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DEVELOPMENT OF COMPUTATIONAL TECHNIQUES TO SOLVE PROBLEMS
EXTERNAL AND INTERNAL BALLISTICS

РАЗВИТИЕ ВЫЧИСЛИТЕЛЬНЫХ МЕТОДОВ ДЛЯ РЕШЕНИЯ ЗАДАЧ ВНЕШНЕЙ И ВНУТРЕННЕЙ
БАЛЛИСТИКИ

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Abstract: The paper is dedicated to the improvement of existing and development of new mathematical methods for ballistics. We consider the interpolation of air drag function by using parabolic spline. Used spline does not require any additional conditions and is stable. The efficiency of the application of parabolic spline for different drag functions is shown. The spline approximation demonstrates good accuracy, saves the behavior of drag functions and can be used in models of external ballistics. The Dirichlet boundary value problem for the unsteady-state equation of convection-diffusion-reaction with the prevailing convection are presented too. For differing is used the parabolic spline that is continuous together with its first-order derivative which does not demand any additional conditions for its construction. Search for solution of the task in the form of a spline is applied to time-discretizable equation of convection-diffusion-reaction. Parabolic interpolation spline that is continuous together with its first-order derivative which does not demand any additional conditions for its implementation over diffusion one.

KEYWORDS: BALLISTICS, AIR DRAG, INTERPOLATION, PARABOLIC SPLINE, EQUATION OF CONVECTION-DIFFUSION-REACTION, MONOTONIC DIFFERENCE SCHEME

1. Introduction

One of the possible directions to increase the efficiency of the software used in the ballistic calculations is improving existing and creating new mathematical methods. The paper considers the use of designed parabolic splines to improve the accuracy and reliability of the ballistics problems solution.

Examples of the parabolic spline using for interpolation the grid functions of air resistance, and the using of spline for the creation of monotonic difference schemes for non-stationary second-order equation containing the first derivative (convection-diffusion-reaction equation) are given. It is assumed that the convective term of the equation is significantly dominate diffusion.

The main factor influencing on the ballistic trajectory characteristics is air resistance. Typically, the air resistance laws are presented in tabular form, functions, and require subsequent interpolation. We propose to use a parabolic spline for this purpose [1].

It is known that the vibrational motion of mortar shell fire at the plane described by the equation of parabolic type comprising first and second derivatives of the solution function. Powder burning processes are also described by such equations. These processes are sensitive to the input data and the coefficients of the equation values, so it is necessary to develop the stable numerical methods for solving boundary value problems for the convection-diffusion-reaction equations. In this work we propose to use a parabolic spline for the construction of monotonic difference scheme to provide stable algorithms for solving equations for large values of Peclet numbers.

2. Parabolic interpolation spline

We will use parabolic spline which is determined as function $S_{n,v}(x)$ called a spline of $n$ degree and $v$ defect ($n, v$ – integer numbers, $0 \leq v \leq n - 1$) with nodes on the grid $\Delta$, if:

- for each segment $[x_i, x_{i+1}]$ function $S_{n,v}(x)$ is a polynomial of $n$ degree;

- $S_{n,v}(x) \in C^{n-v}[a,b]$, where $C^{n-v}[a,b]$ – sets of $n-v$ continuous differentiable functions on segment $[a,b]$.

Let two breakdown points be given on the interval $[a,b]$:

$\Delta_1: a = x_0 < x_1 < \ldots < x_{N+1} = b$,

$\Delta_1: x_0 = \tau_0 < \tau_1 < \ldots < \tau_N = x_N + 1$,

where $x_{i-1} < \tau_{i-1} < x_i$, $i = 1, 2, \ldots, N, N \geq 2$.

In the nodes of the grid $\Delta$, a function $f_i = f(x_i)$, $i = 1, 2, \ldots, N + 1$ are set.

The points $\Delta_i$ are called nodes of interpolation, and $\tau_i$ ($i = 1, 2, \ldots, N$) are spline nodes.

We construct a parabolic spline of defect 1 on the interval $[a,b]$, which satisfies the conditions

(1) $S(x_i) = f(x_i)$, $i = 1, 2, \ldots, N + 1$.

The value of the function at the nodes of the spline $\tau_1, \tau_2, \ldots, \tau_N$ denote $\varphi_i$, $i = 1, 2, \ldots, N - 1$.

The statement [1]. Interpolation parabolic spline $S(x)$ ($v = 1, n = 2$) for a given breakdown $\Delta_x, \Delta_t$ of interval $[a,b]$, which satisfies the conditions (1) exists and is unique.

Proof. To construct the spline we use the Lagrange interpolation polynomial on each segments $[\tau_{i-1}, \tau_i]$, $i = 1, 2, \ldots, N$

$S(x) = f_0 \left( x - x_0 \right) \left( x - \tau_1 \right) + f_1 \left( x - x_0 \right) \left( \tau_1 - \tau_i \right) + \varphi_i \left( x - x_0 \right) \left( x - \tau_i \right)$

for $x \in [\tau_0, \tau_1]$, for $x \in [\tau_i, \tau_{i+1}]$.

...
$$S(x) = \varphi_{i-1} \frac{(x-x_i)(x-x_j)}{(x_j-x_i)(x_{j-1}-x_j)} + f_{i} \frac{(x-x_{j-1})(x-x_j)}{(x_j-x_i)(x_{j-1}-x_j)} + \varphi_{i-1} \frac{(x-x_i)(x-x_j)}{(x_j-x_i)(x_{j-1}-x_i)}$$

for $x \in [x_{j-1}, x_j]$, $i = 2, ..., N-1$.

$$S(x) = \varphi_{N-1} \frac{(x-x_N)(x-x_N+1)}{(x_{N-1}-x_N)(x_N-x_{N+1})} + f_N \frac{(x-x_{N+1})(x-x_N)}{(x_{N-1}-x_N)(x_N-x_{N+1})} + \varphi_{N-1} \frac{(x-x_N)(x-x_N+1)}{(x_{N-1}-x_N)(x_N-x_{N+1})}$$

for $x \in [x_{N-1}, x_N]$.

Let grids $\Delta_x, \Delta_x$ be uniform with a step $h$ and put

$$\tau_i = \frac{1}{2} (x_{i-1} + x_i) = x_{i-1/2}.$$

Consider $S'(x)$ for $x \in [\tau_0, \tau_1]$.

We have

$$S'(x) = \frac{2}{3h^2} f_0 [(x-x_0) + (x-\tau_1)] - \frac{4}{h^2} f_1 [(x-x_1) + (x-\tau_2)] + \frac{4}{3h^2} \varphi_1 [(x-x_0) + (x-x_1)].$$

Derivative at point $\tau_0 = 0$ written as

$$S'(|\tau_1 - 0|) = \frac{1}{3h} f_0 - \frac{3}{h} f_1 + \frac{8}{3h} \varphi_1.$$

We write derivative for $x \in [\tau_1, \tau_2]$ as

$$S'(x) = \frac{2}{3h^2} \varphi_1 [(x-x_2) + (x-\tau_2)] - \frac{4}{h^2} f_2 [(x-\tau_1) + (x-x_2)] + \frac{4}{h^2} \varphi_2 [(x-x_2) + (x-\tau_2)].$$

Derivative at point $\tau_1 = 0$ is written as

$$S'(\tau_1 + 0) = -\frac{3}{h} \varphi_1 + \frac{4}{h^2} f_2 - \frac{1}{h} \varphi_2.$$

Then, from the condition on the first derivative continuity at a point $\tau_1$

$$S'(\tau_1 - 0) = S'(\tau_1 + 0),$$

we shall have

$$\frac{1}{3h} f_0 = \frac{3}{h} f_1 + \frac{8}{3h} \varphi_1 = -\frac{3}{h} \varphi_1 + \frac{4}{h} f_2 - \frac{1}{h} \varphi_2$$

or

$$\frac{17}{3} \varphi_1 + \varphi_2 = -\frac{1}{3} f_0 + 3f_1 + 4f_2.$$  

We write the conditions $S'(\tau_i - 0) = S'(\tau_i + 0)$ for

$$S'(x) = \frac{2}{3h^2} \varphi_{i-1} [(x-x_{i-1}) + (x-\tau_i)] - \frac{4}{h^2} f_{i-1} [(x-\tau_{i-1}) + (x-x_i)] + \frac{2}{h^2} \varphi_{i-1} [(x-x_{i-1}) + (x-\tau_i)].$$

We write derivative $S'(x)$ for $x \in [\tau_i, \tau_{i+1}]$
It should be noted that the use of a cubic spline interpolation for table functions that are areas of rapid growth function may lead to its non-physical oscillations.

Fig. 2 shows a fragment of parabolic and cubic graphs [5]. This example demonstrates one of the drawbacks of a cubic spline. Namely, for step-like functions cubic spline function has variations in the vicinity of a sharp rising. This phenomenon is called the Gibbs effect [5]. It is evident that parabolic spline does not such fluctuations.

Thus, polynomials, that are components of the spline, have low order derivatives of function, we receive system of the equations for internal nodes of the net domain at a point in time \( \tau_k \) for each of the segments, substitute them with the same function in equation (10). On transformation of the expressions derived from the conditions of continuity of the first-order derivatives of function, we receive system of the equations for internal nodes of the net domain at a point in time \( \tau_{k+1} \).

Let two breakdown \( \Delta_{\chi} \) and \( \Delta_{\xi} \) be given on the interval \([0,L]\):

(a) \( \Delta_{\chi} : 0 = x_0 < x_1 < \ldots < x_N = L \),

(b) \( \Delta_{\xi} : 0 = x_0 < \xi_1 < \ldots < \xi_{N-1} = L \),

where \( x_i < x_j < x_{j+1}, i=1,N-2 \).

Let \( C_i \) and \( \varphi_i \) be some grid values and functions, respectively, grids (13a) and (13b), and \( \varphi_0 = C_0, \varphi_{N-1} = C_N \).

We find a solution in the form of parabolic spline. For this we write the piecewise quadratic function \( C(x) \) in \( k + 1 \) moment of time, \( x \in [\tau_i, \tau_{i+1}], i = 0, N-2 \), and find the first and second derivatives of the function on each of the segments, substitute them with the same function in equation (10). On transformation of the expressions derived from the conditions of continuity of the first-order derivatives of function, we receive system of the equations for internal nodes of the net domain at a point in time \( \tau_{k+1} \).

The monotonicity of scheme is proved [2].

Results on the scheme approximation error are given in [7]. Note, that the presence of reaction in equation (6) does not affect the accuracy of the scheme.

5. Examples of calculations

Using developed software numerical calculations were carried out. The coefficients of the equation, initial and boundary conditions were set as follows: \( L = 6; \ D = 0,0005; \ A = \pm 0,2; \ h = 0,001; \ u(0) = 1; \ u(L) = 0; \ u(x,0) = 0; \ V = 1 \).

A comparison of numerical solution of the problem (6)–(9) with the exact solution when \( A = 0 \) is given in [5]. An expression \( A \cdot u \) shall not affect the accuracy of numerical solution, so in this example we are interested only its effect on the quality characteristics of problem solution. Fig. 3, 4 shows a solutions of the problem as a "step" at different points in time.
The numerical solution of the problem can be reproduced in a parabolic spline on the full interval of integration.

6. Conclusion

Thus, we can say that the parabolic spline is an appropriate tool for interpolation of tabular air resistance functions. It should also be noted that the functions presentation in the form of spline is convenient for use in numerical algorithms.

Theoretical studies and the results of numerical experiments show that proposed monotonic difference scheme for the convection-diffusion-reaction equation allows solving boundary value problems for a wide range of coefficients values. This is especially true when convection is much higher than diffusion. Monotonic scheme provides stability numerical solution, and using of parabolic spline allows us to construct a solution as a continuous function at every time moment.

Literature

Influence of Connections Between Three-Phase Cable Conductors on the Quality of Electrical Energy

Abstract: In this article we are referring to distribution of electric energy through three-phase cable conductors on the basis of worked out mathematical model. This model includes availability of inductive and capacity couplings between cable conductors. Calculations made on the basis of this model show that in case of the extension of cable power lines by several kilometers, cross-couplings between conductors result to quality deviation of electric energy due to the occurrence of asymmetry of voltage system on range and phase.

Keywords: Electric cable, quality of electric energy, electromagnetic compatibility, mutual influence, transmission line

1. Introduction

Increasing complication of electrical equipment used by the consumers of electricity becomes the main tendency of modern society development. At the same time more attention is paid to ensuring the quality of electricity and electromagnetic compatibility between the components of electrical systems and networks. Today electronic devices are used in all spheres of industry, energy and transport areas.

These devices perform monitoring and control functions resulted to minimization of harmful impacts. In this case influence of feeder line onto the devices, cross-couplings between components of devices and influence of these devices onto electric network should be taken into the account. Analyzing the electromagnetic compatibility, you have to learn the effects of electromagnetic interference, which are emitted by devices. Besides mentioned above, there are also cables interferences spreading through conductors of power supply. Exactly these power cable lines are the most widespread in the power supply systems of large inhabited localities.

The advantages of cable lines over overhead transmission lines are the following:
- no need for assigning of exclusion zone for high-voltage lines in the conditions of dense development in inhabited localities;
- no need for housing developments demolition in a fenced-off area;
- high reliability of cable lines - they are not affected by weather factors, mechanical damages occur less often;
- cable lines allow to significantly reduce power losses during electricity transmission (according to [1], 30% less than in air lines).

As follows from [2] the total length of the cable networks in modern megalopolis could reach several hundred kilometers.

Given length brings to consideration of cable line as a line with distributed parameters in which currents and voltages could be significantly deviated [3].

Relating to the power cables we can talk about symmetry deviation of three-phase voltage system supplied to the top of the cable. Preliminary calculations for cable with two conductors showed significant deviation of the symmetry both in the range and also phase [4, 5]. Thus, analysis of influence of the three-phase cable on the quality of electric energy is a currently central task. For its implementation we need to create mathematical model of distribution of currents and voltage in the cable. On the basis of this model calculations for different modes of cable work should be executed. Distribution of the current and voltage along the length of the cable should be calculated. On the base of this calculations we will be able make conclusions about influence of connections between conductors in three-phase cables on electric energy quality.

2. The mathematical model of currents and voltages distribution

During calculation currents and voltages in the cable inclusive of magnetic and conductive coupling between its conductors, cable should be considered as a line with distributed parameters. In this case all currents and tension would be functions of two variables – time and distance. Calculation of distance is generally carried out from the beginning of cable. As the beginning we will take that end of cable to which the source of three-phase electric power is connected.

Existing galvanic and capacitive couplings between cable conductors are simulated by conductance G and capacitors C. The reason of galvanic couplings is no ideality of cable insulation. Despite excellence of used materials, any real dielectric has a very low conductivity. Hereinafter, the conductivity G is thought of as conductivity of cable unit of length, measuring in S/m. Conductivity in theoretical electrical engineering usually is symbolized as G_0. Index "0" will be omitted for simplifying indexing.

Capacitive coupling existence is clear - this is inevitably present capacitance between cable conductors, each conductor and the screen too. As well as in case of the conductivities, hereinafter it is thought of the conductor unit of length, measuring in F/m. Besides galvanic and capacitive coupling, cable conductors have a magnetic connection between the M_{13}, M_{13} and M_{23} coefficients of mutual induction. Each of the conductors is characterized by their own specific parameters – inductance L and resistance R. Here it is thought of specific (per length unit) inductances and resistance as well.

 Undertaken analysis allows to make an equivalent circuit of three-phase power cable section. Practicing Kirchhoff's first and second laws, on the basis of this equivalent circuit a mathematical model of the currents and voltages distribution in the cable could be obtained. Taking into account that all the currents and voltages are a function of two variables, mathematical model should be represented in the form of the system of differential equations in partial derivatives. The process of composing of equivalent circuit and mathematical model is described in details in [6]. As follows from [6], mathematical model of currents and voltages distribution in the cable has the following form as system (1).

