sea, and fyrgauun (Pharaoh) gave chase to bring back his people back into slavery; a stroke of his magic staff he split the sea into two parts and that the tribe could on its bottom to move to the other side, leaving helpless the whole army of Pharaoh; he settled in a new land with his people; he was the most loved and approached from all the prophets in the world to God, and because of that he was destined to write the sacred "spudded" page.

At this motif in Karachai-Balkarian people's spiritual poetry has traditionally performed the following songs glorifying the prophets and holy books:

Allah iygendi "Zaburnu" Mussaga,
Buyurgandy "Inzhilni" Hyysaga.
Beck syuyyup tiyishli kërgendi,
Syyly "Quran" Muhammatha.
Allah has sent down "Zabur" Musa,
Requested "gospel" of Christ.
With great love has entrusted,
Noble a "Koran" Muhammad.

A very brief in its content legendary tale "Syulemen" (Solomon) was published in the Karachai-Balkar language twice - in 1996 and 1999 [15]. It retold one story elements of the wisdom of the Prophet and his knowledge of the language of animals. The sentence "The Prophet Syulemen knew the language of birds and animals," as it is the entry of text, and then said that he for one is a crow, a dove, and a wasp, each of them gave the order: a crow and pigeon - who is more beautiful in the world, and the wasp, whose meat is sweeter than most.

Raven says that her beautiful crow is no one in the world, for which he gets a burning singed by the prophet, from which blackened his tail. Golub said that the most beautiful in the world, tied Wheat Haystacks and lambs in the pen, for which the prophet wished it to be a favorite of the people, than he becomes; a wasp just wanted to put in, that the sweetest, "a

Human" meat, as the swallow bites her tongue, and she could only make a sound "Hell ..." (Chchch ...) and lost forever speechless. Seeing this, the snake missing swallow tail, after which it splits.

An elderly narrator Kuliev Shamshyudin Atabievich (1910 born) in 1980, told the following tale-the legend of Solomon [16]. "He knew and spoke a hundred languages, animals, noble beasts and birds. One day, inspecting their possessions on the shores Feyrata (Euphrates), he saw gathered tigers and lions are conspiring to destroy. But they stopped the prophet: "You and recently and brutally exterminated the lions. They are becoming smaller and smaller, and have increasingly. If you begin to destroy them, I will send against you poisonous snakes, which will bring you a lot of suffering and agony. "

Tigers listen to the words of Solomon, and peace, and so he reconciled tigers and elephants. Before that predators were aggressive, attacking the elephants, the offending noble giants.

Many legends, stories and poems, in particular, composed by representatives of the people about the founder of Islam, the prophet of Mohammed, which tells of his extraordinary childhood friendship with Zhabrailov angel (Gabriel), off to the seventh heaven and death. On them we will stop in other works.

Such, in brief topic archeographic spiritual culture in Karachai-Balkar oral literature.

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Revitalization of Ethnicity and Religious Renaissance in the Context of a Change of Civilizational Paradigms of Development of Russia and the World Community
(on the Example of the Kabardino-Balkaria)

Ruben G. Oshroev, Zarema M. Kesheva[1]
Federal State Budget Institution "Institute of Humanitarian Studies" of KBSC of the Russian Academy of Sciences
Nalchik, Russia
[1]kesheva10@gmail.com

This article analyzes the threats and risks for sustainable development of modern Kabardino-Balkaria in the light of a multidisciplinary approach to the analysis of the problems of revitalization of ethnicity and religious renaissance. It expands to the idea that in the context of globalization, as well as the lack of identification cementing space multicultural and multi-confessional Russian society attractive ideology undermines sustainable development as a consideration of the republic and the whole North Caucasus. A systematic approach to lighting the authors raised issues under article appears in the assertion that the individual issues related to the issues of revival of ethnicity and religion do not exist. They are intertwined with various aspects of political, economic, social and cultural dynamics of contemporary Russian society, as well as the geopolitical context.

Actualization of issues related to the stated theme of the local scale has become one of the consequences of overlapping of the two processes of global and regional levels [1]. With regard to regional meso-level, line 1980 -. 90s, marked by the crisis of legitimation of the Russian statehood, according to AH Hog has caused not only the passive mood of alienation from it, but also revived the alternative forms of identity - ethnic nationalism and separatism, Islamic fundamentalism and radicalism [2]. Embossed nature of these processes, given trends in the development of human civilization in which ethnicity, national ideas and national principle, that for a whole historical epoch is not only a fundamental factor in social and political life, but also the driving force, motivated thoughts, behavior of many people and peoples East and West, has become increasingly be questioned and revised in the range of «globalizers» are seen as a clear anachronism which, they say, beckons us back, almost in the cave age. The growth of globalism with its inherent negation of the nation as a traditional form of human society, and on the other hand, international terrorism, using the last but not least the slogans of pan-Islamism and nationalism, create an extremely complex and dangerous situation in the world; these forces, each in its own way, citing the need for the construction of a "new world order" or fanning ethnic and religious contradictions, threatens to involve the countries and peoples in the maelstrom of bloody international conflicts and internal strife [3].

In short, the paradox of the local socio-cultural development of society at the present stage is the existence of the opposite tendencies associated with the fact that in a globalizing world, the problem of finding the identity of the ethnic peoples increasingly acute. It revived interest in the person to their national roots. This is expressed in many different ways: by referring to the history of their ethnic group, to its traditions, customs, rituals, to the desire to create their own state; sometimes to the incitement of inter-ethnic conflicts [4]. An important factor aggravating marked processes became socio-economic situation in Russia as a whole, with its virtually paralyzed production component and the enormous disparities in the level of welfare of the population. Full or partial decline of the main branches of the local economy (agriculture, all kinds of industry, capital construction, transport, tourism), has led to dire consequences, not only purely economic, but also social. The proposal on the legal labor market ten times exceeded the demand. Took an unprecedented scale labor migration and unemployment, the direct result of which were psychological depression and despair [5].

In terms of breaking the political and ideological systems, the economic crisis, a sharp decline in living standards, the spiritual disorientation, accompanied by deterioration of social well-being, revitalization of ethnicity and religious renaissance largely determined the form and content of the transformation of social life. They have become a very important

compensatory function [6]. For decades in the coverage of issues of socio-political and social-economic, ethnic and religious dynamics in the key category includes words such as "ethnicity", «nationalism», «clan», «corruption», «identity», «apathy», «inertia», «frustration», «deprivation», «anomie», «entropy», «Islam», «fundamentalism», «Wahhabism», «Salafism».These transformations have acquired pronounced at the turn of 80th - 90th XX century. The interest in their roots (traditions, customs, ethnic history) acquired a distinct character, which was a kind of defensive reaction, or depreciation mechanism on the background of socio-political, socio-political and socio-cultural conflicts. It is quite natural and obvious that the socio-political organization, which rapidly became established on the former Soviet Union, placed in their policy documents such as the fundamental problem, which corresponded to the needs of the general population in a systemic crisis. This demands the revival of customs, traditions, language, it also needs to know more about the heroic past of their peoples, etc. Over time, against the background of a relative out of the crisis transition period, some non-governmental organizations "choked" by virtue of reducing the population needs to follow their program, while others have been eliminated with the use of administrative resources in the wake of their politicization, when their leaders apart from their core business began to use ethnicity in as a lever to achieve tactical objectives. This is coincided with the second half of the 1990-s [7].

This period falls and another round of acute identity crisis in the post-Soviet space. The fact that the ethnicity, which is the turn of the 80's - 90-ies of XX century. It has become the main source of alternative and meet the requirements for the identification of lost its appeal due to objective and subjective reasons and factors. By this time, the population of Russia has not yet attractive ideological slogans by their nature have been proposed, which would be able to fill a spiritual space as identification of the individual and the population as a whole in the direction of consolidation. The natural reaction of people was massive 'administration of a campaign "in search of themselves (identity), which is the most severe form made itself felt in the North Caucasus. The well-known expression that ethnicity and religion are interconnected like communicating vessels found their striking confirmation. In other words, in the absence of cementing identifikal space of the mass consciousness of the state ideology, in a short-term replacement of its lack of immanent constituents in the form of the revival of ethnicity and its decay, imposing a category of people began to find guidance in the identification of religion. It was promoted by a number of objective conditions and factors. This state of social deprivation and frustration generated by unfulfilled promises as a national and regional scale, and at the level of public organizations, this mass unemployment, this labor surplus, as well as increase the influence of external forces, which as a whole began to form and strengthen the mood of protest among the most diverse population groups [8].

A characteristic feature of Islamic revival in the period under review was the appearance of believing categories of the population (mostly young people), which sought to change their world, everyday life and the practice of worship according to the principles of the original, or «pure» Islam, keeping thus its essence to the outside of the ritual side as it is practiced by representatives of the "traditional" Islam. The latter, supported by SAM KBR, was accused of «young Muslims» [9] in contempt for elders, violation of people's customs and traditions.

Broke intra-conflicts, the specificity of the response to which only aggravated it. Case Study [10] as a whole on the issue of radicalization in the Kabardino-Balkaria, conducted in 2014 in the framework of implementation of social projects under the leadership of one of the authors of this article, revealed a bleak picture. The study broadened and deepened the available views on the fact that the basis of the origins, reasons, conditions and factors of extremism and terrorism in the modern Kabardino-Balkaria is a set of closely intertwined components as an identity crisis; frustration and social deprivation; trends in the transformation of people through ownership in the direction of «the poor get poorer and the rich get richer», which serves as a contributing factor in business and consumer corruption and the ineffectiveness of anti-corruption programs; the absence of cementing a fully functioning multicultural society ideology; the impact of external forces; the dominance of power methods of solving problems in the fight is not with the causes and consequences with; specificity of their information support forming in the public consciousness not only of the North Caucasus, but also in Russia as a whole such a stereotype that unfairly allows you to see in the person of the Caucasian Muslim beseeching, or simply a Caucasian with a beard, and even without a beard, a potential extremist; the absence of effective state program on youth policy; the loss of the educational system of former educational functions; a significant discrepancy between the stated objectives and the nature of their solutions in the various programs on the prevention of extremism and terrorism and countering them.

It is symptomatic that in these circumstances, apathy and inertia of the impressive mass of the Kabardino-Balkaria population supplemented by social anomie and social entropy. The latter manifested itself not just as a measure of disorder, disorder of modern society, but also as a measure of inconsistency of his adopted state target setting. One consequence was the increase of the crime situation in the society, leaving a certain part of young people in the underground. Under these conditions, exacerbated the problem of intercultural and interfaith dialogue, largely determines the specificity of the socio-political dynamics of modern Kabardino-Balkaria.

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[9] The term «young Muslims» rather arbitrary, and their beliefs were separated and the older age groups. In studies of contemporary Islam, the term is generally used to refer to supporters of fundamentalist ideology, whereas the «traditionalists» referred to the older generation of Muslims. Young Muslims in a new way began to approach to many issues of revival of Islamic traditions (so they are called «new Muslims»), criticized not correct Islam «religious» ceremonies, in particular, carrying out «deur», feeding for three days of mourning, wasteful funeral with the distribution of food packages, payment for funeral service and design nakyaha and so on. d. All of this was put to blame the older generation of believers, as well as supporting such a state DUM KBR. They picked up the main cause of the last Muslim discontent activity - the «disappearance» of the money collected in 1993 during the national telethon for the construction of the central mosque. Also condemns the use of alcoholic beverages spiritual persons. See .: Mukozhev A.H. Islam in Kabardino-Balkaria, before and after the October 2005 // Historical bulletin KBIGI. Nalchik, 2008. Vol. VII. P. 216, 217-218.

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Arbitration Tribunals in the Traditional Circassian Society

Fatima A. Ozova

Karachai-Cherkess Honorary Humanitarian Research Institute under KChR Government

Cherkessk, Russia

fo7799@rambler.ru

Abstract— **The legal procedure system shows the level and character of social medium development. In this respect it's of great interest to study the original judicial system of Circassian society. An attempt is made in the article to reveal the characteristic features of the judicial system of feudal Cherkessia.**

Keywords— *arbitration tribunal; prince cour; oath; alternative legal proceedings; witnesses; "head lawyers"*

I. INTRODUCTION

The judicial system of feudal Circassia was represented by two alternative systems - constantly acting princely so-called [h e i] and class arbitration courts [t h a 'ri u 'h a: s a], was formed out of necessity [1].The arbitration tribunals called as [t h a'r i u   'h a: s a] were separated from the direct administrative and military power of the suzerain, although they were dependant on him to some extent [2].In other respects the legal proceedings of both kinds of cases were identical and were carried out on the basis of common law called by Circassians as [a'd i g a 'h a b z a].