This system of the equations is mathematical model of dependence of currents and voltages in cable conductors from the temporal and spatial coordinates. This fact in good agreement with the well-known of the theoretical electrical equations for the single lines. But at the same time, this fact brings considerable difficulties in solving systems of equations. The general theory of solutions of equations in mathematics missing.
\[
\begin{align*}
-\frac{\partial u_1}{\partial t} &= R_1 i_1 + L_1 \frac{\partial i_1}{\partial t} + M_{12} \frac{\partial i_2}{\partial t} + M_{13} \frac{\partial i_3}{\partial t} \\
-\frac{\partial u_2}{\partial t} &= R_2 i_2 + L_2 \frac{\partial i_2}{\partial t} + M_{12} \frac{\partial i_1}{\partial t} + M_{23} \frac{\partial i_3}{\partial t} \\
-\frac{\partial u_3}{\partial t} &= R_3 i_3 + L_3 \frac{\partial i_3}{\partial t} + M_{13} \frac{\partial i_1}{\partial t} + M_{23} \frac{\partial i_2}{\partial t} \\
\frac{\partial u_1}{\partial x} &= G_{11} \cdot u_1 - G_{12} \cdot u_2 - G_{13} \cdot u_3 + C_{11} \cdot \frac{\partial u_1}{\partial t} - C_{12} \cdot \frac{\partial u_2}{\partial t} - C_{13} \cdot \frac{\partial u_3}{\partial t} \\
\frac{\partial i_{1x}}{\partial x} &= \gamma_1 \cdot i_{1x} + \frac{\partial \psi_{1x}}{\partial t} \frac{\partial \psi_{1x}}{\partial x} - \frac{1}{\gamma_1} \frac{\partial^2 \psi_{1x}}{\partial x^2} \\
\frac{\partial i_{2x}}{\partial x} &= \gamma_2 \cdot i_{2x} + \frac{\partial \psi_{2x}}{\partial t} \frac{\partial \psi_{2x}}{\partial x} - \frac{1}{\gamma_2} \frac{\partial^2 \psi_{2x}}{\partial x^2} \\
\frac{\partial i_{3x}}{\partial x} &= \gamma_3 \cdot i_{3x} + \frac{\partial \psi_{3x}}{\partial t} \frac{\partial \psi_{3x}}{\partial x} - \frac{1}{\gamma_3} \frac{\partial^2 \psi_{3x}}{\partial x^2} \\
\end{align*}
\]

Therefore, analytical solution of system (1) is impossible in general. But for particular cases such as sinusoidal time-varying currents and voltages this system solution is possible. This particular case is of the greatest practical interest.

Let us suppose actions of variable sinusoidal voltages in the cable conductors, which in general terms could be fixed as:

\[ u_{1x} = U_{1x} \sin(\omega t + \psi_{1x}) \], \[ u_{2x} = U_{2x} \sin(\omega t + \psi_{2x}) \], \[ u_{3x} = U_{3x} \sin(\omega t + \psi_{3x}) \].

The currents functioning in cable conductors in a general term could be fixed as sinusoidal functions:

\[ i_{1x} = I_{1x} \sin(\omega t + \psi_{1x}) \], \[ i_{2x} = I_{2x} \sin(\omega t + \psi_{2x}) \], \[ i_{3x} = I_{3x} \sin(\omega t + \psi_{3x}) \].

Representing these currents and voltages in complex form into the system (1) after transformations results to the following:

\[
\begin{align*}
\frac{d\hat{U}_1}{dx} &= Z_{11} \hat{I}_1 + Z_{12} \hat{I}_2 + Z_{13} \hat{I}_3 \\
\frac{d\hat{U}_2}{dx} &= Z_{21} \hat{I}_1 + Z_{22} \hat{I}_2 + Z_{23} \hat{I}_3 \\
\frac{d\hat{U}_3}{dx} &= Z_{31} \hat{I}_1 + Z_{32} \hat{I}_2 + Z_{33} \hat{I}_3 \\
\frac{di_{1x}}{dx} &= Y_{11} \hat{I}_1 - Y_{12} \hat{I}_2 - Y_{13} \hat{I}_3 \\
\frac{di_{2x}}{dx} &= -Y_{21} \hat{I}_1 + Y_{22} \hat{I}_2 - Y_{23} \hat{I}_3 \\
\frac{di_{3x}}{dx} &= -Y_{31} \hat{I}_1 + Y_{32} \hat{I}_2 + Y_{33} \hat{I}_3 \\
\end{align*}
\]

The system (2) is a mathematical model of currents and voltages distribution process in the conductors of three-phase cable in a steady sinusoidal mode. In this system, introduced the parameters of the conductors are identical. The system solution (2), obtained by Wolfram-Alpha computer program is as follows:

\[
\begin{align*}
U_1(x) &= \frac{I}{3}(C_1 + C_3) \cdot \chi_{r1} \cdot x + (2C_2 - C_3 - C_1) \cdot \chi_{r2} \cdot x + (C_2 + C_4 + C_6) \cdot \frac{1}{\gamma_1} \cdot \frac{\partial \psi_{1x}}{\partial x} - (C_2 + C_4 + C_6) \cdot \frac{1}{\gamma_2} \cdot \frac{\partial \psi_{2x}}{\partial x} \\
U_2(x) &= \frac{I}{3}(C_1 + C_3) \cdot \chi_{r1} \cdot x + (2C_2 - C_3 - C_1) \cdot \chi_{r2} \cdot x + (C_2 + C_4 + C_6) \cdot \frac{1}{\gamma_1} \cdot \frac{\partial \psi_{1x}}{\partial x} - (C_2 + C_4 + C_6) \cdot \frac{1}{\gamma_2} \cdot \frac{\partial \psi_{2x}}{\partial x} \\
U_3(x) &= \frac{I}{3}(C_1 + C_3) \cdot \chi_{r1} \cdot x + (2C_2 - C_3 - C_1) \cdot \chi_{r2} \cdot x + (C_2 + C_4 + C_6) \cdot \frac{1}{\gamma_1} \cdot \frac{\partial \psi_{1x}}{\partial x} - (C_2 + C_4 + C_6) \cdot \frac{1}{\gamma_2} \cdot \frac{\partial \psi_{2x}}{\partial x}
\end{align*}
\]

In system (3) distribution coefficients \( \gamma_1 \) and \( \gamma_2 \) could be found under formulas:

\[
\gamma_1 = \sqrt{Z_{11} + 2Z_{12}}, \quad \gamma_2 = \sqrt{Z_{21} + 2Z_{22}}.
\]

Wave resistances \( Z_{B1} \) and \( Z_{B2} \) are as follows:

\[
Z_{B1} = \frac{Z_2 + 2Z_1}{\sqrt{\gamma_2}}, \quad Z_{B2} = \frac{Z_1 - Z_2}{\sqrt{\gamma_2}}.
\]

The integration constants \( C_1 \) and \( C_6 \) could be found from the initial conditions. In our case by condition it is known voltages at the beginning of the first, second and third conductors \( U_{11}, U_{22} \) and \( U_{33} \) correspondingly. The loading resistances, connected at the end of these conductors \( Z_{H1}, Z_{H2} \) and \( Z_{H3} \) are considered to be well-known. Integration constants with odd numbers could be found as:

\[
C_{i} = U_{ii}, \quad C_{i} = U_{ii}, \quad C_{i} = U_{ii}.
\]

The second group of integration constants \( C_2, C_4 \) could be found under formulas:

\[
C_2 = \frac{(A_2 - A_2)F_2 + (A_4 - A_4)F_4 + (A_2 - A_2)F_4}{2A_2A_2A_4A_4 - A_2A_2A_4A_4 - A_4A_4A_2A_2 + A_2A_2A_4A_4}, \quad C_4 = \frac{(A_2 - A_2)F_2 + (A_4 - A_4)F_4 + (A_4 - A_4)F_4}{2A_2A_4A_2A_4 - A_4A_4A_2A_2 - A_2A_2A_4A_4 + A_4A_4A_2A_2}.
\]

where:
Asymmetries on amplitude and phase were taken as the main indicators of the quality of electrical energy. Asymmetry on amplitude is calculated as absolute differential value of voltage of separate phases at the cable end. Ideally this difference is equal to zero. Asymmetry on phase is calculated as a deviation of a voltage phase lag of separate cords of a cable from 120 degrees. Ideally asymmetry in a phase is equal to zero.

As a result of calculations, it is found out that, in the case of symmetrical load, magnetic and galvanic connections between cable conductors do not affect both selected indicators. This is explained by the fact that in case of voltage phase difference of A conductor and B conductor their influence on C phase conductor is mutually balanced. Therefore, the main attention, when performing researches, was concentrated on the emergency operation of work of three-phase system arising at break of one of the phases. In this case the influence of one of the cable conductors disappears and begins to appear the influence of magnetic and conductive coupling.

In Fig. 2 it is shown the dependence of asymmetry on amplitude, occurring in conductors of phases A and B at break of phase C. The calculations were performed for the frequency 50 Hz.

The distance from the beginning of a cable (in kilometers) is shown here on abscissa axis, and on ordinate axis – asymmetry on amplitude (in volts). As it is seen, in the middle of the cable under symmetric source the asymmetry in amplitude is more than 1,100 volts (about 11% of the input voltage).

In Fig. 3 it is shown the dependence of asymmetry on a phase for the same cable and same frequency. The distance from the beginning of a cable (in kilometers) is shown here on abscissa axis, and on ordinate axis – asymmetry on phase (in degrees).

From this figure it is visible that with increase of a cable length asymmetry degree on phase increases and can reach 25 – 30 degrees, that is more than 25%.

However, in practice the electrical network analysis is performed at a frequency of the fiftieth harmonic component, i.e. 2500 Hz. Therefore, these calculations were performed again for...
this frequency. In Fig. 3 it is shown the dependence of asymmetry on amplitude, occurring in conductors of phases A and B at break of phase C for the frequency 2500 Hz.

![Fig. 3](image)

**Fig. 3.** Dependence of asymmetry on amplitude on the cable length for the frequency 2500 Hz.

As it is seen from Fig. 4, at the distance 20km from cable beginning the asymmetry in amplitude is more than 4,000 volts, about 40% of the input voltage. There is a very high asymmetry, when work of electrical network is not possible.

However, phase asymmetry for the frequency 2500Hz much higher than for the asymmetry frequency 50Hz. The corresponding plot is shown in Fig. 5.

**Fig. 5.** Dependence of asymmetry on phase on the cable length for the frequency 2500 Hz

From this figure it is visible that with increase of a cable length asymmetry degree on phase increases and can reach 120 degrees, that is more than 100%!

In Fig. 4 and Fig. 5 on abscissa axis the distance from the beginning of a cable (in kilometers) is shown, and on ordinate axis – asymmetry on amplitude (in volts, fig. 4) or asymmetry on phase (in degrees, Fig.5).

4. Conclusions

Traditional of cable transmission lines, effects due to the mutual influences are not involved. However, as calculations have shown, it is impossible to neglect these effects with line length of several tens kilometers

The mutual inductive and galvanic connections between cable conductors lead to the fact that even with a symmetrical three-phase source, connected to the beginning of cable, asymmetrical electric supply comes to the load. These effects are observed only in emergency mode in the case of load asymmetry.

In this article it is described only cases of emergency mode - break of one of the phases. Therefore, further research directions could include:

- work research of cable line under short circuit of one of phases;
- affect research of asymmetry load on the quality of electric energy;
- experimental researches of revealed effects in real cable power lines.

However, conducting of experimental researches is connected with quite substantial difficulties. For their performance it is necessary to have a three-phase cable of very big length – several tens kilometers. Taking into account that the cost of N2XSEY 3×50/16 cable, according to the catalog, is about 50 euros for 1 meter, acquisition of such cable for experimental studies becomes almost impossible. The solution of this problem is the performance of researches on the cables much shorter in length, but frequency much higher than industrial one – 50 Hz. The experimental data obtained in such a way needs to be compared to the calculations, executed under given mathematical model for the same length and frequency. This technique also opens the way for study of transients into three-phase power cables under the presence of inductive and conductive coupling between the conductors.

References

AUGMENTED REALITY AND CYBER CHALLENGES EXPLORATION

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Abstract: Digital environment progress towards real and virtual realities mixing is reasonably producing new understandings for ICT progress expectations. In today's mobile web world, augmented realities are practically integrating 'Internet of Things' (IoT) mobile concept and 3D visualization technologies into a new evolving smart world. This changes our everyday life concepts, adding capabilities with innovative functionalities. However, it also is generating multiple challenges from cybersecurity perspective. This paper studies the problem for human-machine interaction, accentuating on the multifaceted understanding of possible threat sources and attack vectors in the new augmented reality research area. In this context, a system model with prognostic analysis is proposed. The necessity of obtained results validation is finally discussed.

Keywords: AUGMENTED REALITY, IOT, HUMAN-MACHINE INTERACTION, CYBER THREATS, MODELLING, ANALYSIS

1. Introduction

The term “virtual” has become more and more popular in recent years. In general, something virtual has the attributes of something that exists in reality but that “virtual something” is replicated or presented by something else. In computing, the term “virtual memory” exists for a long time and means an approach of using a big amount of memory, which does not exist as hardware memory chips, so that the programmer can use amount of memory without bothering for its existence. Another popular term in the last decade is “virtual machine”. This is an emulation of a particular computer system and working on a virtual machine allows someone to work as if doing so on a real (hardware) machine, which does not exist physically. In general, we can assume that any “virtual” object refers to a specific type of emulation of some real object.

The approach of using the properties of a real object has been used very successfully in training and education. The virtual reality technology was introduced in the form of a flight simulator by Thomas A. Furness III, who is often referred to as the 'Grandfather of Virtual Reality' [1]. According to Sherman and Craig [2] there are four key elements of Virtual Reality - Virtual World, Immersion, Sensory Feedback and Interactivity. The first element is the content of a given medium which may exist only in the mind of the creator and there are ways to be shared with others. The second element means that a user is immersed into alternative point of view – i.e. the feeling of being in an environment. The Sensory Feedback allows the system to track actions/movements of the participant in the emulated system. The forth element is the response of the system to the actions of the participant. Summarizing the concepts above illustrates that the term “Virtual Reality” is used to describe a computer generated environment, in all possible dimensions, in which a human can be part of and interact with the surrounding environment.

The advance of computing power and computer based system allowed the creation of complex and powerful systems. In addition to training of pilots (well-known flight simulators), virtual systems are used in combat training for the military. Using head-mounted display (HMD), gloves, weapons and other items allows proper training for combat. The virtualization makes possible repetition of various situations in a wide variety of terrains and situations [3].

As shown above, Virtual Reality replaces the real environment with a computer generated. Unlike it (but having similarities) the Augmented Reality has a direct view of the real environment, where its elements are supplemented, or augmented by computer-generated sensory input such as sound, video, graphics or GPS data [4]. Generally, in this concept, a view of reality is modified by a computer system and program. As a result, the technology functions by enhancing the presented perception of reality. Similarly to the Virtual Reality, the Augmented Reality uses head-mounted displays, computers and specialized software. In Augmented Reality popular hardware are also accelerometer, GPS and solid state compass. As in Virtual Reality, Augmented Reality is applied in military, industrial, educational, medical and commercial applications. It is used to visualize building projects; to see a content of a packed commercial product; to interact educational content (like historical events, engineering concepts, etc.) with the students; provide otherwise hidden information to doctors or surgeons; provide battlefield data onto a soldier's goggles in real time [5], etc.

A key technology that became wide spread is the mobile computing and communication – smart phones, tables and other devices are already inseparable part of our everyday life. Another important technology, which is emerging and will have an enormous impact on the future according to almost all forecasts and to the most influential companies in the IT sector, is the Internet of Things (IoT). It is very likely that those technologies will integrate with Virtual and Augmented Reality approaches.

2. Dangers of Augmented and Virtual Reality

Having all those gains and benefits does not come without concerns. Using this technology one may not be able to correctly estimate the speed of an object or a car or ignore some of the threats of the real, surrounding environment. And there are serious concerns about those technologies – some can be physical threats, other – behavioral, privacy, security and some can be placed even at a level of “National security threat” [6]. In Table 1 we present a classification of threats in Augmented and Virtual Reality.

<table>
<thead>
<tr>
<th>Types of threats</th>
<th>Examples</th>
<th>Effect</th>
<th>Level of threat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical threats</td>
<td>Devices (like head mounted displays) and sensors do not respond quickly or accurately in the simulated environment</td>
<td>On the health or even life of humans – immediately or in later situations in real environment</td>
<td>High</td>
</tr>
<tr>
<td>Security threats</td>
<td>Criminals or terrorist acquiring those technologies and getting hold of software or communication</td>
<td>Exposure of the security holes of important sectors (police, military, industrial, communication)</td>
<td>High</td>
</tr>
<tr>
<td>Behavioral threats</td>
<td>Using avatars (instead of real person) for destructive behavior – harassing and stalking</td>
<td>Annoying, bullying and stressing others</td>
<td>Medium</td>
</tr>
<tr>
<td>Educational or training threat</td>
<td>Acquiring improper skills and knowledge of environment</td>
<td>Trainees can not cope in real-life situations</td>
<td>Medium to high</td>
</tr>
<tr>
<td>Bad investment</td>
<td>Developing augmented/virtual reality platform can be very expensive</td>
<td>Projects on augmented/virtual reality can bankrupt major developers</td>
<td>Medium</td>
</tr>
</tbody>
</table>
The physical threats may come from the imperfection of devices like head-up displays, or their non-interference with the peripheral vision of the pilot/users as the displays present information only in the central field. Also there is the threat of misjudging relative motions, due to the poorer (or absent) peripheral field.

In regard to the security threats there are significant risks in the way augmented or virtual environments are deployed. The communications used in such platform - voice, position, messages have to be protected and encrypted.

As mentioned above, virtual/augmented reality is often used in training. There is also the issue that those technologies help reducing social and cultural barriers, giving the chance of some to participate at higher level in the educational process. And often this is done using avatar. Here come the behavioral threats, where some individuals can assert a more destructive behavior, showing an non proper conduct of behavior.

Privacy threats are of concern even at present virtual societies like Facebook and Google+. Monitoring of presence, behavior and other issues of their users is alarming and stressful.

While those technologies can bring a great benefit, jumping on their use and development might be for a number of companies. It might be better to start with pilot virtual/augmented reality projects than spending a lot of money and not getting the expected advantage and value.

IoT has also a big security problem – sensors and other devices used in it are built with little or no security requirement. This could lead to serious vulnerabilities in applications in home, cities, industry, etc.

### 3. Cyber threats and challenges Exploration

Further on in the paper the problem with augmented and virtual reality mixing will be studied in a modeling context that allows to outline some trends and beliefs using experts’ opinion, incorporated in a (3.1) system modelling approach and (3.2) probabilistic evaluation, following the approach proposed in [7].

#### 3.1. System Modelling

The organization of this stage is based on the ideas of Vester’s Dynamic System Theory generalization [8], successfully implemented for multiple cyber threats exploration [9], [10]. The modelling is performed, using experts’ opinions, literature analysis data and I-SCIP-SA software environment [11].

A graphical interpretation of Chen’s ‘E-R’ paradigm [12] is used, describing elements, as related entities in the model. All relations (uni- or bi-directional) are weighted in time (times equal to 0, concern static models, whilst – arrays of time values with certain functional – dynamic ones). Graphically, entities are marked with labeled rectangle or circle and relations, with arrows, labeled for both weight (yellow) and time (blue).

The resulting entities classification is obtained via generalization of relations weights visualized into a three dimensional Sensitivity Diagram (SD), using: influence (x), dependence, (y) and sensitivity (z) values. SD is providing four-sector entities classification (in accordance with x, y, z values): green – ‘buffering’, red – ‘active’, blue – ‘passive’ and yellow – ‘critical’. Additional, ‘active’ (white, positive z values) and ‘passive’ (grey, negative z values) reassessment for each of the entities in a certain sector is also accomplished. This is also marked with elements’ sensitivity evaluation towards the z axis. All entities from the model are visualized in SD with indexed balls.

A practical modelling implementation of ‘IoT Gadgets’ into augmented and virtual - mixed ‘Environment’ in the context of ‘Users’ and Machine-To-Machine Artificial Intelligence developments – ‘M2M AI Devts’, evolution together with the smart avatars ‘Advanced Interface’ and ‘Cloud Services’ for the modern connected by ‘Network Comms’ web world is given in Figure 1.

The resulting model SD (see Figure 1b) is defining the following classification for model potential sources of cyber threats: critical: ‘Network Comms’ – ‘5’ and ‘M2M AI Devts’ – 7; active: ‘IoT Gadgets’ – ‘4’, ‘Advanced Interface’ – 6; passive: ’Cloud Services’ – ‘1’, ‘Users’ – ‘3’; buffering: ‘Environment’ – ‘2’.

A further results probabilistic assessment is accomplished as the identified threats and challenges would be interesting for future dynamics trends evolution.

#### 3.2. Probabilistic Assessment

Due to the prognostic nature of results from section 3.1, the studied processes have to be considered from multiple viewpoints. This practically, could be achieved combining selected system analysis entities classification from the SD (giving a priori assessment) with suitable probability distributions shapes. Thus, both experts’ beliefs and development trends can be implemented as given in [7].

Additional further validation via agent-based simulation of cyberattacks towards selected relations of a certain entity of interest is performed. This provides a posteriori simulated probabilities change by assessing hypothetical evolution scenarios.

Five trends have been considered (‘Users’, ‘IoT Gadgets’, ‘Environment’, ‘Network Comms’, ‘Cloud Services’) for the most innovative entity ‘M2M AI Devts’ from the presented model in section 3.1.

A resulting simulation from Matlab R2011b environment, using Beta distribution and cyberattacks probability defined after official statistics and experts’ data beliefs [10], [13] with five-years’ time horizon is provided in graphical form on Figure 2.
According to the presented simulation results, ‘IoT Gadgets’, ‘Cloud Services’, ‘Network Comms’ and smart ‘Environment’ (see Figure 2) are expected to be most probable ($M > 0.5$) for future cyberattacks in the new, mixed augmented reality environment.

4. Discussion

The presented analytical approach for exploration of innovative problems from modern digital world, like ‘Augmented Reality’, mixing in practice the real and virtual world is producing a useful solution towards the proper analysis of the present and future cyber security problems in this new media of human-machine interaction. When the proposed ideas are implementing experts’ beliefs and simulation models, practical experimentation even within real laboratory environment will be of vital importance. Useful support in this sense could be obtained from hybrid simulations, like ‘Academic Cyber CAX 2015’ [14] and ‘CYREX 2016’ [15].

5. Acknowledgement

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References


EXPERIMENTAL INVESTIGATION OF RADIO PERFORMANCE IN WIRELESS ACCESS NETWORK

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Abstract: This paper discusses the design and the implementation of the wireless access network in residential complex with minimum access points. It has been investigated the power of transmitted signal and signal noise ration of the designed network. The experimental results show that the designed network has very good quality performance.

Keywords: ETHERNET, LAN, NETWORK, WI-FI

1. Introduction

The project includes the building of a Wi-Fi network, ensuring wireless internet in a residential complex with minimum number of access points. Having in mind the specific features of the terrain and the complex as well, an optimal ways for installation of the antennas has been chosen [1]. The preliminary report has found that for the execution of the task four access points are enough for ensuring quality broadband range.

![Fig. 1 Variant one](image1.png)

Fig. 1 Variant one

The antennas are situated according to two foreseen variants. Variant one (fig.1) and respectively - variant two (fig.2). For better coverage in the complex, circular (not pointed) antennas are used and the broadcasting angle is 360 degree. The foreseen small distances make possible the usage of less amplifying antennas.

![Fig. 2 Variant two](image2.png)

Fig. 2 Variant two

The distribution of the rooters is at a height between 5 and 10 meters for ensuring full coverage [2].

2. Experiments

For ensuring full coverage, the foreseen four access zones are adjusted at four different frequency channels. For avoiding interference, the frequency channels are overlapping.

Point 1 - 4th fr channel
Point 2 - 1st fr channel
Point 3 - 7th fr channel
Point 4 - 11th fr channel

Fig.3 and fig.4 show the frequency channels in the used working range.
In the experimental part, two measurements have been executed – for each of the controls for wi-fi internet [3].

Fig. 4 shows the resulting values for the level of the signal, the ratio signal/noise and the frequency channels of each router [4].

The right situation and targeting of the antennas ensure the optimal level of the broadcasted signal and its spreading in the covering zones see Fig.5.

The measured value of the signal strength is -24 dBm for the Wi-fi network (fig.6). The results guarantee quality of the signal in the covered zones.

The executed tests prove the optimal choice and adjustments with regard to the ratio signal/noise see fig.7, 8, 9, 10.
The graphical results have been obtained when the rooters work respectively in first, fourth, seventh and eleventh frequency channels.

4. Conclusion

The executed tests and measurements show, that the designed wireless network covers the requirements for reliability and quality of the signal.

For the choice of the hardware has been taken into account the possibility for power supply trough Ethernet (PoE).

The test results of Vo802.11 network make obvious its ability to compete with PSTN using uncompressed voice and the appropriate protocols. The possibility for using compressed format of the data makes the system flexible and preferred from the network designers.

References


DESIGN OF CONTROL SYSTEM WITH INCREASED POTENTIAL OF ROBUST STABILITY FOR NONLINEAR OBJECT USING LYAPUNOV FUNCTION

ПОСТРОЕНИЕ СИСТЕМЫ УПРАВЛЕНИЯ С ПОВЫШЕННЫМ ПОТЕНЦИАЛОМ РОБАСТНОЙ УСТОЙЧИВОСТИ НЕЛИНЕЙНЫМ ОБЪЕКТОМ С ИСПОЛЬЗОВАНИЕМ ФУНКЦИИ ЛЯПУНОВА

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Abstract: The article considers approach to construction of control system with increased potential of robust stability of spacecraft in the class of three-parametric structurally stable mappings. Since modern control systems are developed and operated in conditions of significant uncertainty, increasing the potential of system’s robust stability is one of the key factors that guarantee the system of protection against the generation of deterministic chaos and instability. In this regard, in conditions of great uncertainty, to build a control system with rather wide area of robust stability is proposed a method for constructing Lyapunov functions based on the geometric interpretation of Lyapunov's theorems on asymptotic stability and dynamic systems stability concepts.

KEYWORDS: ROBUST STABILITY, LYAPUNOV’S FUNCTION METHOD, THREE-PARAMETRIC STRUCTURALLY STABLE MAPPING.

1. Introduction

In the modern automatic control theory, one of the key directions is analysis and synthesis of control systems under uncertainty conditions. This is due to various factors such as inaccurate knowledge of mathematical models of technological processes and technical objects, simplifying models, lowering complexity, or neglect of existing nonlinearities and changing control system parameters in an unpredictable manner under the influence of external and internal disturbances. Therefore, the need for creating such automated systems arises, which in time of object parameters change and influence of external disturbances would have been remained not only in steady state but also provide the required quality of operation. The study and synthesis of such systems is carried out in the framework of robust control theory. The idea of robust design is that it is necessary to choose such settings of control parameters so that the influence of external factors on the output characteristics was minimal [1, 2].

Latest studies have identified a great variety of nonlinear systems dynamics. One of the fundamental properties of nonlinear systems is generation of deterministic chaos, forming a "strange attractor" in state space. In dynamical systems it is shown as loss of control system stability. Chaotic modes in the system can act sometimes as unwanted, harmful modes, and sometimes as main useful modes of operation. In the first case, when you construct a control system it is required to suppress or avoid the development of undesired scenario of chaotic processes and instabilities, and the second is to ensure the maintenance of the given chaotic motion system. Chaotic systems are a class of models of uncertainty. Robust stability conditions of these systems allow existence of instability regions of controlled system stationary states. Present conditions for the suppression or exclusion of scenarios with development of chaotic motions process with the help of control is being studied.

Models describing chaotic behavior occur in many fields of science and technology, and in some cases are a more appropriate tool for describing the irregular fluctuations and uncertainty than stochastic, probabilistic model. It suffices to observe that a wide class of chaotic systems is a well — known pseudo-random number generator, appeared long before the introduction into scientific use of the term "chaos". Surprising was revealed the possibility of significant changes in the properties of chaotic systems using a very small variation of its parameters. However, despite the huge number of publications, including several monographs, rigorous results have been accumulated a little, and many issues remain open. Considering a wide range of potential applications, the field represents interest for, both for theorists and engineers on control systems [5].

It should be noted that deterministic chaos is generated in spacecraft orientation and stabilization systems as a result of loss of stability of the existing steady states, i.e. output is determined by the uncertain parameters of a system beyond the boundaries of robust stability. One of the approaches to deterministic chaos control can be expansion of robustness depending on uncertain parameters changes of the system, i.e. the increased potential of robust stability system [6].

The present study represents a new approach to control of deterministic chaos and to the creation of a control system with increased potential of robust stability [7] systems orientation and stabilization of spacecraft, based on the results of the qualitative theory of dynamical systems and catastrophe theory [8, 9], where, in particular, classified and studied elementary structurally-stable mappings, which are limited to and directly determined by the number of parameters. Also used the idea of gradient mode dynamical systems, the potential function of a vector of Lyapunov functions [10, 11, 12]. Also the main results obtained by applying the above methods are covered in this study.

2. Main mathematical model

Let’s review nonlinear system of the spacecraft [13]:

\[
\begin{align*}
\frac{dx_1}{dt} &= x_2 \\
\frac{dx_2}{dt} &= \frac{1}{I_s} (I_y - I_x) x_3 x_6 + \frac{1}{I_s} (-M_{u} + M_{d}) \\
\frac{dx_3}{dt} &= x_4 \\
\frac{dx_4}{dt} &= \frac{1}{I_s} (I_y - I_x) x_3 x_6 + \frac{1}{I_s} (-M_{u} + M_{d}) \\
\frac{dx_5}{dt} &= x_6 \\
\frac{dx_6}{dt} &= \frac{1}{I_s} (I_y - I_x) x_3 x_6 + \frac{1}{I_s} (-M_{u} + M_{d})
\end{align*}
\]

where \(I_x, I_y, I_z\) - are main central products of spacecraft inertia relative to the corresponding axes; \(M_{u}, M_{d}, M_{u} \in M_{d}, M_{d}, M_{d}\) - accordingly, the projection of controlling and destabilizing moments on to the corresponding axes.

The control laws are given in the form of three-parametric structurally stable mappings:
\[
\begin{align*}
-M_{m} + M_{p} &= -x_{1}^3 - x_{1}^2 - k_{12}x_{1}x_{2} + k_{1}x_{1} + k_{2}x_{2} \\
-M_{m} + M_{ip} &= -x_{1}^3 - x_{1}^2 - k_{12}x_{1}x_{2} + k_{1}x_{1} + k_{2}x_{4} \\
-M_{m} + M_{d} &= -x_{1}^3 - x_{1}^2 - k_{12}x_{1}x_{2} + k_{1}x_{1} + k_{2}x_{4}
\end{align*}
\]  \tag{2}

The system (1) considering (2) can be written as:
\[
\begin{align*}
\frac{dx_{1}}{dt} &= x_{2} \\
\frac{dx_{2}}{dt} &= a(\frac{1}{b} - \frac{1}{c})x_{2}x_{5} - ax_{1}^3 - ax_{1}^2 - ak_{1}x_{1}x_{3} + ak_{1}x_{1} + ak_{2}x_{2} \\
\frac{dx_{3}}{dt} &= x_{4} \\
\frac{dx_{4}}{dt} &= b(\frac{1}{c} - \frac{1}{a})x_{4}x_{5} - bx_{1}^3 - bx_{1}^2 - bk_{1}x_{1}x_{3} + bk_{1}x_{1} + bk_{2}x_{4} \\
\frac{dx_{5}}{dt} &= x_{6} \\
\frac{dx_{5}}{dt} &= c(\frac{1}{a} - \frac{1}{b})x_{5}x_{6} - cx_{1}^3 - cx_{1}^2 - ck_{1}x_{1}x_{3} + ck_{1}x_{1} + ck_{2}x_{5} + 0
\end{align*}
\]  \tag{3}

3. Stationary states of control system

Now we determine stationary states of the system:
\[
\begin{align*}
x_{1} &= 0 \\
a(\frac{1}{b} - \frac{1}{c})x_{2}x_{5} - ax_{1}^3 - ax_{1}^2 - ak_{1}x_{1}x_{3} + ak_{1}x_{1} + ak_{2}x_{2} = 0 \\
x_{4} &= 0 \\
b(\frac{1}{c} - \frac{1}{a})x_{4}x_{5} - bx_{1}^3 - bx_{1}^2 - bk_{1}x_{1}x_{3} + bk_{1}x_{1} + bk_{2}x_{4} = 0 \\
x_{6} &= 0 \\
c(\frac{1}{a} - \frac{1}{b})x_{5}x_{6} - cx_{1}^3 - cx_{1}^2 - ck_{1}x_{1}x_{3} + ck_{1}x_{1} + ck_{2}x_{5} = 0
\end{align*}
\]  \tag{4}

From equations (4) we find stationary states of the system:
\[
x_{1} = 0, x_{2} = 0, x_{3} = 0, x_{4} = 0, x_{5} = 0, x_{6} = 0
\]  \quad \tag{5}

Other stationary states are specified by solution of the equation:
\[
-x_{1}^3 + k_{1} = 0, x_{2} = 0, -x_{3}^3 + k_{2} = 0, x_{4} = 0, -x_{5}^3 + k_{3} = 0, x_{6} = 0
\]  \quad \tag{6}

The solution of the equations (6) is
\[
x_{1} = \pm \sqrt[3]{k_{1}}, x_{2} = 0, x_{3} = \pm \sqrt[3]{k_{2}}, x_{4} = 0, x_{5} = \pm \sqrt[3]{k_{3}}, x_{6} = 0
\]  \quad \tag{7}

Lets research robust stability of stationary states (5) and (7) of the system (3) using Lyapunov’s method.