II. TRADITIONAL COURTS -[T H A'R I U 'H A S A]

Every village had its own regular court called [h e 'j a ʃ a]. But the litigant sides had a chance to address their complaints to the traditional arbitration tribunal [t h a 'r i u   'h a s a] if they wished so instead of appealing to the regular court [he'jaʃa]. In each of these cases the jurors [t h a'r i u 'h a s a] consisted of 'respectable old men' could be elected according to the wish of the 'opponents' [3]. All the village courts incl. [h e 'j a ʃ a] and [t h a 'r i u 'h a s a] had a right to investigate all the cases (with the exception of criminal ones) and complaints of local people [4].

It is important to note that arbitration tribunals were the most ancient kind of legal procedure in Cherkessia. The etimology of the lexeme ['h a: s a] indicates that the primary function of this institute was a judicial one. In the 19th century this lexeme continued to denote 'court' [5] or 'a judicial place' [6]. The verb [h a 's a n] means 'to administer justice' [7]. The emergence of a court in Cherkessia called ['h a s a] dates according to the legend from the archaic epoch of [n a: t s]. Having acquired a class character under feudalism the courts retained their archaic form as well as their name ['h a: s a]. ['h a: s a] or [t h a 'r i u 'h a: s a] continued to be 'extremely ritualized'[8]: all their activity was concentrated on oath ceremony. This component of the functioning traditional arbitration tribunals was emphasized by their name [t h a 'r i u 'h a: s a] - Judgement Day [5].

The beginning of differentiating between class-represented meetings   ['h a: s a] and class-represented courts [t h a 'r i u   'h a: s a] was connected with the reforms done by the grand prince ['pʃ i ʃ h u a] of Cherkessia I'nal N'ahu and his grandson the grand prince of Kabarda Beslan II Janhotov. [t h a 'r i u 'h a: s a] differed from the character of functioning of the class-represented meeting   ['h a: s a] by multiple oath ritual. In its activity ['h a: s a] used the oath ritual much less. Han Girei noted that all the cases were investigated by the court whose "laws were based sometimes on the examples and always on clear conscience" [9].The main proof of 'clear conscience' was the oath. the arbitration tribunals [t h a 'r i u   'h a: s a] represented independent judicial institutes that had special algorithm of formation and functioning. All of them were formed on the basis of oath ritual. "The process of taking the oath was very solemn and ritualized" [10]. In different periods of time of its existence taking the oath took place in accordance with the religious doctrine that predominated by Circassians. The oath was pagan during the archaic period. Then it was built on the symbiosis of an ancient pagan basis and Christian postulates and later on the Holy Koran during Islam period. A detailed description of the oath ritual was made by Lule [11]. The importance of the oath ritual in Circassian society was indicated by J. Longwort :"…Their king is an oath. The oath is their single monarch, - everything in the Caucasus is subordinated to the influence and power (morally and metaphorically) of an oath from times immemorial. It is the highest arbiter in all debates as well as the only legislator whose authority makes fulfill anything that its sanction approves. Everyone irrespective of sex or status is its subordinate. Woe be to the unfortunate perjurer who will dare to betray his loyalty to it! He together with all his associates will perish; and his relatives will die like a mangy flock of sheep; his children even after his pleading guilty and expiation of his guilt will leave him like ears of some plant struck by mould or like withered branches of a trunk; and he himself even after having been allowed to drag out a miserable existence to teach others a good lesson will live ruined and conscience-stricken as a burden of the Earth and of its parts, as an exile and a subject of general contempt" [12].

Here are institutes on which the circassian traditional arbitration tribunal was based:

The oath of judges. The elected judges were called [t h a 'r i u h a s] [13] and the jurors were called ['t h a r o 'h a s] as they were sworn in after being elected to God- [t h a] [14]. The so-called 'chief advocates' –['l i k u a] were elected from among the jurors. They played a leading role during hearing of a case. They had a mission of informing the judges about the essence of the matter [13].

A purificatory oath. A guarantee of loyalty of an accused to the oath. This 'rule' or 'a custom' got "a character of legalization from times immemorial "[15] in legal procedure by circassians. Any trial took place in a public and open way. The court could bring in a verdict of not guilty owing to the purifactory oath in absence of proofs of innocence of the accused. "The accused could acquit himself in absence of obvious evidence with the help of so-called purificatory oath" [16]. It concerned even grave crimes: the accused could acquit himself with purificatory oath provided that his purificatory oath could be supported "by two men of honest rules that were stated as his accusers but who could not be allowed to be obvious ill-wishers of the accused" [15]. "This kind of evidence was called [t a 'i r k o'ʃes], that is "guarantee of loyalty to the oath". The number of witnesses is commensurate with the importance of the action (claim) as well as with the gravity of a crime" [13].

The oath of litigant sides. It consisted in the following: the litigant sides were committed " to remain contented with the judgement to be pronounced by the court" [17]. After hearing of a case and bringing in of a verdict the litigant sides took an obligation to observe the judgement orally pronounced " irrespective of its content" according to the oath [18]. If the accused refused from the oath he could also refuse from the execution of a verdict and had a right to appeal to another court [17].

The oath taken by the witnesses to prove guilt. "In order to prove the guilt of a defendant the oath of at least two witnesses was necessary" [19]. The relatives of both of the accused and the defendant including all possible persons concerned were not allowed to take the oath. Much importancewas attached to the discussions of the sides. The advocates of the accused side were also called [w a 't ʃil]

The jury witnesses. [t h a 'r i u a ʃi 'h a t]. Institute of witnesses. "Only persons who are well-known by their honesty and good behaviour can be witnesses"[13]. The witnesses could give evidence under the oath or without it. Everything depended on the importance of the case. This institute could be used in particular when the defendant had been accused of perjury or some extremely grave crimes such as dishonoring a woman or a killing [20].The confirmation made by the jury witnesses [t h a 'r i u a ʃi 'h a t] under an oath was enough to prove that the accused was telling truth. [16].The need for that kind of jury witnesses didn't appear often during legal proceedings by Circassians as there were rare cases of perjury and "everyone cared to keep up his personal honour and dignity as well as the honour and dignity of his whole family" [16]. The sin of perjury restrained people from committing a perjury.

The oath of litigant sides before pronouncing of a judgement. At the end of legal proceedings the litigant sides took again an obligation to observe the orally passed sentence "irrespective of its content [20]. The accuser was obliged "to forget any feeling of aversion to the accused" and the accused was obliged "to implicitly subordinate to the demands of the passed sentence and not to allow himself to evade the due execution of a sentence [13].

The jury guarantors. In conclusion "in order to strengthen mutual connection of the obligations imposed on the litigant sides each claimant and each defendant has accordingly one guarantor from the jury who were responsible for the behaviour of each of them. It rarely occurs that following these measures any defendant or any convicted person will express his dissatisfaction or disagreement with the decision" [13].

III. Consequences

Traditional Circassian society had for many centuries, the original judicial system . Its main feature was the fundamental role of the oath and aiming to reach a compromise in the search for justice . Justice System are reasonably simple and effective .

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Forms of Use of Folk Stories in Modern Kabardian Novel

Hamisha T. Timizhev, Lyudmila B. Havzhokova[1]
Kabardino-Balkarian Institute of Humanitarian Researches
Nalchik, Russia
[1]lyudmila-havzhokova.86@mail.ru

Abstract— **It is well known that the novel is a versatile genre, able to reflect the reality in all its diversity. Possibility genre increases in the critical periods of the life of society. In this article, we aim to: identify the features of the development of the novel in the post-Soviet period on the basis of works very different in style and literary movement of Kabardian writers – H. Shekihachev and M. Emkuzhev. In the article as a method of research used historical and comparative analysis in the context of the all-Russian literary process in the designated period.**

Keywords— kabardian literature; contemporary literature; novel; poetics of the genre; the post-Soviet period; the conflict; psychology; folklore traditions; enlightenment; method, style

A characteristic feature of Kabardian prose of 90-ies became a kind of distraction from spiritual growth and experience of the literary hero in the context of the event-for the benefit of the description of the events themselves. From now on, the writers throw all their energies on the study of the causes that led to such serious changes in society and the fate of the country, followed by a change of historical formation, and analysis – from different perspectives – historical significance of these changes. In prose appears plot and narrative layering. Instead of a black and white palette in the descriptions of the characters in the authors introduce their works hard collisions linked to national, religious and social conflicts.

Do not forcing himself into the framework of a certain ideology, based on historical data and current analyzes, writers tend to cover previously covered the pages of history. All the authors boldly show the centuries-old process of spiritual and moral formation of the Circassians. In the works of close-up (novels, short stories) demonstrated the variety of creative approaches to the problems of historicism and psychology, and philosophy of art has changed in the direction of deepening, and the genre has acquired a new shape. The authors began to pay more attention to the development of his own style, his attainment of handwriting and language. During the reporting period, actively worked famous writers as A. Keshokov, A. Naloev, M. Karmokov, H.Havpachev, H. Shekihachev, B. Zhurtov, M. Elberd, K. Elgar, M. Gubzhev et al. It is their merit to be considered that the national prose in an era of change did not go on the path of modernity cheap and entered into a new time with its Legacy traditions.

On one of the features of the prose of this period – a return to the ethnic and cultural formation, in particular, to the ancient customs of the people, and their interpretation according to the canons of contemporary realities will be discussed in this article. Remnants of the past again become a hot topic for the great novels, seen the light in the study period, "Revenge" of Hamisha Shekihachev [1], "Night of Kadar, or who is right" of Mohamed Emkuzhev [2].

We can not say that this topic is new to the Adyghe (Adygea, Kabardian, Circassian, Circassian foreign) literature (drama of A. Midhat "Adyghe nobles" and K. Ahmatukov;s "Heavy duty", the story of A. Keshev "Abreks", novels and stories of T . Kerashev "Abrek", "The Last shot," "Lone rider" and others.). However, the works of these authors distinguish different level of relationship to the folk traditions and the depth of the psychological structure of the authenticity of images. Both novels have in common, and even put in their basis folk stories. In the first case it is a legend and heroic exploits Esenoko song about brothers, in the second - Circassian traditions about tumbleweeds. And that is not all. More significant storylines folk - real events, experienced and tested Circassians. This raises two novel on historical level.

Unlike the novel of H. Shekihachev, M. Emkuzhev's product is not associated with a particular historical figure, because here more clearly the voices and thoughts of the author, his own approach to the issues and values that for centuries accompanied the Circassians. However, he remains our contemporary, aimed at the main landmarks in the world culture and human values. The style of the novel is complex, it is a kind of "story in history". His reading of many may seem too difficult. It seems that the book contains all the "hunting stories" about the practice of vendetta among all the peoples of the Caucasus. However, the product is undoubtedly calls for reflection.

Multi-layer narrative of the tragic events of the mouth of the author leads to the conclusion that evil is always punished. Against this truth powerless and time, and nature itself, otherwise, why would tumbleweed field aimlessly roam around the world? As already mentioned, the author comes to his narrative modern standards, thus becoming a link between distant times and the present day. He advised us, makes it

clear: no new time or improvement of living conditions could not change a man, and still among us full of evil, envious, greedy, selfish, dishonest.

The characters of the novel "Night of Kadar, or who is right" persecuted the weight of their sins, and they roam in eternal search of redemption. But it is very difficult to find the redemption of man, loyal friend who has committed a crime of jealousy, abandoning his old, who replaced him as a parent. No, this is a heavy burden, not only does not become easier, but only burdened with the passage of time, comparing and linking into a whole eyeballs and isolation of the novel.

One of the main characters in the novel – Hasansh – kidnapped brigands-slavers. He had almost a child, but on the way talks are not a child, "I'm not the first, the last, too, probably, will not be me. The only pity is the mother ... It's a shame you do not understand how sad that I leave home without knowing the name of my father's killer. Here's how can I! Not lucky, and only "[2:47]. In the novel, a young man unable to carry out his cherished plan, but, alas, it does not bring peace, because evil entails new evil. As follows from the narrative, not everything in life is solved by the principle of "an eye for an eye". On the contrary, this path to nowhere – a straight road to disaster, endless mourning, to new bloodshed, to the self-destruction of the people.

This opposition is so ingrained in people's minds that they seem familiar and natural, hatred prevails over common sense, and anyone who thought himself wronged should in no matter what was to repay in blood for blood.

Obsessed with vengeance and another hero - Murat, he does not know the word "sorry" to ever since, until he has accomplished an act of retaliation. But one has to wake up sooner or later, come to their senses, or else there would be no life forward. Adyge has never been inherent bloodlust, cowardice, revelries, although at times they strayed in the fog of ignorance and troubled times. But it is certainly clean, straighten, because it was never deprived of his compassion and forgiveness. He would overcome his circumstances and imposed cruel and unnecessary shackles customs like vendetta. This author is trying to convince us in the closing lines of the novel, which, in fact, lies and the main idea of the work: "The last physical sensation due to the fact that someone fumbles on his feet, body, awkward unleashes it hosts and before the soul, freed, soared, Murat had noticed that the man was not sighted and that the right ear of his triangle incised on ..." [2: 180].

But the drama of the scene in another. Spent their wounded Murat thereby was a boy, whom he had once inflicted a cruel insult, killed before his eyes of his parents as a sign of a blood feud. On that day, the boy bravely blocked the path of the murderer, his piercing gaze, and said to him, looking in his face, that to avenge the murder of their parents, if he stays alive. In response, Murat put out both eyes of a child and notched ear, saying, "Let's see what you can do." Now the

villain with a deadly wound, connected to the road and throw as brutally as he did with others, took pity on him only the blind youth, in which compassion prevailed over revenge. So, Tha (God) "has shown what he can do ..." [2: 161].

Only in the last moments of his life hero he repented of their deeds. But after the suffering he had to go for it: "... between what happened yesterday and what we have today, was a huge abyss - its terrible reality – looked into it, he was shocked: he was really there ?! And what great power is then a simple feeling - sorry if picked it out!" [2: 180]

Novel of Mohamed Emkuzhev "Night of Kadar, or who is right", in comparison with the novel of Hamisha Shekihachev "Revenge", more emotionally saturated. Yes, work is replete with complicated events and descriptions of violence, and yet it gives food for thought, and most importantly, assures the undoubted value of human life. The novel is written in Russian, but Adygian ethnic group affiliation of the author shines through in every sentence, in his manner of thinking and worldview. M. Emkuzhev is one of the best prose writers who have managed to penetrate into the very essence of adygian in order thoughts and feelings of Adygea in its joys and sorrows. For these parameters we distinguish this author in a number of other talented Russian writers, published his works during this period (A. Pshigusov, A. Kushhaunov, V. Vorokov, J. Koshubaev, M. Hakuasheva, S. Alhasova et al.).

At the heart of the novel "Revenge" of H. Shekihachev also are historical trends, reports to have oral folk art. Research historians say that in the Middle Ages a distinction Kabardian society along class lines than anywhere else observed strictly. And all the events in the novel of H. Shekihachev tied to these two layers - masters and slaves. According to written information of travelers and scholars who in past centuries often undertook trips to Circassia is for research purposes, as well as the preserved archival documents can judge what unlimited power and reverence enjoyed princes and nobles. At the same time they are fully lay the responsibility for the security, safety, well-being of their wards. Such noble people of the upper class people compose songs and legends that have survived. But there were other person whose greed have become sources of misery and suffering for all the people. Their names are also the people "immortalized" in folklore samples. The crime of one of them – Daguzha Kuytsukoko - was the beginning of the narrative in the novel. As the length of time the author has chosen a time when to replace the rule of power and strength began to come mind and knowledge, in other words, when the feudal relations began to fade, giving way to a new trend of the era of the need to unite and create a unified state Circassians.

Unification ethnicity strongly prevented such negative figures as Kuytsukoko. The essence of this anti-hero author reveals in the beginning. "During these five words "Circassians have to create a united state" – I ruined a lot of souls. What power, what kind of state? Who needs it? Beggars, loafers and cowards, that's who! Yes, they are not one -

hundred states have created, they remain the same poor. And why do I mess with this general power? The place where I live - this is my power! From now and until now mine, and taste, touch, at once arm compartment. You do not want to lay down his head, and after hand - Do not tie your goat to my wattle fence!" [1:42].

This narrow-minded gentlemen bear to see next to a people with progressive views. They are doing their best to humiliate them, build them, the machinations against. Thus was born the conflict of the novel. However, the main idea of the work is based on the process of the birth of the struggle for the equality of people, for freedom and human dignity of working people. The author managed to bring it up to the reader a skilful combination of artistic techniques with historical authenticity. The class struggle is depicted in the destinies of several generations of birth. First of all, this kind of Eshanoko – Kubatyi grandfather, his son and grandchildren Ozermes, Atabyi and Temirkan.

For the author there is no need to invent an artistic conflict, it came to him ready-made from the very existence of the Circassians. The theme of inequality, moreover, the cultivation of this inequality as a necessary condition for the existence of society, appears to the reader from the first pages of the novel. Impunity doeth evil Kuytsukoko Daguzh taking all possible attempts to humiliate an honest worker and good man Kubatyi Eshanoko. "It is not the first time an animal reproaches me with my low origin, – says Kubatyi. – Nothing wrong with him, I did not say why he feels my patience? Two years ago, he tried to humiliate me in front of people, so we just grabbed their swords. If you try again - then either me or him ..." [1:46]. And when the day of reckoning has come yet, nobility is not allowed Kubatyi kill the defeated enemy, and he escaped injury. However, it is lurking in his heart a thirst for revenge. Kubat died, leaving two sons orphans, Ataba and thirteen teenager Karash.

As if waiting for the long-awaited denouement came from Psizh (Kuban River) in Dzhilyahstaney Kuytsukoko, and declared: "... I have come for your blood debt. Kubat Eshanoko carried him to the grave "[1:48]. Like the dog, attacking stealthily, it appeared suddenly, grabbed the boy and rode away. Forgetting about how he himself once spared and left alive, he mercilessly killed the child and disappeared. Vowing revenge, the road is now embarking Atabyi, and along the way he falls many tests.

Like M. Emkuzhev, Shekihachev skillfully uses in the novel method of "story within a story." Within the narrative as if by itself being born a new story, and the reader learns in the course of other stories, like having an independent meaning, in fact, recognized tell something more out of life, customs, entertaining events. Writer whenever keen to stress that the courage and humanity, courage and compassion are inseparably linked. This invaluable lesson handed down at the end of the novel "Night of Kadar", and in the Shekihachev's novel he

repeated in every action, most of all - in the form of Atabyi and his actions, although other characters to some extent are the bearers of this truth.

If an author puts his hero before a test of courage and character, it means that there are forces opposing him. It supports evil, they are ruthless and cunning. They begin to understand that their time is running out, they are replaced by new people, and their superior strength and intelligence, and high morals. The future scares them, and they are trying by all means to postpone his offensive. An example of this is extremely unpleasant character – Elbazduko Murtazov. The man without honor and conscience plotting against Ataba and even plotting to kill him. But Atabyi wins, and his victory marks the cut-off ear opponent. Bloodlust at Martazova passes with death Atabyi up ever since, has not yet killed his sons – Ozermes and Temirkan. Brothers death scene described in the novel is very naturalistic. The pursuers trap them in the open field, that they ended up in pre-dug pit, and severely crack down on them. On the tragedy of the people we laid the song, whose words and the novel ends.

Pointless in its cruelty, the custom of blood vengeance working on self-destruction of the people was a pain in the hearts of progressive people. This idea was the writer expresses the words of one of the characters: "Look, in whom we have become. There is no peace and quiet between us, brother against brother, son against father ... In the meantime came to strip our lands, steal our cattle. We have come together as the sons of the same father, and fight to the death against the enemy, so no, exterminate themselves. To the benefit that leads to degeneration of the people?"[1: 184].

These words –- the main idea and credo of the author: to serve self-preservation of the people, to work for the sake of it. In the novel, written a lot of images of these key supporters of the idea of every nation – love of country, and high morals. And the author does not hide that it is these characters it is most like. H. Shekihachev gives the best moral qualities Eshanoko family, her older and younger generations. Along with excessive fearlessness, they are the most difficult situations preserve the dignity, purity of heart, humanity and true adygian. The reason for this – the ability to put mind over weapons. And this truth is spoken out loud one of the characters, Atabyi's friend – Aiteke: "Does not the arms deal? In addition, in whom there was so much courage and education, should be as much beautiful thoughts. Tragically, there was no one to pass them ... Whatever you may say, life does not have to wait for a gift in the form of sympathy. As you yourself to life, and it is to you. Since it is not immediately sword, not by force get over ... And if anyone wants to get his happiness with the sword, then what would happen?.. I think people should be smaller swinging blade. Let plowing, sowing, children grow. Much more important is the fact that our lives will move forward, will improve it" [1: 186]. As you can see, in the "Revenge" of H. Shekihachev displays the same basic idea of the highest human values, as in the

novels of the period studied – "Night of Kadar" of M. Emkuzhev, "Bear claws» of S. Mafedzev, "Song of the waterfall" of A. Tuarshev, "Farewell forgive" of V. Vorokov.

Artistic method of a writer brings to our consciousness is nothing but a philosophy of life. Devoting himself to journalism, he, however, does not contribute to their journalistic works of art, which is often the case with members of the profession. Purpose of his characters – to represent the position of the author. Thus, he fully recovers aspirations of the people, they zipped through the centuries, but was never implemented. The main thing in a series of dashed hopes, – the union ethos. Far-reaching dreams and aspirations of your favorite heroes of H. Shekihachev. Atabyi talks about the fate and actions of famous people who have dedicated their life to the unification of the Adyghe tribes, and the reasons that prevented this. Hero remembers the oft-repeated words of the people: "Let us return the Almighty times Inal" – the legendary Prince Inal light, which surpasses his life put the good of the people and thereby preserved the native land. Another hero of this galaxy - "Prince of Princes" Aslanbek Ketuko. Wise was ... how many times he came all Circassia far and wide, all the people said, admonished that no worried each of their welfare, and thought of his native land integrity. Far away he looked, but what do you do if one sees the world from end to end, and the other - within his fence. "The day will come, - said the prince - when Circassians realized it, remember science Inal and equal to them of the princes, but do not be too late? Is near the elbow and try to get it! God does not give us this day when we will bite your elbows "[1: 109]!. These truths the author leads the reader, urging to keep to yourself learning from the past, like a piece of bread for the journey.

Another undoubted value "Revenge" novel – education. Skillful recreating paintings Circassians living in the Middle Ages, with all the attributes of work and life, features of the home environment, traditions and turns of speech. The reader can not help but be interested in the colorful descriptions of events, where visibly felt the spirit of the people, with its folklore, customs, fiery dances and merrymaking. Thus, the stored episodes devoted Adyg armored warrior and his horse rite patient distraction, the ancient wedding ceremony, unique toast, allegory, and more. The author was able not only to insert the picture into the text in the form of applications and harmoniously weave them into a narrative.

We should also mention the author's approach to the events described. He did not just take them from life, and links the scenes from the distant past to the present day, making their comparisons and presents the reader in the form of homework, from which, however, everyone should draw their own conclusions. Thoughts contemporary strong roots tied to the life by ethnic group. All these features enhance the value of the product and give it a right to be considered a significant contribution to the national prose.

As you can see, and H. Shekihachev, and M. Emkuzhev boldly embracing new approaches to old problems. In the examples of the past bitter lessons each of them tries to reveal their methods and to answer the most difficult questions facing today - in the era of understanding deficit, compassion and forgiveness – to mankind. These novels were the beginning of the liberation of the Kabardino-Circassian prose of ideological dogmas and built on them conflict – she turns to the universal, life topics. There has been a clear departure from the formalism, "literature turned to face the real life of Adyge to his inner experience of spiritual life" [3: 156]. Multiform become artistic techniques used by our writers, especially in a romantic and lyrical prose novels like "Revenge" and "The Night of Kadar" the author's voice in the works acquired a hardness, an independent sound. It is increasingly heard in the dialogues of characters in the lyrical digressions, sometimes reduced to moralizing. Images of the characters and their surroundings do not suffer understatement, they have become more open to the reader, and it is - the main feature of the national novel 90-ies of XX century.