4. Research of control system’s robust stability

We investigate the robust stability of the system’s (3) stationary state (5), developed by Lyapunov functions method [12].

We denote components of vectors gradient through:
\[
\frac{\partial V_{x}}{\partial x_{1}} = 0, \quad \frac{\partial V_{x}}{\partial x_{2}} = 0, \quad \frac{\partial V_{x}}{\partial x_{3}} = 0, \quad \frac{\partial V_{x}}{\partial x_{4}} = 0, \quad \frac{\partial V_{x}}{\partial x_{5}} = 0, \quad \frac{\partial V_{x}}{\partial x_{6}} = 0
\]

Also, each component of the velocity vector are to be presented in the form of decomposition according to the coordinate axes \( x_{1}, \ldots, x_{6} \):
\[
\begin{align*}
\frac{dx_{1}}{dt} &= 0, \quad \frac{dx_{2}}{dt} = x_{3}, \quad \frac{dx_{3}}{dt} = x_{1}, \\
\frac{dx_{4}}{dt} &= 0, \quad \frac{dx_{5}}{dt} = x_{2}, \quad \frac{dx_{6}}{dt} = x_{4}.
\end{align*}
\]

In this representation, the gradient vector from the Lyapunov vector-functions and from the velocity vector and its projections on the coordinate axis of the full derivative on time from Lyapunov vector-functions can be represented in the form of:
\[ \frac{dV}{dt} = \frac{\partial V(x)}{\partial x} \frac{dx}{dt} = \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{\partial V_i(x)}{\partial x_j} \left( \frac{dx_j}{dt} \right) = -x_i^2 - \]

\[ -\left( a_{i1} x_i + \frac{1}{2} a_{i2} x_i x_j - a_{i2} x_j \right)^2 - \frac{a_{i1}}{2} \left( \frac{1}{b} - \frac{1}{c} \right) x_i x_j - \]

\[ -\left( b x_j + \frac{1}{2} b_{k1} x_j x_k - b_{k2} x_k \right)^2 - \frac{b}{2} \left( \frac{1}{c} - \frac{1}{a} \right) x_i x_j - \]

\[ \frac{1}{4} \left( \frac{1}{1} - \frac{1}{b} \right) x_i x_j - \frac{1}{4} \left( \frac{1}{1} - \frac{1}{b} \right) x_i x_j - \]

\[ \left( c x_i + \frac{1}{2} c_{k1} x_k - c_{k2} \right)^2 \]

The full derivative on time from Lyapunov vector functions (8) in this construction is negative sign function.

For the components of the gradient vector it is possible to construct the Lyapunov function:

\[ V_i(x) = -x_i^2 - \]

\[ V_j(x) = \left( a_{i1} x_i + \frac{1}{2} a_{i2} x_i x_j - a_{i2} x_j \right)^2 - \frac{a_{i1}}{2} \left( \frac{1}{b} - \frac{1}{c} \right) x_i x_j - \]

\[ -\left( b x_j + \frac{1}{2} b_{k1} x_j x_k - b_{k2} x_k \right)^2 - \frac{b}{2} \left( \frac{1}{c} - \frac{1}{a} \right) x_i x_j - \]

\[ \left( c x_i + \frac{1}{2} c_{k1} x_k - c_{k2} \right)^2 \]

The Lyapunov function derived in vector form, can represent a scalar function of the form of:

\[ V(x_1, \ldots, x_n) = \frac{1}{4} a_{i1} x_i + \frac{1}{2} a_{i2} x_i x_j - a_{i2} x_j + \frac{1}{4} a x_j + \]

\[ + \frac{1}{2} a_{i1} x_i x_j - a_{i2} x_j + \frac{1}{4} a_{i1} x_i x_j - a_{i2} x_j + \]

\[ - \frac{1}{4} \left( \frac{1}{1} - \frac{1}{b} \right) x_i x_j - \frac{1}{4} \left( \frac{1}{1} - \frac{1}{b} \right) x_i x_j - \]

\[ \left( c x_i + \frac{1}{2} c_{k1} x_k - c_{k2} \right)^2 \]

By Morse theorem from the catastrophe theory the Lyapunov's function (9) can be represented as a quadratic form [8]:

\[ V(x_1, \ldots, x_n) = -\frac{1}{2} a_{i1} x_i - \frac{1}{2} a x_j + \frac{1}{2} b x_j - \frac{1}{2} c x_i - \frac{1}{2} \left( \frac{b}{a} + 1 \right) x_j \]

\[ - \frac{1}{2} \left( \frac{b}{a} + 1 \right) x_j \]

Conditions for robust stability of the system (3) stationary state (5) we will obtain by taking into account negative definiteness of the total derivative (8) obtained from the quadratic form (10) in the form of:

\[ k_i < 0, k_i < -\frac{1}{a}, k_i < -\frac{1}{b}, k_i < -\frac{1}{c}; \]

(11)

We investigate the stability of the state equation (3) written in deviations relative to the stationary state (7):

\[ \frac{dx_i}{dt} = x_i - \]

\[ \frac{dx_j}{dt} = -a x_i - a x_j - 3 a \sqrt{k_i} x_i^2 - a \sqrt{k_i} x_i - \]

\[ - a_{i1} x_i x_j - 2 a x_i + a x_j - \]

\[ \frac{dx_k}{dt} = x_k - \]

\[ \frac{dx_l}{dt} = -b x_i - b x_j - 3 b \sqrt{k_i} x_i^2 - b \sqrt{k_i} x_i - \]

\[ - b_{k1} x_j x_k - 2 b x_j + b x_k - \]

\[ \frac{dx_m}{dt} = x_m - \]

\[ \frac{dx_n}{dt} = -c x_i - c x_j - 3 c \sqrt{k_i} x_i^2 - c \sqrt{k_i} x_i - \]

\[ - c_{k1} x_j x_k - 2 c x_j + c x_k - \]

We introduce the notation for the components of the vector gradient:

\[ \frac{\partial V}{\partial x_i} = 0, \frac{\partial V}{\partial x_j} = 0, \frac{\partial V}{\partial x_k} = 0, \]

\[ \frac{\partial V}{\partial x_i} = \frac{ax_i + 3 a \sqrt{k_i} x_i + \frac{a}{2} a x_i x_j - a x_j}{\sqrt{k_i}} - \]

\[ \frac{\partial V}{\partial x_j} = \frac{ax_j + 3 a \sqrt{k_i} x_j + \frac{a}{2} a x_i x_j - a x_i}{\sqrt{k_i}} - \]

\[ \frac{\partial V}{\partial x_k} = \frac{ax_k + 3 a \sqrt{k_i} x_k + \frac{a}{2} a x_i x_k - a x_i}{\sqrt{k_i}} - \]

\[ \frac{\partial V}{\partial x_l} = \frac{ax_l + 3 a \sqrt{k_i} x_l + \frac{a}{2} a x_i x_l - a x_i}{\sqrt{k_i}} - \]

\[ \frac{\partial V}{\partial x_m} = \frac{ax_m + 3 a \sqrt{k_i} x_m + \frac{a}{2} a x_i x_m - a x_i}{\sqrt{k_i}} - \]

\[ \frac{\partial V}{\partial x_n} = \frac{ax_n + 3 a \sqrt{k_i} x_n + \frac{a}{2} a x_i x_n - a x_i}{\sqrt{k_i}} - \]

\[ \frac{\partial V}{\partial x_i} = \frac{ax_i + 3 a \sqrt{k_i} x_i + \frac{a}{2} a x_i x_j - a x_j}{\sqrt{k_i}} - \]
\[
\frac{\partial V(x, \ldots, x)}{\partial x_i} = -x_i, \quad \frac{\partial V(x, \ldots, x)}{\partial x_i} = 0, \ldots
\]
\[
\frac{\partial V(x, \ldots, x)}{\partial x_i} = c x_i' + 3 c \sqrt{k_i} x_i' + \frac{1}{2} c k_{ii} x_i x_i + 2 c k_{ii},
\]
\[
\frac{\partial V(x, \ldots, x)}{\partial x_i} = c x_i' + c k_{ii} \sqrt{k_i} x_i + \frac{1}{2} c k_{ii} x_i x_i - c k_{ii} x_i.'
\]

Also, by introducing notation for the projection of velocity vector components on the coordinate axes, we will find the total derivative from Lyapunov vector-function components [10], which can be represented as following:

\[
\frac{dV(x)}{dt} = \sum \sum \frac{\partial V(x)}{\partial x_i} \frac{dx_i}{dt} = -x_i - \left( a x_i' + 3 a \sqrt{k_i} x_i' + \frac{1}{2} a k_{ii} x_i x_i + 2 a k_{ii} \right) -
\]
\[
- \left( b x_i' + b \sqrt{k_i} x_i' + \frac{1}{2} b k_{ii} x_i x_i + b k_{ii} \right) -
\]
\[
- \left( c x_i' + 3 c \sqrt{k_i} x_i' + \frac{1}{2} c k_{ii} x_i x_i + 2 c k_{ii} \right) -
\]
\[
- \left( c x_i' + c k_{ii} \sqrt{k_i} x_i + \frac{1}{2} c k_{ii} x_i x_i - c k_{ii} \right).
\]

The total derivative (13) is negative sign function. We construct the Lyapunov’s function in scalar form according to the gradient components of the Lyapunov vector-functions by taking into account (13):

\[
V(x) = \frac{1}{4} a x_i^2 + a \sqrt{k_i} x_i' + \frac{1}{4} a k_{ii} x_i x_i + a k_{ii} + \frac{1}{4} a x_i x_i' + \frac{1}{4} a x_i x_i -
\]
\[
- \frac{1}{2} a k_{ii} \sqrt{k_i} + \frac{1}{4} b x_i^2 + b k_{ii} x_i x_i + b k_{ii} +
\]
\[
+ b k_{ii} x_i x_i' + \frac{1}{2} b k_{ii} x_i x_i' + \frac{1}{2} b k_{ii} x_i x_i' + \frac{1}{4} b k_{ii} x_i x_i +
\]
\[
+ c x_i^2 + c k_{ii} \sqrt{k_i} x_i + c k_{ii} x_i x_i' +
\]
\[
+ \frac{1}{2} c k_{ii} x_i x_i + \frac{1}{4} c k_{ii} x_i x_i + \frac{1}{2} c k_{ii} x_i x_i' + \frac{1}{4} c k_{ii} x_i x_i +
\]
\[
+ \frac{1}{2} c k_{ii} x_i x_i' + \frac{1}{4} (c k_{ii} - c k_{ii} \sqrt{k_i} + 1) x_i' +
\]
\[
+ c k_{ii} x_i' + \frac{1}{4} c k_{ii} x_i x_i + c k_{ii} x_i +
\]
\[
+ \frac{1}{2} c k_{ii} x_i x_i' + \frac{1}{2} c k_{ii} x_i x_i' + \frac{1}{2} (c k_{ii} - c k_{ii} \sqrt{k_i} + 1) x_i' +
\]

Using the theorem of Morse function (14) can be represented in the form:

\[
V(x) = a k_{ii} x_i^2 - \frac{1}{2} a (a k_{ii} - a k_{ii} \sqrt{k_i} + 1) x_i x_i +
\]
\[
+ a k_{ii} x_i x_i' + \frac{1}{2} a k_{ii} x_i x_i' +
\]
\[
+ \frac{1}{2} a k_{ii} x_i x_i' + \frac{1}{4} a k_{ii} x_i x_i +
\]
\[
+ \frac{1}{2} a k_{ii} x_i x_i' + \frac{1}{4} a k_{ii} x_i x_i +
\]
\[
+ \frac{1}{2} a k_{ii} x_i x_i' + \frac{1}{4} a k_{ii} x_i x_i +
\]

Conditions for robust stability of the system (3) stationary state (7), we will obtain considering negative definiteness of the total derivative of the Lyapunov vector-functions (14) from the quadratic form (16) as:

\[
k_i > 0, \quad k_i < -\frac{1}{a} + k_{ii} \sqrt{k_i}, \quad k_i > 0,
\]
\[
k_i < -\frac{1}{b} + k_{ii} \sqrt{k_i}, \quad k_i > 0, \quad k_i < -\frac{1}{c} + k_{ii} \sqrt{k_i}.
\]

Thus, the spacecraft control system built in the class of three-parametric structurally stable mappings will be stable in a wide range of changes of uncertain parameters and guarantees from falling into deterministic chaos mode. Steady state (5) exists and is sustainable when changing the indeterminate parameters of spacecraft in the field (11), and stationary state (7) appears if you lose stability state (5) and they simultaneously do not exist. Stationary state of spacecraft (7) is stable when running system of inequalities (15).

5. Conclusion
This work built robust stable nonlinear control system in the class of three-parametric structurally stable mappings, allowing and maximizing the potential of robust stability. Study of robust stability of the system is based on a geometric interpretation of Lyapunov theorem on asymptotic stability. Given example shows the effectiveness of nonlinear control laws.

6. References
JUMP MATH AND THE RISK MANAGEMENT OF EDUCATION

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Abstract: In this article we discuss the success of the program JUMP MATH in primary and secondary school in search for a system of teaching that produces similar results in all school levels of mathematics and possibly in the sciences. We view the program from risk management point of view and from algorithmic perspective. We propose a general frame of teaching mathematics that can be applied from schools to university level with great economic effect if the results are similar like the results of JUMP MATH

Keywords: MATHEMATICS EDUCATION, RISK MANAGEMENT, ALGORITHMS, PSYCHOLOGY

1. Introduction

Education in mathematics is of critical importance for economic development [OECD, 2010] but is largely neglected in countries as Bulgaria, but even in USA, which are below average in pre-high school and high school math according to PISA [OECD, 201]. Worse than that, “the trend data show no significant changes in these performances over time” three years after the initiative “Race to the Top” declared by President Obama. The problem of management by slogans according to Deming is that a stable system needs innovations to achieve significant change and problem solving is not enough [Deming, 2000]. Education in mathematics is both important and underdeveloped which makes it a priority topic for research.

The problems in American education system and policy are noticed many years ago by Feynman who was employed to assess school textbooks in mathematics and noticed both the poor quality of most of the books and the conflicts of interests displayed by those who are supposed to judge them and have their own textbooks in the competition. He goes as far as to blame the entire field of pedagogy as “false science” for its lack of significant results despite of decades of new theories and their applications to students [Feynman and Leighton, 1997].

Despite lack of progress in teaching mathematics on national level, the problem is not unsolvable. Thanks to some recent advances in cognitive science we know better:

• We know how important is systematic practice in acquisition of expert performance [Ericsson et al, 1993]. It is more important that genetic factors and IQ for long term success in a given field (IQ is not very strong predictor)
• We know that everyone is born with the ability to learn school math [Willingham, 2010]
• We know that is possible to increase fluid intelligence [Buschkuehl and Jaeggi, 2010]
• We know more about social dynamics and what causes the “Mathew effect” in education – rich-get-richer, poor-get-poorer or the dependence of success on the initial condition – the early school success which translates to later stages and the early failure that persists [Stanovich, 1986].
• We know what works and what doesn’t with respect to rewards and punishment, intrinsic rewards and extrinsic rewards in learning, that is – the high cost of extrinsic rewards and the learning as its own prize [Willingham, 2008].
• We know that there are systems that work significantly better than current systems in many European countries, USA and Canada, both from the consistent high ranking in PISA of East Asian countries and regions and from the success of JUMP Math.

Our current knowledge is enough to suggest a general framework for teaching science and mathematics that extends beyond primary school and the first year of secondary school, by analyzing the algorithms that work to provide the results of JUMP Math. First we will introduce some notions from dynamic systems and probability to explain the current state of affairs and define risks in teaching mathematics. Second we introduce this system of education JUMP Math and analyze the core principles and algorithms. Third, we propose a general framework for teaching mathematics following those algorithms.

2. Positive feedbacks and risks in education

The Mathew effect is the high level of dependence of success on the initial conditions for it, or the success in education as disproportionately strongly related to early success. Kids who have early success tend to achieve more in later stages of learning that those who don’t. Educated get more educated, the non-educated stay non-educated. In control theory, this mechanism is called “positive feedback” and describes a multiplicative process, such as economic growth in which increasing the output of the system feeds back to the production additively. The student is a dynamical system in which knowledge leads to more knowledge and lack of knowledge is a barrier of acquiring more of it. This is especially true in mathematics in which we have chain dependence of concepts and problems and the lack of knowledge in any part of that chain affects performance from that level on without limitation in the general case - something not-well learned in 1st grade can have effect up to high school [ECS, 2013].

Other than the hierarchical structure of knowledge in mathematics [Barnard, 1996] there is another mechanism that generates positive feedback – the adaptive nature of students. When a student fails a task he adapts to that disturbance by accepting a new reference level for his hers ability, he/she erodes his hers expectations to achieve on a lower level. The erosion of goals is common system archetype, studied in the field of system dynamics [Braun, 2007]. It leads to long term underachievement. This is especially valid if the student receives signals from the teacher that he/she fails because is incapable of success. If a student believes results are due to fixed traits that cannot be removed, it is less likely to put the same effort on the next problem which increases the probability of failure and a further lowering of expectations – a positive feedback that adds on the another positive feedback from the hierarchy of knowledge in mathematics (solving a problem depends on success in solving previous problems).

Positive feedbacks increase variability in a system – the kids who enter first grade have Gaussian distribution both in mathematical ability and in confidence.

If we accept confidence as a barrier for the second type of positive feedback, e.g. not estimating one’s ability from failures or success, we can formulate it as the reverse of psychological sensitivity to failures or how easily a failure in a problem translates into lowered expectations and efforts. Due to the increased variability we observe negative system (ingroup) effect – increase of differences between students. Systems that deserve their name must decrease variability. Random distribution means there is no system – the Gaussian distribution on entering first grade is due
to the work of multiple independent factor (kids coming from different social and hereditary background with different experiences). If the Gaussian distribution persists during the twelve grades, there is no system of education, there is no benefit of putting students in one room and teaching them under the same rules since they do not decrease variability of ability. Furthermore, variability increases which means we have anti-system and not system of education. The persistence of positive feedbacks and multiplying effects of learning is what limits our results and not inherent and immutable differences in students. As Fig.1 show, it is possible for a gifted teacher following JUMP Math to achieve complete transformation in one year and create a class of excellent students.

Other results confirmed in scientific research are – doubling the rate of learning in randomized trial [Solomon et al., 2011]. There are also reports on the site of the program which show similar results, some of them for four consecutive years with one class - [http://www.jumpmath.org/jump/en/research](http://www.jumpmath.org/jump/en/research).

Similar improvements can also be achieved on national level, as PISA findings show for countries like Estonia and Finland [OECD, 2012].

### 3. Managing risks in JUMP MATH

JUMP Math as a system of guided discovery is based on cognitive science and has a lot of different techniques that help educating every child even if he/she needs special attention. The textbooks for teachers are often 600 pages long or more. These vast amount of information may lead researchers and teachers to believe that this is just a random collections of techniques developed by several gifted teachers, but in fact the whole system can be explained by few simple algorithms that govern most of the content that has been created.

- **Divide and conquer** – Due to the individual differences of students for a given volume and/or complexity of a problem only a certain percentage of them will be able to solve it without help. To minimize that risk the problems are divided into sub problems and solved sequentially. If the complexity/volume of every sub problem is small enough, all students will solve it. This also minimize the risk of wasting time in rework with the students that fail.

- **Linear progression** – After a problem is solved, the next problem is incrementally harder in such step so every student to be able to solve it. As a rule several problems belonging to one complexity domain will be solved by just increasing visual complexity, for examples adding with increasing numbers without changing the algorithm, may it be finger counting or general. Each step is large enough to cause adaptation – increase of expectations and confidence, brain adaptation as a result of learning, but also small enough to be solvable for everyone. This also minimize both the risk of someone failing and the time, spent on a problem by the teacher. Students who are more advanced get harder problems in the same complexity domain to practice while the teacher is focusing attention on those who lag behind, which is related to the next algorithm.

- **Sequence learning of concepts** – a linear combination of previous two algorithms that takes care of the complexity of the material and allows only one new concept at a time to be introduced and then practiced enough so everyone can use it well before moving on next concept. Concepts evolve from simple to more complex instead of presenting the more complex and reducing from there. An example is the way fractions are taught – first geometric representation to form intuitive understanding, then actions with same denominators, then with different denominators, then to mixed fractions. Second sequence is by actions – from simple to more complex – addition before multiplication before division.

- **Recursive teaching** – Failures of some student to solve even sub-problems which are well divided is a sign of a missing link in the mathematical chain of knowledge. The teacher returns back on the material, with years if he/she has to until the place of breaking is identified. Then new set of problems is given to be practiced until success.

- **Network of concepts** – problems are solved using wide variety of techniques and different concepts (just like theorems can be proved fin many different ways). This helps students to form stable network of concepts and appreciate mathematics in depth, not just memorize algorithms of computation. Geometric representations, patterns and real world metaphors as well with other tools are used. This minimizes the risk of fragile knowledge and also help with increasing confidence through joy of understanding as complimentary of the joy of success.

- **Proactive control of confidence** – students are praised for their success and not critiqued of their failures, they are encouraged to develop the so called “growth mindset”. Evaluations and rankings are not accent to manage the risk of adaptation to them and to make differences persistent or increasing.
The results from careful and efficient applications of this algorithm is maximally increased knowledge for every student.

There is one more risk which is for the teachers, since there is similar variability and Gaussian distribution on certain metrics for them. Although it cannot be addressed the same way as the risks for the student, there are seminars for them and they have very specific and large textbooks to prepare their lessons. Due to the nature of the program, this variability translates into variability of results – from marginally better than other programs to complete transformation which is in itself a serious success. Other very important mechanism that decreases the variability is the adaptive nature of teachers. Teachers learn by teaching and having fast feedback from their students. A systematic approach to teaching students has a feedback that encourages systematic learning by the teachers.

4. Results of Discussion

High school mathematics and even university mathematics up to the level practiced by Fields medalist has the same hierarchical structure. Problems on every level can be divided and conquered (a main tool for mathematical research), teaching can be gradual, sequential and recursive. Praising and avoiding accent on ranking is still possible, although there are many of extrinsic awards for outstanding achievements made with good intentions that actually represent an obstacle and lead to Matthew effect in recognition of scientific achievement [Merton, 1968]. With increased complexity of mathematics the effort to make it understandable also increases in volume as well the formed networks of concepts, but is still finite and thus we hypothesize that the goal is achievable. Thus, we propose to use those algorithms on every level of mathematics education by creating different content for every separate course that follows the principles which derive from them. A major part of such frame is usage of latest cognitive science research and constant revision and update of both content and methodology to reflect them.

- Usage of algorithms from JumpMath for gradual, sequential and recursive teaching.
- Emphasis on practice, deliberate and large in volume.
- Usage of intrinsic rewards, praise and proactive control of confidence of students
- Constant evolution and innovation in content and methodology in accordance to latest results from Cognitive science in cooperation with other teachers in the field that follow the same frame.
- Actively requesting feedback from students - what is hard, why is hard, what is not understood for the higher levels of education.
- Starting students on research in University as early as possible. This is an extension of the guided discovery to the academic level.

5. Conclusion

It is widely accepted as “common sense” that some people achieve better success in school or expert status in some field due to inherent traits as IQ despite growing body of results showing the contrary [Ericsson et al, 1993]. Many people responsible for designing the systems and methods of education especially in some counties in Europe, USA and Canada believe this and accept the centered Gaussian distribution at the output of the system as normal in contradiction with systems theory. The success of countries like Finland and regions in East Asia where growth mindset is encouraged and variability in knowledge and skills is much lower as proof that this common sense is largely a myth. One promising system, originating from Canada – Jump Math is showing us how to transform education by using simple algorithms to manage risks. This is achieved by breaking negative system patterns like the Matthew effect and erosion of goals with the use of latest results from Cognitive Science. The core principles of this system are applicable to all level of mathematics because of its fractal nature, showing self-similarity in hierarchical structures on every level of complexity and abstraction. We propose general frame from which new content can be created for mathematics courses in high school and university and can be taught with similar (as we hope) result as the results of JUMP Math in primary school and first two years of secondary school. Mathematics is critical for economic success and should be the focus of systematic effort of policy makers in education with noticeable results in short time if risk management algorithms such as these in the proposed frame are applied.

6. References


EXPLOITATION RESULTS OF MANAGEMENT INFORMATION SYSTEM FOR MEDICAL PERSONNEL IN THE MILITARY MEDICAL ACADEMY, SOFIA, BULGARIA

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Abstract: An Administrative Information System (AIS) by definition includes digitized systems supporting storage, retrieval, processing and maintaining information in support of administrative services in one unit, regardless of its profile. AIS, operating within the health establishment, does not include document that is directly related to medical and health information, nor with patient data and records. The urgent need to develop application for administrative management of medical staff in MMA, stemmed from the fact that the institution has a number of components of an integrated information system in conformity with Bulgarian standards of medical care, which covers 90% of the activities in the hospital, however, it serves mainly medical and health activities and the related documentation, but not the administrative part. [1,2] The introduced in production three years ago solution is developed according to the following standards: ISO 13606-4: 2008, ISO / TS 21547: 2010, ISO 18308: 2011, ISO 27789: 2013 and ISO / IEC 15408-2, performs author’s system internally administrative services, satisfying the requirement to communicate to different users working in conditions ranging medical and non-medical legislation and statutory regulations. [3] The goals that were put in implementation, on the one hand include requirements to facilitate the work of medical secretaries who are mainly responsible for the preparation of many administrative documents, on the other - to reduce and minimize the time consumption, consumables and labor, which itself actually lightens the load of the military medical experts. As a military hospital, the MMA can ensure that a consultation meeting of the most skilled medical experts can be called up in 10 minutes to respond to any kind of medical problems. It was established in 1844, and today, its framework, it has the Medi-cal School committed to creating new genera-tions of military doctors. It is also recognized as a scientific research center of excellence. Military Medical Academy has 27 clinics and 17 institutes, the Specialist Outpatient Clinic, the Poison Control Center, the Emergency Department and the Solid Organ Transplantation Center performing more than 5000 diverse diagnostic and therapeutic pro-cedures. The MMA operates as a part of the Ministry of Defense. Thanks to its military organizational structure and commitment to providing the best, most comprehensive qual-ity medical care, it has been rewarded and recognized as a medical institution meeting the highest world standards. The MMA has always been opened to all our citizens, and since its recent full integration in the National Health System, it serves 40% of civilian patient population. Each year, it has more than 230.000 civilian outpatient visits, of which more than 20.000 result in hospital ad-missions. [4]

2. Material and method

At this moment there are several information systems, integrated and functioning, but still lots of paper documentation is processed and is the most powerful tool for the Bulgarian medical practitioner. At the table below we present the paper document workflow in Military Medical Academy before introduction of the system:

<table>
<thead>
<tr>
<th>Department</th>
<th>Report</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Department</td>
<td>Night work</td>
<td>monthly</td>
</tr>
<tr>
<td></td>
<td>Republican working</td>
<td>national holidays</td>
</tr>
<tr>
<td></td>
<td>Overtime</td>
<td>quarterly</td>
</tr>
<tr>
<td></td>
<td>Hazardous work</td>
<td>monthly</td>
</tr>
<tr>
<td></td>
<td>Doctors available</td>
<td>monthly</td>
</tr>
<tr>
<td></td>
<td>Republican consultants Duty</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Forming report N76</td>
<td>to work more hours</td>
</tr>
<tr>
<td></td>
<td>Distribution paid to clinics pathways</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Information for NHI to appear doctors monthly</td>
<td>to work more hours</td>
</tr>
<tr>
<td></td>
<td>Information for physicians specialty years</td>
<td></td>
</tr>
<tr>
<td>Personnel</td>
<td>Information for resignations years</td>
<td></td>
</tr>
<tr>
<td>Occupational Health records</td>
<td>expert</td>
<td>Annual maintenance</td>
</tr>
</tbody>
</table>

Table 1: Paper document workflow in MMA before introduction of management information system

Fig.1: Variety of paper-based graphics in MMA.

There are regular reports, but periodically are required and others: list of people from the duty team on a date / courts for/, rescue teams in the holidays, emergency teams and etc. Apart, each department secretary prepares and makes scheduling unit, where participate 4 positions - doctors, nurses, paramedics and a consultant for the month. To select the most needed and preferable parameters, we have investigated the web and found one of the most comprehensive comparative analysis based on the website Captterra – the smart way to find software [6], where we found 17 software solutions compared with each other in relation to 41 parameters.

We used 3 of them – Healthcare Delivery Management by Ankota, Avisena Practice Manager by Avisena and Practice Expert by California Medical Systems with selected 21 parameters:
1. Medical informatics standards application - European or international
2. Year of development and implementation
3. Platform - desktop or web solution
4. Size of the hospital - such as labor
5. Location - location development decision
6. Management of meetings and commitments under framework regulating stations - preparing schedules themselves compartments visits by patients
7. Automatic reminders
8. Change UI customization
9. Import / export of data - to and from Word / Excel
10. Demographics
11. Email Integration
12. Integration into the BIS
13. Mobile access
14. Multilanguage
15. Multi location
16. Schedule of doctors
17. Dates sisters
18. Reports, reports, statistics
19. Prepare a schedule according to legal requirements
20. Ability to prepare a separate schedule
21. Schedule Staff
22. Sound reminders
23. Website Integration

Based on the international developments and experience and according to each unit in the organization scheduling requirements, we have chosen to set number of shift types (day, evening, night) in a given time period with an opportunity to define and individual preference for shift types.

The solution takes into account the availability of qualified personnel, nurses’ preferences for particular days, shifts, units; and regulatory and union requirements. Regulatory and union requirements govern the number of hours worked, overtime, time off between shifts, staffing ratios, certifications and credentials. Government regulations in some states mandate nurse-to-patient ratios and healthcare organizations must document, by means of staffing reports, that they are meeting, or trying to meet the ratios.

The software supports pattern scheduling and automatically generate work schedules using industry standard or user-definable schedules and it is with pre-designed shift patterns for compressed work week, 8, 10, 12, and 24 hour fixed and rotating shift schedules that meet scheduling needs of MMA.

It doesn’t allow conflicts, duplicate shift assignments, overlapped shift assignments, and conflicts with scheduled time off. Print schedule views, lists, assignment calendars, and reports to communicate schedule information to management and employees.

The software is fully integrated and developed on the base of the following ordinances:
1. Ordinance on the types of work which establishes reduced working hours Application № 1 to the Decree № 267 of 12.12.2005
2. Ordinance on working time, rest and leave adopted in1986 Ordinance № 2 of the order establishing responsibility for duty or location of employer
4. Ordinance № 16 OF 21 August 1996 on the organization of hospital care in state hospitals
5. Instructions № 2 of 10.01.1996 on the organization of work and of working time in public health institutions, bodies of state sanitary control and Sanatorium establishments
6. Ordinance № N 18 of December 19, 2012 In order for distribution of service time servicemen of the Defense Ministry, structures directly subordinate to the Minister of Defense and the Bulgarian Army, its reporting beyond the normal duration and determination of the remuneration for execution of assigned duties over the total duration of service time for duty during weekends and official holiday

3. Results
Based on the conducted survey, graphically presented on Fig.3., we can draw the following conclusions:

![Fig.3: Inquiry results.](image-url)
2. In order to optimize the poll we have prepared two pairs of related issues, namely: 4 and 7 - investigating respectively difficulties in using the system and comfort; 3 and 8 also - consumed, but not entirely cover the spheres.