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The Modifying Features the Tsvetooboznachayushchikh of Adjectives in Turkic Languages

Makhti Z. Ulakov[1], Lyudmila H. Makhiyeva[2], Boris A. Musukov[2]

Kabaradino-Balkarsky Institute of Humanitarian Researches

Nalchik, Russia

[1] maxtti@mail.ru, [2] kbigi@mail.ru

Abstract— **Article is devoted to polyaspect research of formal and semantic features of adjectives of the main and ottenochny tsvetooboznacheniye of Turkic languages in the positive and comparative degrees participating as in primary nomination, and further morphological and their lexico-semantic development, education free and the leksikalizovannykh and also terminological phrases. In work both full, and elliptirovanny forms of the modifying affixes are investigated, features of phonomorphological transformations are analyzed, the role of a metaphor and verbal associations in creation of various segments of lingvotsvetovy space is shown. In article the generating features of descriptive adjectives as the transpositional units participating in formation of phraseological units and the paremicheskikh of designs are considered.**

Keywords— degrees of comparison; weakening of a sign; affix of diminutive degree; postpositional elements; tsvetooboznachayushchy bases; physiographic appelyativa

In Karachaevo - the Balkar language, as well as in other languages, four degrees of comparison of adjectives function. Positive degree has no special indicators and signs of comparison, is an initial form for formation of other degrees of comparison. Also others treat such adjectives tsvetooboznachayushchy bases like акъ 'white', a kjara 'black', къызыл 'red', Sara 'yellow' as well. Distinctive lexico-semantic feature of these words is that they designate something independent of what relations and communications exist with other phenomena of reality, that is it is impossible to explain why these words are called so, but not in a different way. In positive degree "color" adjectives call quality of objects irrespective of qualities of other objects, without comparing this subject to others of degree of this quality. By means of degrees of comparison of adjectives as distinction in the potential of the same sign which is shown in various objects with various saturation is shown grammatical category. As N. K. Dmitriyev noted, degrees of comparison in Turkic languages "... did not develop in one standard scheme, in one general normalized paradigm yet. They, as usual happens in young people and recently created literary languages, store on themselves traces of that variety and the facultative use which so characteristic of dialects" [1].

Let's take for example Karachaevo - the Balkar derivative word жашилсыман with greenish value [2], zhashit the

expressing weakening of the sign put in the motivating basis 'green' and formed by means of an affix of diminutive degree - сыман. This affix is used as a regionalism only in the Karachay Karachaevo option - the Balkar language, is loan in Balkar option: жашилсыман 'greenish' – it is weaker, than 'green' and, the use of greenish value, emphasizes manifestation of the weakened quality. The positive degree which is initially put in lexico-semantic structure of the word zhashit 'green' and diminutive in lexico-semantic structure of the word жашилсыман 'greenish', in a paradigm of values make each other binary opposition, that is distinction in the potential of quality is available here.

In Turkic languages, the synthetic and analytical forms of comparison proceeding from one standard degree of quality called in grammatical science by positive degree differ.

Manifestation of quality is considered from the point of view of logic, and from the point of view of grammar is an initial and main form of an adjective from which all other forms by means of special affixes are formed. Positive degree is characterized by lack of morphological indicators. Also tsvetooboznachayushchy words are among similar bases: къызыл 'red', Sara 'yellow', акъ 'white', kjara 'black' and others [3].

In Turkic languages in general two types of comparison differ: 1) concrete where comparison of quality comes to light as a result of comparison of objects; 2) abstract where comparison of quality is not connected with comparison of objects, and it is connected with processes of word formation by means of various postpositional elements. In grammars of Turkic languages only the first type belongs to degrees of comparison of adjectives, and the second - is considered in the section of word formation. The abstract type of comparison, according to N. K. Dmitriyev, is included by two forms: form of easing of quality and form of strengthening of quality [4]. The form of easing of quality is expressed by means of synthetic means, at the same time analytical forms do not meet.

To number of the adjectives of an ottenochny tsvetooboznacheniye expressing incompleteness of quality, weakening of the sign concluded in a subject of a derivative

basis the adjectives formed on model a tsvetooboznachayushchy adjective + an affix - сыман, for example, акъсыман 'whitish, whitish' belong [5]. These bases are not combined with adjectives of the main tsvetooboznacheniye and therefore do not participate in creation of motley segments of lingvotsvetovy space; being combined with an accessory affix - лыкъ, forms a noun акъсыманлыкъ with abstract whitishness value. The derivative tsvetooboznachayushchy adjectives designating a quality easing form, being combined with nominal bases, participate in formation of attributive phrases. The adjective of an ottenochny tsvetooboznacheniye акъсыл 'whitish, whitish' gains further morphological development by means of an easing affix - сыман and keeps connotive values of an ottenochny tsvetooboznacheniye, concluded in the making word, for example, акъсыл 'whitish, whitish' + сыман = акъсылсыман 'whitish, whitish'. Does not take part in further word formation of an adjective, however, being combined with nouns, forms free phrases. The fact that the derivative basis duplicates value of the making basis acts as the certificate that the affix - сыман is form-building.

Adjectives of an ottenochny tsvetooboznacheniye къарасыман 'blackish, darkish'; къызылсыман 'reddish'; кёксыман '1) 'bluish', 2) 'bluish, 3) 'glaucescent', 4) 'grayish', 5) 'greenish'; жашилсыман 'greenish'; сарысыман 'yellowish'; морсыман 'brownish' were formed from the making bases — adjectives of the main tsvetooboznacheniye of a kjar 'black', къызыл 'red', кёк '1) 'blue', 2) 'blue, 3) 'gray', 4) 'gray', 5) 'green'; zhashit 'green'; Sara 'yellow', a pestilence 'brown' by means of an affix - сыман, the quality easing expressing a form. These adjectives as lexemes of an ottenochny tsvetooboznacheniye are not combined with adjectives of the main tsvetooboznacheniye, do not participate in word-formation processes.

Morphological feature of adjectives of an ottenochny tsvetooboznacheniye in the Turkic languages expressing a quality easing form is that they form system of the integrating elements of Turkic languages and participate in separate word-formation processes by means of all-Turkic affixal morphemes on occasional model.

Their integrating units formed on model a tsvetooboznachayushchy adjective + an affix of comparative degree - ракъ//-the rivers, - ыракъ//-ирек, - уракъ//-юрек, for example, акъ 'white' + - ыракъ = агъыракъ 'whitish' belong to number of adjectives of an ottenochny tsvetooboznacheniye in the Turkic languages expressing a quality easing form (to. - балк.) ; a kjara 'black' + - ракъ = къараракъ 'darkish'; къызыл 'red' + - ыракъ = къызылыракъ 'reddish'; Sara 'yellow' + - ракъ = сарыракъ 'yellowish'; кёк: 1) 'blue', 2) 'blue'; 3) 'gray', 4) 'gray'; 5) 'green' + - юрек = кёгюрек: 1) 'bluish', 2) 'bluish'; 3) 'glaucescent', 4) 'grayish'; 5) 'greenish'; zhashit 'green' + - ирек = жашилирек 'greenish'; a pestilence 'brown' + - уракъ = моруракъ 'brownish'. In derivative bases агъыракъ and кёгюрек phonomorphological transformations are noted: at

formation of a form of comparative degree in an intervocal position on a joint of a root and an affix къ> гъ there is also an ozvoncheniye of a concordant phoneme. Also adjectives of an ottenochny tsvetooboznacheniye, for example, акъсыл 'whitish, whitish' + - ыракъ = акъсылыракъ 'whitish' can serve as the making bases for formation of forms of comparative degree; кёксюл: 1) 'bluish', 2) 'bluish', 3) 'glaucescent', 4) 'grayish', 5) 'greenish' + - юрек = кёксюлюрек: 1) 'bluish', 2) 'bluish'; 3) 'glaucescent', 4) 'grayish'; 5) 'greenish'; къызгъыл 'reddish'; 'pinkish + - ыракъ = къызгъылыракъ 'reddish'; 'pinkish'; саргъыл 'yellowish'; саргъылыракъ 'yellowish' + - ыракъ = саргъылыракъ 'yellowish'; моргъул 'brownish' + - уракъ = моргъулуракъ 'brownish'; akjsyldy 'whitish' + - ыракъ = акъсылдымыракъ 'whitish'; кёксюлдюм: 1) 'bluish', 2) 'bluish'; 3) 'glaucescent', 4) 'grayish'; 5) 'greenish' + - юрек: 1) 'bluish', 2) 'bluish; 3) 'glaucescent', 4) 'grayish'; 5) 'greenish'; kjyzgjyldy 'reddish'; 'pinkish' [6] + - yrak-къызгъылдымыракъ 'reddish'; 'pinkish'; sargjyldy 'yellowish' [7] + - yrak-саргъылдымыракъ 'yellowish'; моргъулдум 'brownish' + - уракъ = моргъулдумуракъ 'brownish'.

The affix - cancer together with phonetic options in Turkic languages is the quantitative modifier of major importance. The direction of this modification can be absolutely opposite, that is in one cases - ракъ strengthens the basic concept, in others as in Turkmen, weakens the main quality of an adjective. In Tatar there is a double position: one consider - ракъ as the strengthening component, others — weakening [8].

In "Grammar of Karachaevo - the Balkar language" is indicated 1976 that comparative degree is formed by means of an affix - ракъ and its phonetic options [9] and that it designates distinction in quantitative expression of a sign of one subject in comparison with another: къараракъ 'black', 'blackish' from the word of a kjar. Further it is noted that "the affix - ракъ expresses: 1) incomplete measure quality: сыйдамыракъ 'gladkovaty', къараракъ 'blackish' etc.; 2) points to reduction or insignificant increase or prevalence of quality: Seong Mengden of a zhashyrakjs 'You is younger than me'; 3) this affix expresses incompleteness of quality in adverbs: Ol Senden теркирек keld 'He came rather you'.

The affix - ракъ is an indicator of diminutive degree of adjectives and serves for expression слабопроявляющегося quality or a sign without its comparison with the same quality in other objects: агъыракъ 'whitish' [10].

The most common among adjectives of Karachaevo - Balkar and other Turkic languages are the adjectives acting in positive degree and participating in education as free, and the leksikalizovannykh of phrases, and also various terminological designs: cf. according to V. V. Radlov in dzhagataysky book language of joint stock company баш letters. 'the white head', pyrene. 'the Egyptian millet' [11]; in Karachaevo - the Balkar language of a kjar of a container 'black millet'.

The phrase акъ a container the 'white millet' used in separate Turkic languages in Karachaevo - the Balkar language does not meet. The phrase of a kjar of a container 'black millet' is used in Karachaevo - the Balkar language as the ethnographic term, for example, as in Ana's proposal of a yryskhysa of a kjar тарыдан yes кёпдю. 'It has riches more black millet'.

The word of charm in Kyrgyz in the third value 'shredded fried grain soup (wheat or barley, seasoned with milk, fat, and also without seasoning)' participates in formation of the tsvetooboznachayushchy phrase a penalty of charm of letters. 'black soup', pyrene. 'soup without seasoning' as a part of which the component a penalty 'black' in positive degree is used [12].

Both in Turkic languages, and in Mongolian for designation of yellow segments of lingvotsvetovy space Sara's word 'yellow' and its phonetic option a sphere of II with yellow value is used. The word a sphere in Mongolian is combined with the word of a buda with 'millet, millet' value and the sphere of a buda 'yellow millet' forms the free phrase [13].

In the Kyrgyz adverb and dzhagataysky book language according to V. V. Radlov's dictionary the ethnographic term omau/odau in 'white new yurta of the groom' value, for example by joint stock company omau id [14] is used.

In many Turkic-speaking regions, in particular in in what are engaged in cultivation of sheep and production of felt products of various coloring the terms connected with wool processing are used. The main natural coloring of wool are white and black and therefore such tsvetooboznachayushchy terms, as in Karachaevo - the Balkar language meet: акъ кийиз 'white felt', kjara кийиз 'black felt'. On the other hand, there are also artificial dyes with which use felt products of these coloring with the corresponding names turn out, for example, just as in Karachaevo - the Balkar language: кёк кийиз 'gray felt', Sara Kiyiz 'yellow felt'. Cut out patterns from these separately painted cloths and put on monophonic felt products of a natural coloring. Phrases акъ кийиз and a kjara кийиз make binary color opposition.

If in Karachaevo - the Balkar language for formation of free phrases the making basis къуш 'eagle' is in some cases used, then in a historical and linguistic source of Kumadgu-Bilig [15] is marked out the obligatory use of this lexeme with a color component a penalty 'black' in leksikalizovannny value as in the offer кōккä сÿрдÿ a penalty a jackpot полуп 'it rose to the blue sky as an eagle...']. In Karachaevo - Balkar language in the fairy tale "Kjarakush" the free phrase къаракъуш in 'mighty eagle' value is used: 1) on the one hand, as an appellative and 2) with another – as a proper name.

In Karachaevo - the Balkar language the tsvetooboznachayushchy phrase of a kjar халкъ in figurative sense 'the simple, working people' was historically used. The same phrase in the same value can be found in Kumadgu-Bilig,

for example, as in the offer одунлук, äбäклiк janik корғулÿк — a kyly□a penalty ол jyrak mur кулук! 'the debauchery, haste and timidity, is character of the simple people, you be farther from them, about (God's) slave!'.