3. The study proves that when medical secretaries participate in experimental design and testing, they are afterwards more than satisfied with the system and find it necessary.

4. Only 14 of the respondents - 2 doctors and 2 medical secretaries found no difference in working with experimental software. Here it is worth noting that doctors require only a printout of your schedule and statistics about hours but not handle tables and introduction of administrative information.

5. Strongly positive attitude is 160 by 200 respondents on better management of the overall process of preparation of schedules in MMA - Sofia.

6. 160 of 200 believe that the system - actually implemented, would accelerate the process of preparation of monthly schedules and definitely would ensure security and accuracy of the reports.

7. Only 20 of the 200 encounter some difficulties in working with the software. 

4. Conclusion
The very nature of medical staff scheduling demands efficiency when it comes to managing scheduling for staff and physicians at medical offices, hospitals, home health services, medical centers and other medical care facilities.

With so many positions and skill requirements to meet, there is no room for anything less than total staff organization, especially when the staff count reaches into nearly thousand people, operating 24/7 and covering hundreds of shifts.

The model of software as the first of its kind solution for the Bulgarian environment was presented at an international forum in Ukraine in March 2013 [7], it is introduced in June 2013 and works successfully until the current moment.

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THE IDEA OF THE TECHNICAL PROGRESS AND THE POLITICAL ECONOMISTS (18TH AND 19TH CENTURY)

ИДЕЯТА ЗА ТЕХНИЧЕСКИЯТ ПРОГРЕС И ПОЛИТИКОНОМИСТИТЕ (18 И 19 В.)

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Abstract: If we assume the definition of political economy as a science responsible for the distribution of resources and goods in society, we will find a fundamental reason and a motive to be interested in the issue of technical progress. We will consider technical progress as a social, economic and political phenomenon that is at the heart of many debates on behalf of “optimistic” political economists and others who have a more “pessimistic” vision. Our study is based on the attitude of some of the most famous political economists from the period of the 18th and 19th century during which political economy gets institutionalized and the industry develops revolutionary.

KEYWORDS: TECHNICAL PROGRESS, POLITICAL ECONOMY, ECONOMIC, SOCIAL

1. Introduction.

The question of the importance of technical progress is as old as political economy itself. If we take the variety of definitions of political economy in accordance to the various aspects of economic activity, we can present it as the science of wealth, of scarcity, of exchange or selection. We will use with the definition formulated by the French economist Raymond Barre. In his “Political economy” (1955) he writes: “The science of economics is the science of administration of scarce resources. It studies the forms which the human behavior adopts while managing these resources; It analyzes and explains the terms according to which one individual or society affects the scarce resources or the satisfaction of the many and unlimited needs”[1].

Thus we have two main reasons to be interested in technical progress as a process of development and improvement in order to overcome the problem of scarcity of resources, but also of satisfying the needs of the people and improving their standard of living.

To acquire scientific shape, the big movement driven by progressive ideas took considerable amount of time, although even in ancient times (in Ancient Greece, Mesopotamia, Ancient Rome) optimistic utopian philosophies for the emergence of technical innovations are not missing. Various political economists show profound interest in the idea of technical progress as early as the 18th century, i.e. when political economy was institutionalized and industry developed revolutionary.

Technical progress is one of the major phenomena in the study of the dynamics of individual economies. Over the years it was at the heart of many contradictory socio-economic debates, and some economists were optimistic, calling it a “messiah” of growth, development or improvement of working conditions, while others approached the subject matter rather pessimistically and indicated it as a reason for economic instability or enslavement of the worker.

We will attempt to validate our claims related to the idea of technical progress through a research based on the works of several famous political economists from the 18th-19th century.

2. Results and discussion

The distinction of technical process as a decisive factor of economic growth, linked to the role of the machines as well, is first met in England at the beginning of the Industrial Revolution. Adam Smith, often regarded as “the father of political economy” (as defined by J. B. Say) testifies to that in his known work “An Inquiry into the Nature and Causes of the Wealth of Nations” (1776). For him the Industrial Revolution as a movement is the result of the division of labour, the expansion of markets and the introduction of new products. The division of labour, the way Smith puts it, allows for order establishment, which is the basis of a well-established social and professional hierarchy in the manufacture of pins (inspired by “Encyclopedia: or a Systematic Dictionary of the Sciences, Arts, and Crafts” by Diderot and d’Alembert). It helps to increase labour productivity through three different circumstantial reasons: “[F]irst, to the increase of dexterity in every particular workman; secondly to the saving of the time which is commonly lost in passing from one species of work to another; and lastly, to the invention of a great number of machines which facilitate and abridge labour, and enable one man to do the work of many” [2: 10]. This way Smith draws a conclusion that technical progress is a result of labour division and a reason for the prosperity and wealth of nations.

In Smith’s exposé the division of labour meets its social limitations. At the end of his work, which concerns the topic of participation of the state in education, he returned to this problem, but not to highlight its positive significance. The negative effect of the division of labour is observed mainly in the long term.

“In the progress of the division of labour, the employment of the far greater part of those who live by labour, that is, of the great body of the people, comes to be confined to a few very simple operations, frequently to one or two. But the understandings of the greater part of men are necessarily formed by their ordinary employments. The man whose whole life is spent in performing a few simple operations, of which the effects are perhaps always the same, or very nearly the same, has no occasion to expert his understanding or to exercise his invention in finding out expedients for removing difficulties which never occur” [2: 602,603].

Nathan Rosenberg [3: 127-139] maintains the thesis that, on the one hand, Smith is very concerned regarding the detrimental effects that the division of labour has on some moral and intellectual qualities of workers, but on the other hand, boldly believes that exactly its potential is a prerequisite for technological change. Technical progress is not only the result of the creativity of workers and industrialists but should also be addressed to “philosophers”, which today we call “scientists”. “Many improvements have been made by the ingenuity of the makers of the machines, when to make them became the business of a peculiar trade; and some by that of those who are called philosophers or men of speculation...” [2: 12].

Interest regarding the technical progress is also shown in the viewpoint of David Ricardo. In 1821 Ricardo added a chapter XXXI to the third edition of his book “On the Principles of Political Economy and Taxation” (1812), entitled “The Machines”, claiming that this is “a subject of great importance” [4: 282].

Ricardo changes his initial opinion expressed – that the introduction of machines cannot affect employment – and took on the opposite stand, i.e. that rapid innovations may even be harmful.
“That the opinion entertained by the labouring class, that the employment of machinery is frequently detrimental to their interests, is not founded on prejudice and error, but is conformable to the correct principles of political economy” [4: 287]. His theoretical conclusion is confirmed in practice – the idea of technical progress is not a recipe for overcoming poverty and unemployment among the population during the 19th century in England.

Ricardo’s analysis on technical changes is relevant to the issues of distribution. As he mentions at the beginning of chapter XXXI of his “Principles”, his goal is to explore “the influence of machinery on the interests of the different classes of society” [4: 282]. Word is about the way mechanization affects the distribution of the gross product between capitalists, landowners and workers. Ricardo analyses separately the results of technical improvements in the different sectors. In agriculture, they have a positive impact in terms of profit for manufacturers and incomes of workers. “With every increase of capital and population, food will generally rise, on account of its being more difficult to produce. The consequence of a rise of food will be a rise of wages, and every rise of wages will have a tendency to determine the saved capital in a greater proportion than before to the employment of machinery” [4: 289, 290].

In the other sectors, such as industry, for example, the introduction of machines gives a different result – although there is a certain benefit for the consumer, that does not change the capitalist’s profit, except at the beginning and for a short period of time. According to Ricardo “who made the discovery of the machine, or who first usefully applied it, would enjoy an additional advantage, by making great profits for a time; but, in proportion as the machine came into general use, the price of the commodity produced, would, from the effects of competition, sink to its cost of production…” [4: 282].

Ricardo does not limit his observations and ideas only to his nation’s borders. At the beginning of the Industrial Revolution he addresses the issue of substitution of labour with capital in the context of free trade international relations. Even though the use of machines might have a negative effect, it should be encouraged because developers will navigate their capital abroad, “for if a capital is not allowed to get the greatest net revenue that the use of machinery will afford here, it will be carried abroad… By investing part of a capital in improved machinery, there will be a diminution in the progressive demand for labour; by exporting it to another country, the demand will be wholly annihilated” [4: 290].

J. B. Say, a liberal economist and businessman (in the cotton processing industry in Auehy, France), also has relation to technical progress as being interested in the enterprise and its management. In 1815 he wrote “A Treatise on Political Economy”, speaking out in favour of technical progress and the use of machinery.

In his work he poses a series of questions, among which: “What can be an indication for the progress of industry in a certain country?”; “… isn’t it [technical progress] catastrophic for the working class?” and so on [5: 44-46].

On the first question J. B. Say answers that a clear sign of technical progress is the existence of new products that are being promoted on the market or when there has been a reduction in the price of known products. In both cases, that is beneficial to society and there are new benefits earned. Say also adds that there are reasons that lead to technical progress and the progress of human knowledge, good laws, good administration in the country, and others, such as division of labour, better use of technical equipment in the industry, and natural resources.

On the second question, particularly relevant for its time, J. B. Say answers that according to experience countries that have introduced the most machines use the most workers. He defends his thesis, giving as an example the printing and cotton industry that with the advent of machines involved many more people than before [5: 44-46].

We will also note Say’s original economic thought in terms of the developer that reflects the dynamics of the economy or technical progress. Say goes further than Cantillon or Turgot, speaking about more up-to-date functions of the entrepreneur – as a coordinator of material resources and human resources, taking risks, opposing the routine, and taking part in the spreading of scientific ideas. This is the image of the revolutionary in the economy, which is forming the basis of the Schumpeterian idea. The implementation and use of increasingly sophisticated machines that allow increase of production reducing the quantity and quality of the workers’labour belongs to the entrepreneur. This progress in the technique used allows an increase in the produced wealth. “The increase of income is due to the result that we named technical progress” [5: 85].

Claude Frédéric Bastiat is one of the prominent representatives of the liberal economic school along with A. Smith, D. Ricardo, J. B. Say and others, defending the freedom of the individual from any form of power. Bastiat is often referred to as the “French journalist economist of the 19th century”. In one of his last pamphlets “That Which is Seen, and That Which is Not Seen” (1850), in chapter VIII dedicated to machinery he reveals his attitude toward technical progress: “But to curse machines, is to curse the spirit of humanity!” [6: 35].

To explain their importance, Bastiat emphasizes on the interest of the consumers, stating as their natural tendency the desire to buy profitably – be it from a foreign manufacturer, or one holding mechanized production. He defined this as “which is seen”. But there is another part – “which is not seen” – and must be foreseen by any economist.

Thus, Bastiat poses the question of who primarily benefits from the success of technical progress (through the deployment of machines). This can be the capitalist inventor manifested as a result of his courage and genius. In the long term, however, the inventor is being forced to reduce his product’s selling price and subsequently perhaps the one who will have the greatest benefit will be the purchaser of the product, the general public as a whole (including ordinary workers), and all of mankind [6: 34]. From the market of goods that provides actual results on the labour market: the reduction of the product price leads to an increase in consumption, which in turn leads to increased production and consequently to an increase in hiring of workers.

According to Bastiat, technical progress enables the user, saving from one item, to make his choice in the purchase of another, and thus to foster the development of other sectors. If there is a drop in the price of newspapers for example (from 80 to 48 francs, i.e. there are realised savings of 32 francs), this will not lead to a proportional increase in their consumption, but the savings will be directed towards the purchase of other goods [6: 34]. If we use the subway instead of an expensive car, we will have the opportunity to make the choice of buying a book, going to a restaurant or anything else. This, according to Bastiat, is due to the fact that “[i]t is thus that the trades are bound together. They form a vast whole, whose different parts communicate by secret canals; what is saved by one, profits all” [6: 34]. In this sense, the problem of unemployment caused by the introduction of new machines can also be resolved by steering the workforce to other activities or sectors.

Although John Stuart Mill does not have such a radical attitude toward the role of technical progress, he replaces labour with capital, analyses technical knowledge and innovations which enable cost reduction. Mill often identifies technical progress (which consists of exercising the power of man to nature) with the progress of society.

In his “Principles of Political Economy” he claims that the characteristic features of technical progress consist of increasing capital, population growth, improvement of the means of production, and he is setting a goal to study the effect of each of them [7: 253].

In his essay “Utilitarianism” Mill defines the progress of society in
moral and political terms. The social environment is something natural and necessary for people, as the idea evolves from the moment society moves away from the primitive (wild) state of being. In any civilized society the interests of all individuals must be respected. This way, the more society progresses, the more people get the sense of belonging to others and it becomes natural to take care of their welfare [8:94, 95].

In the 19th century Karl Marx was one of the first to note that the evolution of the means of production associated with technical progress, determines the course of history.

“… the conception of history we have sketched we obtain these further conclusions: (1) In the development of productive forces there comes a stage when productive forces and means of intercourse are brought into being, which, under the existing relationships, only cause mischief, and are no longer productive but destructive forces…” [9:53]

Marx develops a “sceptical” theory of the action of technical progress in the capitalist society. This progress has a negative impact on some capitalists who are not capable of following this dynamics and proved uncompetitive on the market, but it has a detrimental effect especially on the working class and their productive forces which is reduced to the bare minimum. According to Karl Marx, the replacement of “live labour” (the labour of workers) with “dead labour” (the one of the machines) under capitalism leads to the so called “alienation” (a term first proposed by him). This state of the worker is explained with the feeling of frustration. The idea of alienation became popular in social circles and can be explained in the following way: “Owing to the extensive use of machinery, and to the division of labour, the work of the proletarians has lost all individual character, and, consequently, all charm for the workman. He becomes an appendage of the machine, and it is only the most simple, most monotonous, and most easily acquired knack, that is required of him. Hence, the cost of production of a workman is restricted, almost entirely, to the means of subsistence that he requires for maintenance, and for the propagation of his race” [10:12].

This Karl Marx’s theory of the technical progress as an opposition of labour is not supported in future developments of economists. Marx continues his analysis, defending the idea that the introduction of technology should become a social process and the technical progress should play a central role in the economic evolution of society. This is also related to social change, and special production relations, i.e. the emergence of a new class. This is the “class which forms the majority of allmembers of society, and from which emanates the consciousness of the necessity of a fundamental revolution, the communist consciousness, which may, of course, arise among the other classes toothrough the contemplation of the situation of this class” [9:53].

Karl Marx’s idea of technical progress is associated with a progressive change of society towards communism. In this new society people work and specialize in a specific task. An ideal society is created, where everyone can develop their own skills, each one gives the best of himself and can be compared to a work of art. In it the collective has a joint future, workers share and communicate without feeling limited and poor. One famous text out of “The German Ideology” forms Marx’s belief in this “communal perspective”.

“Communism differs from all previous movements in that it overturns the basis of all earlier relations ofproduction and intercourse, and for the first time consciously treats all natural phenomena as power, which is reduced to the bare minimum of their natural character and subjugates them to the power of the united individuals[…]. Only in community (with others) individual has the means of cultivating his gifts in all directions; only in the community, therefore, is personal freedom possible” [9: 54-57].

Marx is not the only one who imagines this “new society”. Before him, Saint Simon advocates a new socio-economic system composed of industrialists, researchers, engineers, etc., who will help France become a prosperous country with a strong entrepreneurial spirit. Utopianism in the theoretical developments of Charles Fourier is best known for the so-called “phalanx” – labour communities of up to 1600-1700 people. The British reformer Robert Owen creates his own mill in New Lanark, which becomes a model of communal organisation and is visited annually by thousands of people.

3. Conclusion
Since the beginning of our century economic progress achieved significant results thanks to the integration into the public and private establishments of departments specialized in carrying out research in order to increase labour productivity and create new products. According to linguists, the term “technical progress” dates back to the Middle Ages (12th - 14th century) and is associated with many innovations in various areas, such as the invention of glasses, the compass, the printing press and many more.

Since the late 19th century and the triumph of industrialization, the idea of technical progress has its special place in the writings of political economists.

The interest it creates is determined by the result, i.e. the consequences that it has on the individual and society as a whole, on the institutions and political life. The technical development cannot be viewed only as a description of the types of techniques and methods used since ancient times. This evolution is not autonomous; it is a product of social relations as well. Technical progress is an economic, social and political phenomenon, although a number of modern economists are struggling with these details and assess it only through the prism of economic aggregates.