In Kutadgu-Bilig it is also possible to note people value, for example, in the offer älгä-jass's penalty курыдур пажын — mili cöcмä jacca ожадур mizhin 'who opens before the people, dries the head, who speaks language, hurts the teeth'. People value is expressed in the phrase äl penalty. In some Turkic languages this value consists in the separate word the ulus which on the other hand, being combined with the word a penalty 'black', gives the tsvetooboznachayushchy phrase a penalty the ulus 'the black people' [16].

Some free phrases in positive degree meet the use of "color" components also in Ц/З a dialect of Karachaevo - the Balkar language, for example, of a kjar of kjyfets "black plum, prunes" [17].

In "Samples of national literature of Turkic tribes" of V. V. Radlov as a part of a simple sentence at the same time meet two the tsvetooboznachayushchikh of the adjectives unveiling lingvotsvetovy features of a surface of physiographic objects from the different parties, for example, the joint stock company таскылнын an ozarynda сарыг chaza чадыр 'on that side of the white mountain lies the yellow plain' [18].

In designation of color of horses in Turkic languages tsvetooboznachayushchy adjectives in positive degree are also used. Distinctive feature of their functioning is that if in one languages phrases like акъ ат 'a horse of white color', a kjara ат 'a horse of black color' are used, then in others for designation of white color or dark color emim 'white horse' and a penalty боз are used by emim 'black horse' according to the phrase of joint stock company боз. Combinations акъ and боз, a kjara and боз in Karachaevo - the Balkar language, unlike noted languages, give respectively light-ashy, light gray, dark-ashy and dark gray coloring.

The word Coba "pale yellow" in Tatar, besides designation of color of pets, on the other hand, in a syntagmatic environment participates in designation the ottenochnykh of segments of lingvotsvetovy space: Coba Kyzyl of "murugiya" (color of a horse); Coba rounds "kaury" (color of a horse) [19].

In V. V. Radlov's dictionary names of colors of horses depending on color of their wool, for example, by joint stock company боз ат 'a light gray horse' are also noted (kir.), кŏк боз ат 'a dark gray horse', Kyzyl боз ат 'a dun horse' (osm.), боз кыр ат 'a bay horse' (osm.) [20]. In materials of drevnetyurksky writing tsvetooboznachayushchy names of color of horses, for example, for example, boz by at 'horse of gray colour' [21] are also used.

The light gray coloring, both natural, and artificial is a result of mixing white and black flowers, drawn more towards

a white ratsvetka. Also emergence of the white rasvetka gravitating to gray is result of such mixture: Bir-birde акъ - боз a bulutla to an ustukku-ustukk болуп, жаз basha кёчгюнчю a kjanatlylacha, eln of a basha of a bl to a yotedila 'Sometimes the light gray clouds segmented as spring migratory birds, float over the village'. If the word боз has at the same time two real values: 1) gray; 2) light-ashy, that its use in a combination to the word ат 'horse' has one value, for example, боз ат 'a gray (gray) horse'. The phrase ak-boz ат has one value 'light gray horse' (that is the gray coloring gravitating to white). The following occurs among the natural combined coloring at color of horses of Karachays and Balkars: kjara-boz ат 'a dark gray horse', kjara-burul ат 'a dark-roan horse', kjara-kjolan ат 'a dark-brown horse', kjara-kjongur ат 'a dark-brown horse', kjara-kjuba ат 'a dark and bay horse', kjara-pestilence ат 'a dark brown horse'. Cf. къызыл ат 'a red, kaury horse', Sara At 'a red horse', Torahs ат (балк.) 'a red-brown or reddish and red horse with a black mane and tail', Torah ат (карач.) 'a bay horse', Torah жарыкъ ат 'a savrasy, light-bay horse' (карач.), Torah къан ат 'a bright bay horse'. In Karachaevo - Balkar language occurs among names of astronomical objects the Torah айгъыр — asters. the name of the star entering Small Medveditsa (карач.), Torahs айгъыр 'A bay stallion' (балк).

The tsvetooboznachayushchy adjectives in positive degree forming free phrases terms, Sara айгъыр 'A red stallion', Kjara айгъыр 'A black stallion' also occur among names of heavenly bodies in Karachaevo - the Balkar language.

Among names of stars from constellation of the Big Dipper (Zhetegeyle) various tsvetooboznachayushchy phrases of type are also noted: Акъ айгъыр 'A white stallion', Kjolan айгъыр 'A spotty stallion', Kjyzyl айгъыр 'A red stallion' [22].

Akjbozat — asters occurs among names of astronomical objects in Karachaevo - the Balkar language in language of a hunting calendar. the name of the star entering Small Medveditsa.

In mythology of the Turkic people since ancient times historically there is a thought according to which the earth is based on Sara of öкуз upon a yellow bull [23]. In "Samples of national literature the tyurksikh of tribes" according to V. V. Radlov meets the tsvetooboznachayushchy phrase designating color of one of pets in Kyrgyz in the following offer шäшäмдa öгуз of bars to eknän son берäін 'is scarlet my mother has a motley bull, I will bring him' [24].

Thus, the tsvetooboznachayushchikh of adjectives of Turkic languages in positive and comparative degrees is universal formal and semantic feature of the use the fact that with their help are designated as the main, and ottenochny segments of lingvotsvetovy space, are formed free, leksikalizovanny and terminological phrases. Combinations of adjectives of the main and ottenochny tsvetooboznacheny revealing the principle of the semantic rapprochement caused by a nomination sign it is reflected in designation of colors of horses, heavenly bodies.

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Analysis of the Main Outlines of the Problem of Narcotism in Modern Society

Aminat D. Vislova

Kabardino-Balkarian Institute of Humanitarian Researches

Nalchik, Russia

avislova@mail.ru

Abstract— The article is devoted to an actual problem of drug addiction. Presents the statistical data and attempts to uncover the major trends of drug use in the population. Raise issues, reflecting the scale of drug trafficking and its impact on the global economy. The analysis of the drug situation in Russia and Kabardino-Balkaria Republic. Particular attention has been paid to the issue of escalating trade in synthetic drugs. Analyzed the practice of implementation of the method of screening adolescents to the presence of drugs in the body. Is a reasonable conclusion about the need for monitoring the drug situation at the global and regional levels.

Keywords— narcotism; drug addiction; drugs; teenager; prevention; screening

Drug problem is becoming increasingly important in the modern world. A century of struggle with drug addiction has not led to tangible results.

Determine the actual state of the problem extremely difficult and talk about her specific contours can be with a degree of conditionality and experiencing some inconvenience, since flows it quirky and latent. We will try to bring greater clarity to the understanding of the problem and identify the most pressing issues related to modern trends of drug addiction in the population.

The number of people who use drugs exceeds 3% of the world's population. More than 200 million. people have tried drugs at least once, 100 million of them. -regular users, 50 million. -chronic patients. Has been growing rapidly the number of juvenile drug addicts and women. The average age of young drug abusers is 13-14 years. The trend is "rejuvenation" of age committing the first samples of the drug.

According to expert data in the world proceeds of drug trafficking are from 500 billion. up to 1.5 trillion. dollars per year. Only in Western Europe, the annual income of the drug trade reaches 200 billion. dollars. The main filling traffic money moving illegally in relation to legal money in the banking system, make up the drugs and they reach the level of 78%. To increase drug money investments into the world economy presents and the fact that only one 2009 in banking systems part of the leading world countries as liquid capital to compensate for financial losses amid the financial crisis was sent around 352 billion of drug money. A large part of drug money is used for development of drug trafficking and the financing of terrorist organizations worldwide [1]. About 20 thousand mercenaries destabilization in Syria financed by Afghan drug production [2]. Fuelled by the actions of terrorists and international crime in the North Caucasus are financed from Afghan drug trafficking [3].

Drug addiction is one of the most global problems facing Russian society. Drug prevalence in adolescent and youth Wednesday reached a level threatening Russia's national security. According to the Office for drug control and crime prevention of the United Nations, the percentage of the Russian population, involved in the abuse of opiates, 5-8 times higher than in Europe, and in Germany in 20 times.

Due to the use of narcotic drugs and psychotropic substances annually in our country perishes fans. Pax. Given the high degree of drug flow latency, it is considered that the number of actual drug users in dozens of times more than officially registered. According to a rough estimate, about 3 million in Russia. people regularly consume psychotropic means, to 6.5 million. people use them sporadically, and the order of 18 million. people have tried drugs at least once. The vast majority of the two thirds of consumers is teens and youths aged 14-30 years. The vast majority of addicts live 3-5 years after the first reception. Only 10% of addicts survive to the age of 30. Drug overdose becomes the cause of death or disease, developed against the background of reduced immunity (e.g., sepsis is a blood infection) [4]. In the words of g. Landau, refugees from their own countries is not the worst and much worse from his time.

Drug screening only up to 10% of drug addicts, and only 1% of them manage to rehabilitate, and the rest happens relapse, which they cannot resist.

According to official data from the FEDERAL DRUG CONTROL SERVICE of the RUSSIAN FEDERATION 80% of street crimes committed for the purpose to get funds for another dose of the drug.

Drug abuse affects the economic well-being of the country. So daily .8mn. Russian drug users spending 4.5 billion roubles on drugs and thus deduce from GDP to 1.5 trillion rubles annually, that in one and a half times the budget of the Ministry of defence and 3.5 times the budget of the Ministry of health. Real annual damage the country's economy is at least 4 trillion rubles [5].

The modern scale narcotization indicate trends of the industry, which in the structure of the shadow sector of the economy of the country is independent field. Here it is important to bear in mind that the magnitude of the problem of the underground economy with sufficient precision to describe

difficult, but various estimates put its share in the structure of the real economy reaches 50% and more.

In the midst of an economic crisis, very noticeable figures reflecting total budgetary costs of prosecution of drug users and keeping them in places of deprivation of liberty-100 thousand addicts that constitute 96 billion rubles annually. In comparison: the contract price to Russia two acclaimed French Mistral vertoletonoscev amounted to 1.2 billion euros (76.8 billion rubles).

Drug situation in Kabardino-Balkar Republic (KBR) is not encouraging. The number of persons, occasional drug users in the Republic is growing from year to year: over the past three years, at 46 per cent [6]. Placed in the Interior Ministry of Kabardino-Balkaria Republic (KBR) is human 1244 with drug dependence [7]. More than 80 percent of drug addicts in the Republic use the poppy. Poppy with similar admixtures, imported from abroad, hundreds of thousands of tons-by the courts through Novorossiysk. The main suppliers of dirty poppy-Turkey and Holland [8].

Dynamics of crimes related to drug trafficking in the structure of total registered in the CBD, tends to increase with: 2011-10.4%; 2012-12%; 2013-14.3%; 2014-15.6%. The ratio of criminal cases in production to the Court is as follows: 2010 -535:346; 2011. -472:310; 2012 g. -472:328; 2013. -388:284; 2014-458:278. In the structure of seized narcotic drugs, psychotropic substances and potent 2014godu dominates the share of marijuana (142655gr.), hash oil (3371gr) and heroin (2778gr.) [9] at the beginning of 2015. offences related to illicit trafficking in narcotic drugs and psychotropic substances accounted for 11.6% of the total number of crimes common focus identified in the Republic. Categorized as serious and particularly serious are more than half of the reported crimes in this area.

Experts are confident that the level of drug use threatens the nation's gene pool, if 5% of the population use drugs. And how to find out to what extent we are close to the border and that prepares us day coming? Because serious monitoring the drug situation is virtually non-existent, and expensive in this lesson. However, it is a choice between "for" and "against" life, however, as in the case of abuse of "debut".

The emergence of new threats and challenges associated with the increasing activities of crime, increased terrorism, extremism, the emergence of new types of narcotic drugs and psychotropic substances, the steady decline in Russia's population, owing to the expansion of drug trafficking had necessitated the adoption of "the strategy of the State anti-drug policies of the Russian Federation up to the year 2020. It states that the modern drug situation in Russia poses a serious threat to the security of the State, the economy and the health of its population [10]. The State programme for the rehabilitation of drug addicts up to 2020 will spend 175 billion. BR [11].

Faster drug arrives with a new chemical compound, modified formula which fall into the list of prohibited substances. Information about teenagers and young men get faster than adults, to protect them from the drug. Young people are not only informed about the different types of drugs. Studies have shown that 40% of teenagers aware of how and where you can buy drugs.