Political economists from the 18th and 19th century, led by Smith, Say and Bastiat generally share the same “optimistic” attitude – technical progress increases labour productivity and reduces production costs; it has an impact on the prices of goods, but also there are social effects associated with the prosperity of the nation, the advancement of knowledge and the development of institutions. We can add Mill to these authors, as he identifies technical progress with the advancement of society in a moral and political aspect.

Other economists have a more pessimistic viewpoint on the issue. For example, Ricardo’s opinion is that production with the use of machines is more of an economic and social threat to the working population. According to Marx, the replacement of the “living labour” of the worker with the “dead labour” of the machines leads to “alienation” in the capitalist development and the only way to technical progress is linked to radical social change.

All political, economic and social institutions today are strategically oriented towards innovation. We can no longer pose the question whether technical progress is significant for the economy and society as a whole because there is no doubt that the answer is necessarily positive.

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THE DEVELOPMENT OF THE TELECOMMUNICATIONS MARKET IN BULGARIA

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Abstract: ICT is a very dynamic sector, developing at a rapid pace in the recent years. The development of technology enhances the ability of the operators to provide new and better services, at constant price reduction of the services. Nevertheless, the total volume of the electronic communications market in 2014 constituted 3.1% of the total GDP (Gross domestic product) of Bulgaria.

In the state there is a steady trend of increasing the share of the mobile services compared to the fixed services. Mobile voice services have a leading role in the development of the electronic communications market. With the development of broadband technology, although at a slower pace is increasing the penetration of the fixed broadband access. Services for data and / or internet access are on third place by importance in the telecommunications market.

ICT is a very dynamic sector, developing at a rapid pace in the recent years. The development of technology enhances the ability of the operators to provide new and better services, at constant price reduction of the services. Nevertheless, the total volume of the electronic communications market in 2014 constituted 3.1% of the total GDP (Gross domestic product) of Bulgaria.

From the middle of year 2014 the country launched the presentation on market of services for mobile Internet access provided via LTE technology. At the end of 2014 customers using LTE access, are 0.3% of the subscribers of mobile Internet. The proposed subscription and prepaid plans for end users are providing broadband access in international area with download speeds up to 75 Mbps and upload speeds up to 25 Mbps, with included data capacity traffic on maximum attainable speed depending on the selected tariff plan can reach 300 GB per month.

Introduction of new technologies in the telecommunications is bringing about to increased investment. According to the Bulgarian CRC in 2014 a total of 516 enterprises made investment in the construction and maintenance of public electronic networks, which is 9% more than the previous period. Compared to previous years the total investment from these companies is increased.

In long term it is expected the development of the electronic communications market in Bulgaria to follow the global trends in the sector. In the forthcoming years will continue the migration of subscribers to fixed voice services to mobile services. The growth rates of services for broadband and mobile services will slow down due to the market saturation.

The development of 4G services and operation of LTE network will facilitate a favorable impact on the future development of the electronic communications market in Bulgaria, as well as the increasing demand and offering of bundled services including mobile and fixed broadband. The number of subscribers of mobile broadband access will continue to have a high growth, as it is expected in the future the development of mobile internet to overtake the fixed broadband. It is expected the use of services for mobile Internet access to increase as a result of the development of services based on LTE network having improved characteristics in terms of maximum achievable transfer speed compared to mobile networks of third generation.

2. Role of EU for the development of the telecommunications

An important role for the development of the telecommunications market have and the EU legislative proposals. The adoption of decisions for harmonized spectrum use and timing of market mechanisms directly affect the timely implementation in Member States of the new telecommunication technologies affecting all sectors of the economy and the lives of citizens.

The implementation of EU legislation at national level directly contributes to the convergence between the three sectors - transport, energy and telecommunications.

As an example of this interconnection of transport and telecommunications might be indicated the implementation of Decision № 585/2014 / EC of the European Parliament and of the Council from 15 May 2014 on the introduction of interoperable Union-wide service eCall (publ. OJ L 164 / 02.06.2014. In our country the Decision is introduced by adopted “Rules on implementation of eCall in public terrestrial mobile electronic communications networks in the Republic of Bulgaria” in accordance with Art. 3 of the Commission Recommendation from 8 September 2011 on support for EU-wide eCall service in electronic communication networks for the transmission of in-vehicle emergency call 112 (eCall).

"ECall" is an emergency call from the vehicle to the 112 done automatically by activating the onboard sensors of the vehicle or by manually dialing, which through mobile networks brings a standardized minimum set of data, and sound connection between the passengers in the vehicle and the most appropriate public center for receiving emergency calls.

The undertakers providing public terrestrial mobile networks and / or services (enterprises) provide technical capability to carry out of eCall from anywhere in the Republic of Bulgaria, with the condition that there is provided coverage of at least one public terrestrial mobile electronic communications network. They are required to provide the transmission and the routing of eCall between the onboard motor vehicle equipment and the Center for receiving emergency calls of the "National System 112" of the Ministry of Interior.

The deployment of high speed fixed and mobile electronic communication networks throughout the Union requires substantial investment, a substantial proportion of which are the costs of engineering and construction activities. The limitation of some of the engineering and construction activities associated with high costs, would increase the effectiveness of the deployment of the broadband access.

In this regard and in order to implement EU legislation it is prepared a draft of purposive law on electronic communications networks and physical infrastructure. The draft law is in the process of reconciliation in accordance with the national legislation. The implementation of this law will facilitate and encourage the deployment of high-speed electronic communications networks by promoting joint use of existing physical infrastructure and by creating conditions for more efficient deployment of new physical infrastructure so that these networks could be deployed on a lower price.

One of the main themes of the draft-law is the sharing of already built infrastructure with different functions for the deployment of high-speed electronic communications networks in particular - the settlement of social relationships between operators of poles infrastructure for the provision of electricity and the provision of electronic communications.

The current regulatory framework for electronic communications networks and services reflects the development of the sector for the period until 2009, i.e. post liberalization period. But it is not ready to meet the challenges of rapidly developing technologies and innovations. The focus of the future regulatory framework for electronic communications should be shifted to gradually reduce regulation as far as a result of the implementation of the current regulatory framework are overcome the barriers of market entry - there is a strong competition between both in terms of infrastructure and in the field of services. The new framework should ensure a smooth transition from an ex ante to ex post regulation.

**Conclusion**

To outline the future development of the sector, the regulation should meet the challenges which the online platforms/social networks are setting in point of services offered and the order in which they will interact with traditional telecom operators.

The simplification of rules includes the elimination of outdated, sector-specific provisions as well as those that were not implemented, as a result from a specially made individual studies for the implementation of each of the directives in each of the 28 EU Member States . It is necessary to pay special attention to this in the future framework in terms of convergence, specific measures to be implemented horizontally and in parallel in all three sectors - telecom, energy, transport, including in the environmental sector - specifically, for decarburization. It should not allow duplication of obligations/rights resulting from the general or horizontal EU legislation and telecom directives.

The development of a digital single market and the implementation of the objectives in key strategic documents, both at European and national level by 2020, requires the frame to have goals aimed at promoting and facilitating investment. Regulation should be focused primarily on the imposition of horizontal measures covering all sectors. The definition of sector specific measures should follow the general framework and to be in consistent with the objectives and not to create competitive advantages for market participants in a particular sector preferably to other sectors.

**Literature**

[1] Документи на Министерството на транспорта, информационните технологии и съобщенията
[2] Документи на КРС
LEGAL FRAMEWORK FOR THE PROTECTION OF CBRN AGENTS IN BOSNIA AND HERZEGOVINA

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Abstract: In this paper the authors present legal framework for the protection against CBRN agents in Bosnia and Herzegovina. By critical analyzing existing legal framework the authors will determine plausible legal course of action in cases of danger caused by CBRN agents. Namely, although use of CBRN agents for industrial purposes is thoroughly regulated the may be abused in the various activities against civil society. The may be abused through the acts of terrorism and sabotage and misused through inadequate handling of the agents and their byproducts. The final goal of this paper is to examine the applicable value of the existing legislation in this area in Bosnia and Herzegovina.

Keywords: CBRN, LAWS, LAW, GMO, SECURITY, PROTECTION.

Introduction
Possession of CBRN agents practically indicates the possibility of their usage against one country. If certain foreign force have tendency to attack, and at the same time is familiar with the fact that target country posses CBRN agents, then that foreign force has an excuse to use these agents against target country. Bosnia and Herzegovina (furthermore BiH) is signatory party of all important Agreements, Conventions, Decisions and other legal acts 1, and with its politics it is determined to fight against the usage of CBRN agents in armed conflicts. However, the more realistic scenario would be terrorist attack using CBRN agents, then involvement of BiH in armed conflict where CBRN agents would be used. In the recent history, two major events took place and raised the fear of this hazard: breakup of Soviet Union in 1991 and terrorist attack on USA on September 11th 2011 (Vrdjuka, 14). Considering this, there are four key issues in this problematic: along with nuclear terrorism, there are discussions about terrorism using biological and chemical weapons; nuclear terrorism requires either complicated production process or stealing of radioactive materials or weapons, and it is easier to produce and acquire biological-chemical agents; it is necessary to determine the motives of terrorist attack using CBRN agents; and it is necessary to have an adequate sanctions for usage of aforementioned weapons and agents (Vajtić, 305). Therefore it is necessary for BiH to create and adequate legal framework for regulating the area of usage, protection and reaction to usage of CBRN agents. Considering this, the topic of this paper is legal framework for usage of CBRN agents in BiH. This topic derives a problem that we will be discussing in this paper, and it is defined through the question if the BiH is capable to provide a defense against effects of CBRN agents? The goal of this paper is to present regulation of aforementioned area in BiH. For collection of data and analysis, and for drafting of this paper, methods of content analysis and deduction have been used. Legal acts regulating the areas that are directly or indirectly related to the CBRN protection, have been analyzed and recommendations for improvements of current situation have been given through conclusions

Results and discussion

1 Treaty on the Non-Proliferation of Nuclear Weapons (NPT), The Comprehensive Nuclear-Test-Ban Treaty (CTBT), Convention on the Physical Protection of Nuclear Material (CPPNM), Biological and Toxin Weapons Convention (BTWC), Chemical weapons Convention (CWC), Dual Purpose Products List EU strategy for supporting disaster risk reduction in developing countries Council of Europe decision on establishing Civil Protection Mechanism, Council Directive 95/21/EC on the central of major accidents involving dangerous substances, Mutual Aid Agreement between the Ministry of Security of BiH and Ministry of Interior of Montenegro on providing assistance in the case of a natural or other disaster, Mutual Aid Agreement between the Ministry of Security of BiH and Macedonian Government on protection from effects of chemical agents, as well as providing assistance in the case of accidents and incidents that involve chemicals, as well as coordination of activities for its planned realization. This is a legal framework for the protection of the citizens, tangible assets and environment from dangerous activities and affects of poisonous chemicals (Ministry of Civil affairs, Ministry of Foreign Trade and Economic Relations, Ministry of communications and Transport, Ministry of Security), and oversees the implementation of these regulations.

Civil defense service, as well as Laws on the protection and rescue of people and property in the event of natural or other disasters, is regulated by Entity legislations 2. Together with the Law on the protection and rescue of people and property in the event of natural or other disasters in BiH, and also regulates the system for protection and rescue of people and tangible assets in the event of natural or other disasters in BiH, and also regulates the system for protection and rescue of people and tangible assets in the event of natural or other disasters. Administrative and technically-operational tasks of protection and rescue in Entities and District of Brčko of BiH, are performed by competent institutions and governing bodies of entities and District of Brčko of BiH.

BiH Criminal Code 3
BiH Criminal Code, in comparison to Criminal Codes of neighboring countries, does not have some significant differences that should be mentioned, except the difference in the State system. Beside the State level Criminal Code, BiH has same Codes on

Legal base for regulation of this are in BiH is within the Law on Ministries and other governing bodies of BiH (BiH Official Gazette 5/03). This Law determines the responsibilities of Ministry of Security of BiH for coordination: international cooperation in carrying out of civil defense, coordination of activities of the Entity civil defense services in BiH and harmonization of their plans in the event of natural or other disasters afflicting BiH, and adoption of protection and rescue plans and programs 2 (this implies drafting of the Program for protection from chemical weapons and reaction in the case of accidents and incidents that involve chemicals, as well as coordination of activities for its planned realization). According to aforementioned facts, competent institutions of BiH Council of Ministers are passing the regulations derived from their direct competency concerning the protection of the citizens, tangible assets and environment from dangerous activities and affects of poisonous chemicals (Ministry of Civil affairs, Ministry of Foreign Trade and Economic Relations, Ministry of communications and Transport, Ministry of Security), and oversees the implementation of these regulations.

BiH Laws related to this problematic are: Framework Law on the protection and rescue of people and property in the event of natural or other disasters in BiH (BiH Official Gazette 50/08) is regulating the protection and rescue of people and tangible assets in the event of natural or other disasters in BiH, and also regulates the system for protection and rescue of people and tangible assets in the event of natural or other disasters.

BiH Criminal Code 3
BiH Criminal Code, in comparison to Criminal Codes of neighboring countries, does not have some significant differences that should be mentioned, except the difference in the State system. Beside the State level Criminal Code, BiH has same Codes on

2 Law on the protection and rescue of people and property in the event of natural or other disasters in BiH, (BiH Official Gazette 39/01) Law on protection and rescue in case of a natural or other disaster, 111/12, while Brčko District of BiH, for implementation of regulations from the area of civil protection is using the state law.

3 This area is regulated by Articles 166, 193a, 193b, 194, 194a and 201. Criminal Code of BiH, BiH Official Gazette 303, 303, 3703, 5406, 6104, 3065, 5506, 3207, 810, 4714, 2215 and 4015
Entity level and District of Brčko level that must be harmonized with the State one.

In accordance with the BiH Criminal Code, import of hazardous materials in BiH is incriminating, and this regulates the sanctions for the people who are importing or by abuse of his position or authority, contrary to regulations, enables import of radioactive or other material or waste harmful to the life or health of people into Bosnia and Herzegovina.

It is forbidden to make or improve, produce, stockpile or store, offers for sale or buy, intermediate in a purchase or sale or in some other way directly or indirectly transfers to another, possess or transport chemical or biological weapons, or some other means of combat prohibited by the rules of international law.

This also regulates and prohibits the use, in any way, of chemical or biological weapon or means of combat, the means of controlling disorder as a method of warfare. Whoever, at a time of war or armed conflict, orders the use of chemical or biological weapons, or some other means or method of combat prohibited by the rules of international law, or whoever uses them, will also be sanctioned.

Unauthorized traffic of chemicals, is the criminal act that prohibits import, export, transport or intermediation in a sale or traffic of chemicals without a license prescribed by the Law on the implementation of the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction (hereinafter: the Law on the CWC Implementation) or whoever gives untrue data in the procedure for issuance of the license under the Law on the CWC implementation. Even the act negligence is punishable by this article.

Behavior that is especially incriminating, and draws criminal sanctions is related to unauthorized use of nuclear material, its transportation, storage, alteration, disposal of or disperse, as well as taking away nuclear weapon by use of force or by threatening an instant attack upon another person's life or limb, or in any other illegal way, with the aim to unlawfully appropriate it. The criminal act is committed even by deceiving someone through false representation or suppression of facts, or by keeping someone in deception, or by use of force or threat by or any other form of intimidation demands to receive nuclear material, or threatens to use it in order to cause numerous deaths.

Endangering of nuclear object is considered as criminal act. More precisely, the criminal act is committed if one is obstructing the work of nuclear object, or damaging the nuclear object, or by using it in a manner that can cause dangerous leakage of nuclear or other radioactive material that can cause danger to human lives and health and property on a larger scale.

Especially it is well defined the criminal act of terrorism using CBRN agents. It is illegal to manufacture, possess, acquire, transport, supply, use or perform training for the use of weapons, explosives, nuclear, biological or chemical weapons or radioactive material, as well as research into, and development of, biological and chemical weapons or radioactive material; or to release dangerous substances, cause fire, explosion or floods the effect of which is to endanger human life; or threat to perpetrate any of the afore mentioned acts that can cause death of one or more individuals.

Regulation of this problematic in other laws

The legal base for regulation of this area in BiH, on the state level, can be found within the Law on Ministries and other governing bodies of BiH (Official Gazette 5/03).