In February 2015 year ban entered into force trafficking, consumption and promotion of new potentially hazardous consumption of psychoactive substances, established by federal law No. 7-FZ of February 3, 2015 "on amendments to certain legislative acts of the Russian Federation". Its adoption is associated with a massive spread in Russia the so-called K2 spice, which is informally referred to as the newly introduced substances causing a person State narcotic or other toxic substances, yet made to the list of drugs [12].

Synthetic ("design") drugs supplied to the country as bath salts, fish food, etc., received wide prevalence among adolescents and youths. In big cities they are advertising on street poles and asphalt surfaces. Traffickers are expanding not only sales, but also places of their implementation. Synthetic drugs are available in schools, youth clubs and in the courtyards of the houses.

Most synthetic cannabinoids in ordinary life referred to as "herbal smoking blends" or "spajsy" (from "spice -spice, spice) synthesized under the leadership of John Huffman (Huffman J.W.)-Professor of chemistry Klemsonskogo University of South Carolina (United States), and subsequently patented [13]. The first letters of the chemical formula is a Professor, under whose initials start they were developed.

For the first time "spajsy" appeared in the smart shops in Western countries at the beginning of the present century, and after a few years have proliferated in our country. The emergence of special interest to adolescents it is associated with the release of the cult novel by Frank Herbert's Dune.

Consumption of "K2 spice"-a serious problem that is gaining increasing popularity in the teenage Wednesday. Chemical-physical features of synthetic drugs are such that they are easily absorbed by mucous in the human body. They can smoke, sniff, BREW as a tea, take in beverages. "Spajsy" and similar mixtures cause effects similar to ènteogenam, i.e. plants that were used to achieve the changed state of consciousness for religious purposes.

In "spajsah" found toxic and other substances with narcotic drugs and Psychotropic Substances Act. A particular danger is the synthetic component type JWH-018, 250.317, which are pollinated by different sets of slaboaktivnyh entheogens in order to produce psychedelic effects. It is this additive increases the stopping power "and" in 5-6 times. Their consumption leads to various violations of memory, intellect and other violations of mental health with the subsequent formation of dependency and deterioration of the personality. Active substances "K2 spice" much more psychoactive substances, herbal preparations of cannabis group, resulting in the emergence of toxic effects. It has been scientifically proven that eating plant cannabinoid is a factor in the development of paranoid forms of schizophrenia [14]. Along with this, it is argued that synthetic cannabinoids, contained in the tobacco mixes of type "spice", able to produce various forms of mental pathology. Smoking blends are a major cause of suicides committed by adolescents. It

should be noted that the mental health of the rising generation and without anesthesia raises legitimate concern. So, according to the Institute of the human brain Russian Academy of Sciences, mental health problems are at 15% of children, 25% of teenagers and almost 40% of young men of military age.

It is believed that the "Spice" is the only brand of the company "The Psyche Deli, which manufactures its products in the territory of Northern Ireland. If the company's net profit in 2006 totaled 65 million pounds, then in 2007 it increased by more than 1000% and reached 899 million pounds [15]. Over the past eight years the popularity of K2 spice in the world only gaining momentum.

K2 spice seizures in Russia and "designer" drugs has increased over the past seven years in 130 times, today this figure is 22 tons. Currently 734 of various mixtures of known properties [16]. In the fall of 2014 in Russia a wave of mass poisoning «spajsom» MDMB: killed more than 40 people asked for medical help more than 2 thousand people [17].

Given the seriousness of the threat to public health in Austria, Germany, France, Sweden and Finland banned sale, distribution and all "K2 spice. Spajsy and other smoking blends are prohibited on the territory of Russia under threat of criminal prosecution and imprisonment for up to eight years.

Dynamics and specificities of the anesthesia teenage Wednesday is an indicator of psycho-social disadaptation large part of teenagers. This points to the need to improve social and adaptive capacities of the adolescent, the formation of psycho-social competence and adequate social behaviour.

To explain the causes of teenage drug abuse, over 43 theories. Geneticists, neuroscientists, psychologists, sociologists, drug experts are trying to find answers to the causes of drug abuse. There are countless studies of biological, medical, psychological, sociological and other aspects of the problem. In practice, however, cannot turn the tide and, in many cases, the teen makes a choice in favor of the drug, often voluntarily. This demonstrates the need to coordinate research and formulation of evidence-based recommendations for social practice.

Risk of anesthesia is most pronounced in the age range from 12 -18. Compared to other stages of the development, this period saw the decision as many development challenges: exemption from parental care and inclusion in a peer group (Kle); construction of psycho-social identity-knowledge of "who am I?", the sensations of the fact of our own being, meeting with "real I" (e. Erickson).

The crisis process of self-identification is associated with knowledge of values and ideals and definition of smysložiznennyh landmarks. Need to take independent decisions on the threshold of adult life and the difficulties encountered in their implementation, may disappoint. Social norms and requirements can be perceived not quite adequately and treated as not quite fair and even hostile. It is important that the subculture group of authentic standards are consistent with the goals of self-fulfillment and sense of adequacy and lasting ownership of its own self. Therefore, age-specific peculiarities of the development of the teenager are essential

in the context of the occurrence of interest in drugs and abuse "infestation".

To identify possible ways of drug prevention in adolescent Wednesday appear to be real challenge for health and education. One way to do this is to skrinirovanie teens for signs of drugs in the body. This procedure can be carried out only with the consent of the parents or if the sanctions from the Ministry.

That positive is in the implementation in practice of such a survey?

Adolescent drug risk very baffled and I am sure that it is not personally touches. It is more concerned with the possibility that forbidden-secret may become apparent. In turn, the person offering the trial drug, convince a teenager that nobody knows about it. Skrinirovaniâ method reduces to zero arguments of drug traffickers and motivates teen "think hundred times before you try the drug. He knows well what happens when adults become aware of the fact that use of the drug. Another argument in favor of the skrinirovaniâ is that a teenager may not provide the time of the survey. It may examine at any time, and hardly a teenager wants to be in a hopeless situation, fall into the category of neglected society people just because someone persuaded to commit trial banned substance. In most cases, this can serve as a barrier to the teenage and youth anesthesia Wednesday.

In addition to the benefits, the question arises, how reliable can be data skrinirovaniâ. It is argued that it is now possible to talk about the accuracy of the results only in relation to the classical drugs, and "traces" of the "K2 spice» in the blood are discovered if they were used for three months. This and lost time, and substantial argument for drug traffickers, which undermines the credibility of those who try to resist narkotizmu. According to experts, the positive results can be obtained also using certain medicines prescribed by your doctor. Only conduct additional laboratory tests allows you to clarify the reasons for the positive reaction to the presence of drug or drug metabolite in the body.

In general, modern reality, related to the magnitude of the prevalence of drugs and drug addiction, the effectiveness of treatment, the level of effectiveness of legal measures counter-narcotics as well as the effectiveness of the preventive measures do not allow build optimistic prospects for the future. We can only talk about what you want to monitor the drug situation on the basis of evidence-based recommendations.

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Research Representations Primary School-Age Children about Drugs and Their Relationship to Drug Addicts

Aminat D. Vislova

Kabardino-Balkarian Institute of Humanitarian Researches.
Nalchik, Russia
avislova@mail.ru

Abstract—**The article presents the results of an empirical study of representations of 9-10 year olds about drugs and drug addicts and their relationship to him. The main task was to identify information sources on various aspects of drug abuse received by children and awareness of types of drugs, methods of their use. The questioning method was used. The reliability of the results of the study were tested using statistical processing with application of the criterion χ2.**

Keywords— drug addiction; addiction; drugs; narcotic information; narcomania situation; children of primary school age

INTRODUCTION

The specific conditions of the present stage of development of society, social exclusion of a large part of the population of Russia provokes the growth dynamics of drug consumption. The current system of drug response for various reasons is uneven and inadequate reality. The main feature of the situation is that the problem of drug addiction is becoming more common among the younger generation.

Based on the data of sociological and psychological research, analysis public opinion research, conference papers and a number of factors that contribute to social narkomanian secure situation. This flattening problem non-medical use of drugs to health and law enforcement officials; rejuvenation of the age at which to start the introduction to drugs; the increase in the number of drug users, particularly among children and adolescents; the emergence and the increasing prevalence of a new social phenomenon – abuse the youth subculture, which «reproduces» the behavior of the addict and expands the circle of young people - drug users; uncertainty and the lack of scientifically grounded concept of a healthy lifestyle.

The public report, «Drug Addiction - a Threat to the Nation», notes that in recent years the number of drug users in Russia has increased several times and taking into account the age category most addicts (13-25 years old), is threatened almost all the new generation of the country.

The growing awareness that drug prevention should be a priority, and for this you need to maximize early detection of symptoms of psychological predisposition to drug use in childhood and adolescence. In recent years, increasing attention of scientists attracted to issues of prevention of drug abuse

among children of primary school age and attempts of modeling the most effective forms and methods of forming antinarcomanian attitudes in the younger generation.

Ideas antinarcomanian education of children has developed in the works of a number of domestic and foreign scholars (V. V. Bartsalkina 1990, 1995; V. V. Guldan 1989, 1990, 1991; D. V. Kolesov, 1998, 1999; A. D. Vislova 2001, 2009; E. V. Zmanovskaya 2008, 2011; J. Moskovitz, 1989 [1]; M. Zukerman, 1979 [2], etc.).

We define narcotizm as a social phenomenon, combining drug addiction, alcoholism, chemical abuse, tobacco. One of the types of deviant behavior, reflected in the deliberate use of narcotic and/or other psychoactive substances for the illusory perception of the real world as a way of avoiding internal and external factors of distress [3].

Drug addiction is understood by us as a disease caused by non-medical use of narcotic drugs and psychotropic substances, which manifests itself in a passion for them and their consumption in increasing doses. Drugs or substances considered as drugs of vegetable or synthetic origin, which leads to use of psychophysiological dependence. Under narcogene information reported is understood drugs and other psychoactive substances, their properties cause an unusually pleasant mental sensations; manufacture and use of the technology; assurances about the safety of low-dose and the possibility at any time to stop taking them ("jump") [4].

Among the complex causes of the risk of formation of drug addiction, of great importance is the age factor. According to a well-known expert in the field of Developmental Physiology D.V.Kolesov, "human behavior, which offer to try drugs, to a large extent determined by its age-psychological characteristics" [5].

V.V. Bartsalkina studying the origins of the early initiation of drug abuse, reveals both external and internal reasons for this phenomenon. "Focusing on the whole person, - she writes, - it must be seen in close connection with his age and individual characteristics, as well as the environment in which he lives and develops and where it can hide the roots of bad habits" [6].

One of the main reasons why children start their acquaintance with drugs is the desire to assert themselves at the

expense of the kind of "elite", able to feel high emotions, inaccessible to ordinary people.

Despite years of study of the individual addicts, motivation and psychological readiness to drugs, sex and age characteristics of drug abusers, it should be noted the lack of knowledge about the issue of the causes that encourage the formation of installation on addicting narcotic substances.

In connection with the trend of rejuvenation of the beginning "narcomanian career" of particular relevance is the study of the ideas of children 9-10 years on drugs to develop their resilience in a situation narkomanian temptation.

The present study is devoted to the study of psycho-pedagogical and social factors in the emergence of attitudes on drug use in children of primary school age.

Subject of research: presentation of children 9-10 years on drugs and their impact on the decision on the use of narcotic substances.

The purpose of the study: the study of perceptions of primary school age children about drugs and drug addicts and their relationship to him.

The main objectives of the study are:

1. Development and testing of questionnaires to identify the level of awareness among children of primary school age about the different aspects of drug abuse;

2. Analysis and statistical processing of the results of research and the formulation of conclusions and proposals for the development of algorithms for the formation of children's resistance to drugs.

Research method: questionnaire survey.

The base and the organization of research.

The study involved 500 pupils of 3-4 classes of secondary schools of the Kabardino-Balkarian Republic (KBR), aged 9-10 years, including 172 - children of school №1, 25, 9 and 5 in Nalchik, 165 - from Maysky and 163 - in rural schools Cherek district (the villages Kashkhatau, Zaragizh, Babugent, Aushiger).

To identify the perceptions of primary school children about drugs, their methods of use, the main causes of familiarizing them and identify their attitudes towards drugs and drug use, we developed a questionnaire containing questions both closed and open character.

A questionnaire survey was conducted in classrooms in secondary schools. The survey was completely anonymous.

It turned out children's knowledge of what drug, how it looks, does the health and a person's mood and awareness of the types of drugs, methods of their use and degree of danger. The questionnaire included questions aimed at establishing the views of children about the external characteristics of the addict and the main reasons for the use of drugs.

However, it was revealed exposing children to persons suffering from addiction and the possible risk of introducing them to drugs. Also considered the opinion of the surveyed

about whether they need a person to know about drugs and drug addicts.

The respondent's attention was focused on two important issues: about whom social status is a drug addict and what are the possibilities of acquiring the drug. Concretize the sources of information from which the children receive information about narcotic substances, analyzed the context of the discussion of the current issues with adults and peers.

Ahead of the possible concerns that may be caused by the formulation of these questions (Is not it too early to such questions are given to children? Would not it have the curiosity of children, able to provoke interest in drugs?), we refer to the competent authority of the WHO that in places where grow drug crops should begin prevention of drug abuse at an early age.

RESULTS

Results of the study showed that the children surveyed age group have sufficient information about the drug. According to 415 respondents drug has the form of powder. The fact that a drug is a tablet, according to the answers 261children, and the same number of children says that the drug - a dried grass. The remaining answers were distributed as follows: "cigarette" — 234; "solution" — the 210 and 49 children "do not know" looks like a drug.

Children of primary school age demonstrate a high level of knowledge of different names of drugs. They listed more than 10 kinds of drugs: marijuana, hemp, cocaine, hashish, heroin, morphine, poppy seeds, crack, LSD, etc. Children in their replies both in Nalchik, and in Maysky area discover apparent drug such whistle-blowing on cocaine (284 pers.), heroin (165 pers.) and anasha (160 pers.). Then called marijuana (69 pers.), poppy (57 pers.), cannabis (47 pers.), morphine (16 pers.). It is noteworthy that 145 children do not know the names of any drugs. Of these, 67 - schoolchildren in Nalchik, 44 - Cherek district and 34 - Maysky area.

The study found that almost half of the respondents know about ways of using drugs. According to them, the most popular form of consumption of the drug is its intravenous (193 pers.); "inhaled powder" (155 pers.); "smoke" (95 pers.); "take a pill" (62 pers.). At the same time 275 schoolchildren surveyed in this group do not have the knowledge about how to use drugs. The main part of respondents - 358 children - had never seen a drug.

A large majority of the studied (457 pers.) categorically denies the existence of samples of any drug-active ingredients; they were offered once, but refused 16 children; from a few sentences refused 11 people; the first time agreed six; at first refused, then agreed five children. If ever offer drug 468 primary schoolers argue that won't try it; 10-not sure whether tried or not; 7-be sure to try; 5 children try when they grow up and "provided that no one will know"; four are ready to try a narcotic substance.

On the question of what is usually associated with the decision to try a drug received more responses than the question of the choice "to accept - not to accept." The main reason for experimenting with drugs primary schoolers called:

• curiosity (it is interesting to know what it is) (33 pers.);

• to wondered passed boredom (12 pers.);

• to not consider "wimp", "small" (11 pers.);

• not to offend the one who offers the drug (2 pers.).

Answers the question about the possibility to get drugs as follows: "I don't want to, no need to"- 213 pers.; "impossible"- 135 pers.; "I don't know"-77 pers.; "easy"-34 pers.; "difficult"- 32 pers.

According to 267 pupils, a drug is a substance that can change a person's health. The ability to change the mood indicates 217 pupils. The vast majority- 354 -believes that the drug increased quickly and is difficult to refuse.

Children believe that drugs initially improve and then worsen a person's mood - 176 pupils, improve mood - 129, worsen the mood of 101, first worsen then improve a person's mood – 85. A significant number - 123 pupils - answered that they know nothing about how the drug affects the mood and only 6 people believe that the drug alters mood.

It appreciates the risk of ill health as a result of drug use (446 pers.). Only a small part of the surveyed said that the drugs improve health (13 pers.) Or have no effect on it (11 pers.).

In the development of this assessment, the children say that drugs pose a real danger to people (434 pers.), for people of weak will (76 pers.), for sick, weak people (71 pers.), only for children (63 pers.). Ignorance showed 25 children.

Answering the question about the number of samples of the drug, dangerous to health, younger students identified: numerous samples (200 pers.), one sample (185 pers.), 2-5 samples (120 pers.), 10 -15 samples (130 pers.). It should be noted that 18 people showed ignorance about the number of hazardous samples, four believe drugs are safe.

External signs of drug abusers are treated children differently: kind of a sick man with a pale face (315 pers.); a dirty, ragged, scary (102 pers.); beautifully, fashionably dressed (54); as usual, all (29). Units gave their description addict: "looks like a bad", "he has delayed the movement, blank stare", "the weary kind", etc. many children (103) do not know how it looks like a drug addict.

Children relate differently to the drug users: will feel pity (248 pers.) unpleasant feelings (219 pers.) are indifferent (97 pers.).

The study found that 338 pupils are not familiar with the person who uses the drug, and 144-faced people consume narcotic substances.

In the presence of a hazard in the immediate vicinity indicate child answers the question of who is a drug addict: it is a familiar adult (69 pers.), senior friend (52 people.), the same age (17 pers.), an unfamiliar adult (9 pers.), relative (7 pers.), neighbor (5 pers.).

Interesting data obtained during the clarify the question of who can be an addict. Almost half of pupils (274 pers.) believes that this is a film actor, a little less replies had been received in favor of a businessman (231 pers.), followed by singer (209 pers.), athlete (133 pers.), the police (85 pers.), physician (78 pers.), judge (61 pers.), "anyone" (43 pers.). Couldn't determine the social status of a drug addict just 49 schoolchildren.

The main causes of drug use children consider:

• can not stop once started (315 pers.);

• they are not lucky, they are unhappy (136 pers.);

• they have nothing to do (104 pers.);

• that it became interesting to live (90 pers.).

Some children explain that «the addict has nothing to lose and to calm down he's on drugs". Difficulties caused this issue have 72 children who answered that they do not know why people use drugs.

Answers pupils about whether a person know about drugs and drug use is necessary, distributed almost equally: 238 of them believe that it is necessary and 214 - do not see the need, 47 – "do not know" that it is more expedient.

The results of this survey showed that the leading carriers of information about drugs and drug abuse for them are TV programs (376 pers.), films (316 pers.), on the same level is the information received from the teacher and from books, magazines (for 127 pers.); from conversations with friends get their information - 97, and from parents - 87.

Therefore, children receive enough information about aspects of addiction from different sources, which implies further discussions in the near surroundings.

However, almost two thirds of respondents (329 pers.) have argued that with no one talking about these issues. Rarely talk about it with friends-88 people, sometimes talk with teachers-55, with parents-40, often with friends share information - 23.

With adult children of primary school age often discuss issues related to the influence of the drug on human health (128 pers.), effects on mood (32 pers.); so as you can get (13 pers.) and how to use (11 pers.).

While the majority of respondents (351 pers.) claims that topics related to drug abuse, with adults they are not discussed.

Information about the effects of drugs on health 106 children share with their peers and half a smaller amount talking about the effects of drugs on mood; 14 - share information about how to use drugs and 12 – with friends to discuss issues about how to get drugs.

It turned out that 349 children did not focus attention on different aspects of drug abuse in communicating with friends.

According to 231 of the children interviews adults about drugs characterized as intimidation and a show indifference to them (187 pers.); and will not experience any interest to similar information by older people (63 pers.).

Friends talking about drugs seem uninteresting (247 pers.) or frightening (157 pers.), but some part be of much interest (81 pers.)

From answers to the question of what information about drugs would get respondents, showed that a majority of students (225 pers.) does not wish to receive any information about them; many people are interested in the nature of their impact on health (169 pers.); in the mood (73 pers.); want to know what flavor are drugs (39 pers.); 19-wonder how you can get drugs (16 pers.) and use it (19 pers.).

CONCLUSIONS

1. Children receive a large amount of various drug information from different sources, however, among them dominates the information provokes the risk for him.

2. Children of primary school age have mostly one-sided information on drugs and drug addiction, which prevails over the information received from adults. The nature and content of the information communicated to children their peers and older age are different from the didactic-instructive, but does not reflect the real picture of drug abuse information obtained from adults.

3. Found a phenomenon of being at drug information received of children depending on the place of residence (the Center and the periphery). Awareness among children about drugs in rural areas below. This fact can be explained by the most specific preservation of traditional ethical norms of ethical behavior in the most remote areas, which serves as a kind of buffer on the way of drug addiction.

The study formed the approach to the understanding of the factors contributing to the formation of a negative attitude of children to drugs and the risk of initiation to him.

The main factors affecting the formation of children installation on a sample of the drug include the lack of a focus for anti-drug education; availability and importance of information about drugs obtained from information sources, from peers and older students, focusing on the safety of low doses and "light" drugs.

Figuring out how understood (or not understood) the problem of drug abuse by children of primary school age opens the possibility of correcting misconceptions, allows to create from them a new installation, eliminating the risk of drug abuse.

These materials can be recommended to school teachers for use in the organization of educational work, and in the process of training teachers in pedagogical colleges and institutions in the training of psychologists and social workers.

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Development of the Principles of the Quality Management System Which Based on the Economic Theory of Value

Marina F. Guskova
Moscow State University of Railway Engineering (MIIT)
Moscow, Russia

Fedor F. Sterlikov
MSUTM named after K.G. Razumovsky (FKU)
Moscow, Russia

Abstract — **The paper presents theory of a value, allowing to study in detail the interests concerning the quality improvement of both consumers and other stakeholders development of principles of quality management.**

Keywords — value, usefulness, cost, system quality management principles.

One of the most important principles of quality management is customer orientation[1]. The other principles are designed to provide the first, while remaining the basis for all activities in quality management. Any valid quality management system is designed to improve the economic performance of the company such as revenue, profit, and to increase its competitiveness and achieve sustainable results.

GOST ISO 9000-2015 States that the organization to achieve sustainable success in the first place to gain and keep the trust of consumers and other stakeholders in its activities.

The basis of success is defined by creating value, implementing the above requirements and interests. Will focus on the proposals for the development of the first principle.

To do this, the authors propose to Refine the essence of the concept "value".

The concept of the value of ambiguously interpreted by representatives of different scientific schools. A few decades in economic science were disputes about the place and significance of each of the interpretations of the values in the solution of the main problem of the economy – maximizing meet the needs of limited resources. This opposition was manifested in defending their notions of value defended the labor theory of value and marginal utility theory of market relations.

One group of scientists has come to dominant the meaning of the labor theory of value, and the second - the theory of marginal utility. Historic sequence of development of these theories, some scientists tried to imagine how the development of value theory from the labor theory of value to marginal utility.

However, one and the other school was considered the regularities of formation of values, one on each side, only two levels of management (microeconomics and macroeconomics), not taking into account all stakeholders, as reflected now in the ISO standards. Stakeholders more and comprehensive study of the patterns for each of them is of considerable interest [2,3,4].

Our studies suggest that the role of the labor theory of value and the theory of marginal utility to determine if the analysis of market interdependencies, in defiance of the generally accepted two positions of micro - and macro - levels with five levels of management:the solution of the main problem of the economy – maximizing meet the needs of limited resources. This opposition was manifested in defending their notions of value defended the labor theory of value and marginal utility theory of market relations:

- nanoeconomics (Economics of man),
- supermicroeconomics (the economy of family),
- microeconomics (Economics),
- macroeconomics (national economy),
- supermakroeconomics analysis (world economy).

At each level of management are presented to the dominant or needs, or the cost of the goods.

From the position of this approach to the analysis of the dominant (most powerful) need is 5 elements manifested at different levels of management.

The power dominance of the components of the value at five levels of management in a General view is shown in Fig 1.
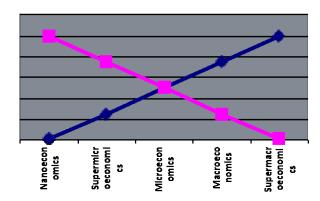

Fig 1. The power dominance of the components of the value at five levels of management in a General view

Given the different roles of the parts values on five levels of management, it is necessary to analyze their relationships (utility and value) is carried out separately.

At different levels of management in different ways manifest themselves components of the theory of value, namely utility theory and the theory of value.

Let's start the analysis with the lowest level of management – with the economy people (nanoeconomics).

On the level of economy person of the two components of the theory of value fully manifested usefulness. The unit benefits can be in the limit of 7 billion levels of utility (marginal utility by the number of inhabitants of the planet). You can agree to the applicability of fully at this level of the theory of marginal utility. It plays a crucial role here.

The cost at this level is manifested in the "compressed" averaged condition. Cost constitute srednedushevye the cost of abstract labor, which are the costs of the enterprise with the average conditions of production: the average capitallabor ratio, average skillful workers, etc. Cost benefits at this level in the form of its price is constant, regardless of the individual consumer.

If we consider the management level of the global economy, we can see that the utility of the good is of no variability. The usefulness at this level is manifested in the "compressed" averaged condition.

The theory of marginal utility is practically not involved at the level of the world economy. Consider the situation with production of apples. For example, the world produces a million tons of apples. Additional Apple has no less utility than the previous Apple. The usefulness of the Apple is equal to one, as all previous instances.

At the level of the world economy fully manifests itself the cost benefit. Unit benefit can take many forms of expression of value, namely prices, in different markets: national, regional and other. At this level of management is fully valid labor theory of value, which plays a crucial role. It has repeatedly stated, the most ardent opponents of the labour theory of value.

As for the other levels of management, the following can be noted.

At the economic level of the family the utility of the good is less important than the economy of man, but the role of the cost increases slightly.

At the economic level of the individual enterprise, the value and cost benefits are about the same. Not coincidentally, microeconomic analysis allowed to find reasonable influence (role, value) in a market economy and the labor theory of value and the theory of marginal utility. And, as the historical analysis of these economic theories, rather an ideological and political arguments had an impact (pressure) on more than a century, the conflict between these economic theories.

At the level of the national economy the value of labour theory of value increases to a greater extent than at the level of business Economics, value theory of marginal utility still more reduced.

The relationship of utility and cost in the context of the synthetic theory of value expresses the following model

$$V = \frac{u}{c}, \text{ where}$$

V – Value,

U- Usefullness,

C – Costs.

This model captures the direct value of the utility, and backward – with the cost. This concerns the ratio of essential economic relations.

The model is transformed into a formula by taking into account other factors, for example, elasticity values for the usefulness, cost and other arguments

$$V = \frac{a b U}{c d C}, \text{ where}$$

a, b, c, d – coefficients of elasticity at different arguments.

We are interested in the relationship of usefulness and value can be described by the coefficient of elasticity.

Elasticity coefficient values for utility is the following formula:

$$EI = \frac{\Delta U}{\Delta C}, \text{ where}$$

ΔU - the increase in utility units of the good,

ΔC - the increase in value as a reaction to the increase in utility.

This indicator allows to estimate the dynamics of changes of relations of utility and value.

The identified model of the relationship of values with usefulness and value expresses the structure and content of the synthetic theory of value.

Studying forms of utility, cost and value at five levels of management should be noted:

For each subject, interested in improving the quality of a product, process or system they take various forms:

At the level of the economy of man is the demand, showing the following relationship:

$$Demand = \frac{Quality}{Price}$$

On the economy of the enterprise level:

$$Efficiency = \frac{Income}{Costs}$$

At the national economy level:

$$Total\ demand = \frac{GDP}{Price\ level}$$

Levels of management	MANIFESTATIONS IN EMPIRICAL ECONOMIC RESEARCH		
Man economy	Quality	Self	Price
Family economy	Integrated quality	Self demand	Integrated price
Enterprise economy	Income	Efficiency	Costs
National Economy	GDP	Total demand	Price level
World economy	World product	World demand	World price level
All 5 levels	UTILITY	VALUE	PRICE
Levels of management	THE ESSENCE OF THE THEORETICAL ECONOMIC STUDIES		

Table 1. The essence and forms of the components values for the 5 levels of management

In this way, we can say that whatever preference theories of value and usefulness has not be given by scientists, economic practice has to take into account poleznosti, and cost characteristics of the goods. The demand for a product and determine its quality and price. This confirms the objectivity of the manifestations and use of the theory of value of goods.

The proposed interpretation of the concept of value will more clearly define the range of interests of all stakeholders in the organization with a working quality management system, which will allow you to build relationships with organizations external environment on mutually beneficial terms. Application of the principle of customer orientation depends on understanding its needs.

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Public-private partnership as a promise form of investments

Ramilya R. Savchuk

Moscow State University of Railway Engineering (MIIT)

Moscow, Russia

savchukrr@gmail.com

Abstract — **The article contains the analysis of the legal framework governing PPPs in Russia, as well as the basic reasons and difficulties of interaction between the parties in the framework of PPP, in addition, to determine the prospects for PPP development in the Moscow region.**

Keywords — Public-private partnership (PPP); legislative support; PPP typology; main frames jf the projects, which implemented under the PPP.

In Russia PPP is a new form of long-term interaction between government and business in a particularly important tasks solving under conditions of mutually beneficial cooperation.

Traditionally, the scope of public-private partnership in the implementation of projects are the objects of social and transport infrastructure, and the driving force of this process was the growing trend to reduce state involvement in the economy. The idea of PPP is basing on the theory of the mixed economy, however, it can't be assumed that any interaction between the state and private capital is PPP. The main criterion for inclusion in this, in our view, is the fulfilment of those business functions that are traditionally performed by the state. The maintenance and development of infrastructure (production, transport, social), which is the most typical example.

Unfortunately, there is no a single view about how the legislation should be executed in public-private partnership, also there is no the experience of some countries shows that a single PPP law, and the main principles reflected in many different legal acts and norms of civil law (Japan, England, France and Australia). There is the example of countries that went the other way and adopted a separate law on PPP (Greece, Germany, Brazil and other countries of Eastern Europe).

This approach to institutionalise PPP can be explained by the fact that the first group of countries PPPs has developed in a natural way ("bottom"), and appropriate changes are gradually applied to already existing laws. Countries which has separate laws on PPP, a public-private partnership was "from above", i.e., the state was especially interested in the active promotion of PPP. This group of countries includes Russia.

Ukraine, Moldova, Kyrgyzstan already has a PPP laws. In other neighbour countries just separate acts, which governing a different forms of PPP.

Russia has a law which regulates a PPP in 69 federation entity, but almost it is a declarative documents. Along with the regional legislative acts in Russia there are also Federal laws dated 21.07.05, No. 115-FZ "On concession agreements" dated 21.07.05 g I. No. 94-FZ "About placing of orders for deliveries of goods, performance of works, rendering of services for state and municipal needs", which is also considering the implementation of PPP projects. To some extent, regulates PPP and the Federal law dated 22.07.05, No. 116-FZ "On special economic zones in the Russian Federation" (because this determines the provision of business incentives in a particular area – is also an option of PPP in the broad sense).

There is 7 main types of PPP in table 1.

Table 1. **A typology of PPPs depending on the scope of the rights and obligations of the private partner**

№	Short name	Name	Description
1.	BOT	Build, Operate, Transfer	The concession mechanism: construction, right of use (without ownership rights) during the term of the agreement and transfer to the state
2.	BOOT	Build, Own, Operate, Transfer	Similarly to item 1, but the right of ownership on the duration of the contract belongs to the private partner.
3.	BTO	Build, Transfer, Operate	Similarly to item 1, only the object transferred to the state immediately after construction. The private partner operates the facility during the term of the agreement, and reimburse public costs of the regular payments (the contract lifecycle)
4.	BOO	Build, Own, Operate,	Similarly to 2., but upon the expiration of the agreement the object remains in the ownership of the private partner
5.	BOMT	Build, Operate, Maintain, Transfer	The emphasis on supporting the viability and maintenance of the object. The right of ownership remains with the public partner.
6.	DBOOT	Design, Built, Own, Operate, Transfer	Similarly to 2., but the duties of the private partner includes the design of the facility agreement

7.	DBFO	Design, Built, Finance, Operate	Emphasis on responsibilities of the private partner to Finance the construction and service. Public partner reimburses the costs of the regular payments.

International practice shows that successful development of PPP on a national scale requires legislative support of a significant number of other legal standards. Namely, you need to specify the following concepts:

- the company with a target capacity (a company created specifically for the project; SPV-company);
- the mechanism of selection of projects;
- the possibility of signing a direct agreement between the parties the implementation of the project, including project funding;
- the use of object agreement as collateral, and the exercise of the right of pledge;
- the mechanism of social control (disclosure of information).

The diversity of cooperation between the state and private sector partnership occupies a special place. Model and structure is actually a PPP, in turn, is also very diverse, but they share certain characteristics, allowing to allocate the partnership into an independent economic category. The partnership is built as a formalized cooperation of public and private entities specifically created under different objectives and based on the relevant agreements of the parties. As the experience of countries with developed market economies, the main features of PPP that distinguish it projects from other forms of relations between the state and private business are the following:

- identified, and in some cases a sufficiently long duration of partnership agreements (from 10-15 up to 20 years or more, with concessions up to 50 years). Temporal limitations are clearly observed: the projects are usually created for a specific object (port, road, social infrastructure, etc.), which should be completed by a certain date;
- specific forms of project financing: private investment, complemented by public financial resources (often significant), or joint investment of several participants;
- implementation of partnerships in a competitive environment, when every contract or concession takes place, competition among several potential participants;
- the specific form of distribution of responsibility between the partners: the government sets the objectives of the project from the standpoint of the interests of the company and determines cost and quality parameters, monitor the implementation of projects, while the private partner undertakes the operational activities at different stages of the project – development, financing, construction and operation, management and implementation services to consumers;

- the division of risks between the parties to the agreement on the basis of corresponding agreements of the parties.

In Fig.1 is a schematic diagram of interaction in the framework of public-private partnerships.
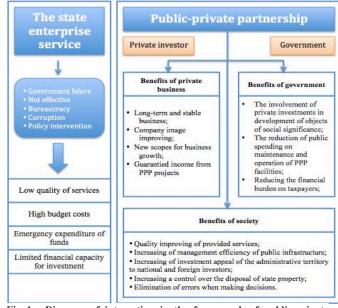

Fig 1. Diagram of interaction in the framework of public-private partnerships

Partnerships between business and the state require coordinated decisions in the interests of the members of the partnership - the two major institutions of modern society and economy. PPP is not a simple addition of resources. Each of the partnership parties has its own goals, solve their specific tasks, have different motivations. So, the government is interested in increasing the volume and improving the quality of services, infrastructure and socially oriented sectors of the population and economic agents. Business is interested in stable revenue and profit growth. Of particular importance is the PPP for the economy of the regions where based on it the development of local capital markets, goods and services. However, the interests of the state and business can't just not match, but to be contradictory, so the conclusion of the contract of partnership must be preceded by negotiations of the parties, balancing the interests and goals of the projects.

There are more than 80 normative legal acts of different levels and quality of regulating investment activities in Russia now. They were created at different times, from different professional levels, so they have a lot of contradictions. Accordingly, the application of this legislation is difficult, of course, deters private investors.

A new stage in the development of cooperation between the state and business, as well as in improving the investment climate in Russia began with the adoption of the July 13, 2015 the Federal law N 224-FZ "On state-private partnership, municipal-private partnership in the Russian Federation and amendments to certain legislative acts of the Russian Federation". The act further anticipates the adoption of a large

number of related normative legal acts concerning the procedure of deciding on the implementation of the project and the selection of candidates; the procedure of control of implementation, and termination of the PPP agreement. Currently there is an active preparatory work on the law on public-private partnership in the military-industrial complex (initially, this sector, along with utilities were excluded from the scope of the PPP law). All these legal acts will allow you to develop channels of penetration of private investments to the sphere of state regulation.

You should consider other factors hindering the development of PPPs is not only legislative gaps. Major problem is the lack of mechanisms for effective funding: the high cost of borrowed money and the reluctance of banks to give long-term loans and unfavourable investment climate in Russia in General and the attitudes of entrepreneurs in particular.

Practice shows that participating in a PPP, mostly large investment funds state-related (including informal), and funding for the implementation of projects take the state or quasi state banks.

I want to elaborate on the prospects for PPP development in the Moscow region.

Practice shows that the PPP increasingly developing where there is a lack of budgetary funds, and in Moscow, with its budget of about a billion dollars that problem to date arose. Moscow authorities have had to seriously consider attracting private partners only when we are talking about raising the level of comfort for residents of the capital, large-scale landscaping, improving the quality and accessibility of public services, combat traffic congestion, the expansion of administrative boundaries, the unloading of the Moscow ring road

The last year of active actions of the Moscow Government to promote PPP projects will contribute to the promotion of the capital in this rating to the forefront. In Moscow there is no law on PPP. Practice shows that is beneficial to the state agreement usually does not cause claims from inspection bodies.

According to experts, PPPs are possible in the reorganization of industrial zones within the ring road. Such a project will attract the attention of potential investors because of the shortage in the capital of new sites for construction. While the old industrial enterprises, occupying up to 30% of the area of the capital, are of great value to developers. Therefore, Moscow would have the right to demand from potential investors projects that benefit not only business, but also the city as a whole.

In conclusion, I would like to say that in modern conditions of innovative modernization of the domestic economy is of fundamental importance to the dissemination of the projects implemented through public-private partnerships.

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