Law on defense of BiH (BiH Official Gazette 88/05) is regulating the right and obligation of the Armed Forces of BiH to provide assistance to civil authorities in responding to natural disasters and technical-technological accidents. This Law is defining the assistance to civil authorities in implementation of measures for chemical protection and rescue.

Law on service in the Armed Forces of BiH (BiH Official Gazette 88/05), prescribes the establishment of the service for “atomic-biological-chemical defense (ABCD)”. This area is not precisely defined. The Armed Forces of BiH have 10,000 soldiers, and “ABCD” is created to protect from CBRN agents only those members of the Armed Forces that are engaged in performance of their combat or peace operations. Assistance to the civil authorities is provided only upon their request.

Law on the Red Cross Society of Bosnia and Herzegovina (BiH Official Gazette 49/04) is defining the activities of this society. Important aspects of this Law related to the protection from CBRN are: organizing and providing assistance to the citizens in order to alleviate the consequences of natural disasters, epidemics and armed conflicts; co-operation with health services, medical services of the Army forces in BiH and civil defense in order to provide care for the wounded and sick in case of armed conflicts, natural and other disasters.

Law on food in Bosnia and Herzegovina (BiH Official Gazette 50/04) is defining the base to provide high level of human health protection and interest of consumers related to food products, taking into consideration, at the same time, the variety of the available food products, including traditional products. All of this should be done by providing the efficient functioning of the domestic market. This Law is determining the unique principles related to the questions of safe and quality food and livestock food.

Very important aspect for the general society health is regulation of GMO in human food and livestock food. Uncontrolled distribution and usage of GMO in human and livestock food can cause certain health risks, because the affect to human organism and damage that can cause was never thoroughly analyzed. These questions are regulated by the Law on GMO (BiH Official Gazette 23/09). This Law sets the conditions for limited use, importation, deliberate release into environment, and marketing of products that are composed of “GMOs”, contain “GMOs”, or are derive from “GMOs.” The goal of this Law is: to provide a high level of protection of human lives and health; health and welfare of livestock; protection of environment; protection of interests of consumers regarding the GMO and GMO products, as well as live modified organisms; better and more efficient control of food products for presence of GMO in accordance with EU standards; and functionality of BiH market.

This Law is defining the obligation of the party that filed the request for or already has permit to place on the market products that are composed of “GMOs”, contain “GMOs”, or are derive from “GMOs to implement the monitoring plan in order to reveal or notice direct or indirect, current or deferred adverse effects of products that are composed of “GMOs”, contain “GMOs”, or are derive from “GMOs to the human health and environment. The Bylaw on Conditions of Monitoring the Environmental Impact of Genetically Modified Organisms or Products Containing and/or Consisting of or Originating from Genetically Modified Organisms (BiH Official Gazette 64/14) is covering the conditions, content and the scope of monitoring of products that are composed of “GMOs” that contain “GMOs”, or are derive from “GMOs, that are placed on the market, its use, as well as the manner of reporting on monitoring findings.

Since 2004, EU introduced the regulation that all human or livestock food that is derived from GMOs or contain GMOs must be clearly labeled. This was done in order to ensure the high level of protection.

In BiH, it is forbidden to grow GMOs, even thought there are data indicating that this is happening at the north-east of BiH, where they are growing soya beans. That problem was raised by Agricultural Association of Semberija. In the meantime, nothing has changed (Musli, 2015). But, food containing GMOs can be imported. With all these facts, we are partially respecting the EU standards for this area, with no obligation to put clear label on presence of GMOs in the food, even though it is regulated how to label GMO products that are placed on the market. During the procedure of placing on the market products that contain or are derived from GMO, all involved subjects are obliged to: put on unpacked or unpacked product label stating: “This product contains GMO components” or “This product contains genetically modified (and then the name of the organism)”.
The labeling obligation is not be applied to the products that contain traces of approved GMOs or are composed of, or are derived from, in ratio that does not exceed 0.9% for each food component or for the one ingredient food, under the condition that this content is accidental or technically cannot be avoided.

In Serbia, the obligation of labeling GMO products is regulated by the Law on consumer protection, Official Gazette 79/05, in part II, article 10: “Product that is result of genetic engineering or contains genetically modified components, must be labeled in the proper manner”. This Law prescribes the sanctions for not adhering to this rule. If this Article is fully implemented, citizens would have a possibility to make a choice while buying a food.

Croatian Government is about to pass the changes of the Law on GMO, in order to implement within this Law all the relevant EU directives and allow or prohibit GMO. The protection of the Croatia will be to forbid growing of GMO cultures and the Croatian territory. Passing of the amendments and changes to the existing Law, or even passing the new Law on GMO is expected by the end of 2015 (Vidov, 2015).

Regulating the area of radiation and nuclear damage

Law for accountability for nuclear damage (BiH Official Gazette 87/13) defines the issues of civil accountability for nuclear damage, caused by using the nuclear energy for peace purposes, wherever that damage occurred, as well as other important issues related to this accountability.

Law on radiation and nuclear safety in BiH (BiH Official Gazette 88/07) is regulating the control system of ionizing radiation sources, protection of citizens, current and future generations, as well as environment from exposure to, or possible exposure to ionizing radiation. It is applied to all situations where there is a possibility that exposure to ionizing radiation occurred, or there is a potential for it, except situations that are not covered by this Law. Also, this Law defines the accountability for nuclear damage. The purpose of this law is to ensure the protection from ionizing radiation – radiation and nuclear safety of BiH citizens. Serving that purpose, State regulatory agency for radiation and nuclear safety has adopted several legislations that regulate inspectorate supervision of radiation and nuclear safety, and defining questions and acts related to handling and dealing with sources of ionizing radiation.

Regulation of prohibition of chemical weapon usage

Chemical agents are not as lethal as biological agents, and these agents are easier to control. Danger of using chemical weapon as type of CBRN agents, is more realistic then usage of nuclear weapon. Tokyo subway terrorist attack, that happened in 1995, using sarin, is a warning of this reality (Hofman, 2006). Therefore, reaction of possible treat of chemical agents' usage must be fast and efficient, and it needs to be regulated by different Laws and bylaws. Law on implementation of Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (BiH Official Gazette 15/06) defines obligations, prohibitions and limitations related to chemicals in BiH according to Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (RBiH Official Gazette, Special edition – International agreements, 7/96) in accordance with obligations of BiH.

By program on protection from chemical weapons and reaction in the case of accident or incident involving chemicals in BiH, it is defined the organization and functioning of anti-chemical protection, i.e. system of measures, actions, forces and means of protection and rescue (response) in the case of threat or usage of chemical weapons, but also in the case of uncontrolled release into environment of poisonous chemicals.

This area is also regulated by other bylaws, such as: Book of Rules on BiH Coordination body for protection and rescue in the case of natural and other disasters in BiH, Instruction on the method and procedure for border crossing in the case of providing/receiving international aid, regarding protection and rescue, Standard operation procedures on engagement of the Armed Forces of BiH in providing the assistance to civilians in the case of natural or other disaster.

Protection of the citizens from biological agents

Biological agents are more lethal then chemical ones, so the extraordinary precaution and focus is needed in prevention of using these agents and reaction to situation where they are applied. BiH Entities are authorized for this. Law on prevention of citizens from infectious diseases of FBiH (FBiH Official Gazette 29/05) is determining infectious diseases which prevention and control is in interest of FBiH, and it is defining the actions for prevention of citizens from infectious diseases. Law on prevention of citizens from infectious diseases of Republika Srpska (RS Official Gazette 14/10) is defining the system of protection of citizens from infectious diseases, the list of infectious diseases and conditions that need to be reported immediately, actions that should be taken in order to prevent or control infectious diseases, authorizes bodies within institutions that issue an order for actions on prevention and control of infectious diseases, responsibilities of health institutions, legal bodies, entrepreneurs and individuals on implementation of actions for prevention and control of infectious diseases, as well as other important issues from this area. It is necessary to emphasize that District of Brčko did not adopt Law on prevention of citizens from infectious diseases; instead they are using Law from Republika Srpska that regulates this area.

Law on health protection of FBiH (FBiH Official Gazette 46/10) regulates policies, procedures, organization and implementation of health protection, institutions within the system of health protection, rights and responsibilities of individuals using health protection, as well as content, performance method and supervision of health protection system at the territory of Federation of BiH.

Law on health protection of Republika Srpska (RS Official Gazette 106/09) regulates availability of health protection, policies of health protection, rights and responsibilities of citizens in acquiring health protection, different levels of health protection, establishment, cessation of work and organization of health institutions, bodies within health institutions, work organization, work time and strike within health institution, positions of health care professionals and assistant, certification and accreditation of health care institutions, special provisions, financing of health care institutions, supervision, expert audit boards, as well as other important issues regarding organization and implementation of health protection.

Law on health protection of District of Brčko (Official Gazette of District of Brčko of BiH 38/11) regulates availability of health protection, rights and responsibilities of citizens in acquiring health protection, different levels of health protection, establishment, cessation of work and organization of health institutions, specific aspects of work of health care professionals and assistant, certification and accreditation of health care institutions, private practice, determination of death and autopsy, expert bodies, chambers, supervision and other important issues regarding organization and implementation of health protection in District of Brčko.

Transportation of dangerous substances

Contamination with CBRN agents is directly influencing eco system and through that, life and health of population. In order to preserve eco system, states from the region passed laws on environmental protection and numerous legislations regulating the area of handling dangerous substances and prevention of environment from negative consequences once they are released.

Law on transportation of hazardous materials did not pass Parliament procedure. Recommendation of EU Delegation to sub-committee for transport, environment, energy and regional development was to regulate this on Entity level. Therefore, Federation of BiH is using Law on transportation of hazardous materials (SFRY Official Gazette 27/90 and 45/90) and Book of Rules on transportation of hazardous materials by road (SFRY Official Gazette 76/90), form former SFRY. Republika Srpska passed its own Law on transportation of hazardous materials (RS
Official Gazette 1/08 and 117/11). Brčko District regulated this matter by Law on transportation of explosive materials and flammable liquids and gases (Brčko District of BiH Official Gazette 27/07) and Law on transportation by roads of Brčko District of BiH (Brčko District of BiH Official Gazette 10/06, 19/07, 23/08, 04/11 and 31/13).

Law on transportation of explosive materials and flammable liquids and gases (Brčko District of BiH Official Gazette 27/07) is regulating transportation, trade and usage of explosive materials and flammable liquids and gases on territory of Brčko District of BiH.

Law on transportation of explosive materials and flammable liquids and gases (RS Official Gazette 16/96, 110/03, 67/05 and 1/08) defines that during production, transportation, trade and usage of explosive materials and flammable liquids and gases, authorities bodies are obliged to ensure that security measures prescribed by law and other legislations, are in place in order to protect lives and health of people, material assets, living environment and traffic safety.

Based on Amendment LI, paragraph 5, item 3 of Constitution of Republic of Bosnia and Herzegovina, Presidency of former Republic passed Directive with statutory power on transposing and implementation of Federal Laws. These laws were implemented in BiH as republic Laws. Law on prohibiting of construction of nuclear power plants in SFRY was on that list (SFRY Official Gazette 35/89).

Law on Environmental Protection (RS Official Gazette 53/02), Law on Environmental Protection (Brčko District of BiH Official Gazette 24/04, 1/05, 19/07 and 9/09) and Law on Environmental Protection (FBiH Official Gazette 33/03) are regulating: protection, maintenance, renewal and improvement of ecological quality and capacity of environment, as well as quality of life; procedures and conditions for management, maintenance and rational exploitation of natural resources; legal framework and institutions for maintenance, renewal and improvement of protection of environment; financial activities related to environment; duties and tasks of administrative bodies on different levels of Government. Content of these laws is not the same in both Entities and Brčko District, but it is very similar, without major differences.

Unlike other countries, BiH has codified written Constitutions, with modest differences when it comes to regulations of matters related to protection of environment.

Environmental Protection in BiH does not have constitutional protection at the state level, because BiH Constitution does not include the right to healthy environment or its protection. But, the right to healthy environment is the part of the right to life that is prescribed by Article II/3.a of BiH Constitution. Besides that, all international acts that Constitution of BiH is referring to are implemented, especially European Convention for the Protection of Human Rights and Fundamental Freedoms that has primacy over all other Laws in BiH. Environmental protection is the subject regulated by Constitutions of Entities, even though Constitution of FBiH and Constitutions of 10 cantons in FBiH did not define the right to healthy environment. Only Constitution of Republika Srpska is defining this, stating that "individual has a right to healthy environment". There are no special responsibilities of the State or Entities when it comes to this right, but it is stated that in accordance with the law everybody is responsible to protect and improve environment, in accordance with its own capabilities. Protection of constitutionality is under jurisdiction of the Constitutional Court of BiH, and on Entity level is under jurisdiction of entity courts, but it is necessary to emphasize that authorities of BiH Constitutional court and Entity constitutional courts are different (Tomasević et al., 2015).

BiH has very complex system, when it is compared to legal regulations of neighboring countries. State system of BiH is constructed in such manner that it is not possible to implement one part of the law on the State level, but instead of having one law that would be applied throughout BiH, there are three laws in place. Governmental structures focused on this issue and neglected the real problem. Therefore, BiH does not have Plan for reaction in Emergency situations. Serbia has National strategy for protection and rescue in emergency situations and Croatia has Plan of reaction in cases of emergency situations that define even the smallest details of involvement of all members in CBRN defense. BiH does not have such document that strictly regulates procedures during the emergency situation. Responsibilities of all individuals that are part of the rescue operation would be defined by such document. Currently, there is only "Methodology for development of plan for protection and rescue".

Very important document for the security of one country is Action Plan for nuclear safety. According to the Law on radiation and nuclear safety in BiH (BiH Official Gazette 88/07), and upon proposal of the State regulatory agency for radiation and nuclear safety, BiH Council of Ministers will pass the State action Plan on protection of citizens from ionizing radiation in emergency situation or nuclear accident. Unfortunately, that plan has still not been passed. Based on that plan, the Agency would be responsible, in accordance with international conventions and Vienna convention on civil liability for nuclear damage, to prepare a State plan for nuclear safety on the case of nuclear accident in other country that can influence the nuclear safety in BiH.

Conclusion

Considering the fact that this area is not completely defined in BiH, it is necessary to harmonize state level legislations with those on entity level and to prepare a register of CBRN agents. It is necessary to establish compatible state level unit for CBRN defense, with high quality forensic equipment and laboratory. At the state border and border crossings, it is necessary to raise the level of control and to provide the members of Border Police and Custom Service with adequate equipment for detection of hazardous materials that are being transported into the BiH. At the same time, we must prepare a State Action Plan for emergency situations and protection of the citizens from ionizing radiation in emergency situation, nuclear accident or nuclear damage, as well as in case of nuclear accident in other country that can influence the nuclear safety in BiH. When it comes to control and supervision, it is necessary to enhance the level of health – security inspections of import and storage of CBRN agents in BiH, supervision of dangerous spots and high risk sports, control of the disposal of dangerous waste, planned control of construction and land usage (limitation and prohibition of constructing the chemical factories in a vicinity on settlements). In the area of management of hazardous materials in it necessary to regulate in details the method of disposal (neutralization, removal, burning) of contaminating materials/dangerous waste, methodology of collection, dissemination and usage of information, surveillance system and information system in the case of accident involving hazardous materials; labeling and usage of hazardous materials, storage of hazardous materials (places and procedures for storage) and especially transportation of hazardous materials. At the end, it would be necessary to emphasize the importance for the State to regulate the contamination control of crops, land, different products, food and water as well as to define the criteria for preparing the list of commercial companies, factories and other legal bodies that can potentially cause the accident involving hazardous materials.

References

EXAMPLE OF SECURITY MANAGEMENT SYSTEM OF THE ORGANIZATION –
COMPONENTS AND CONCEPTS

ΠΡΙΜΕΡ ΝΑ ΣΙΣΤΗΜΑ ΖΑ ΤΡΑΠΕΖΙΔΟΠΛΗΣΗ ΕΝΑ ΣΙΓΚΥΡΟΤΗΤΑ ΝΑ ΟΡΓΑΝΙΖΑΙΩΝ –
ΚΟΜΠΟΝΕΝΤΙ ΚΑΙ ΚΟΝΣΕΠΤΗΣ

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Abstract: Issues related to security are intertwined in all areas of the life of an organization. Many of them are considered and documented
organizational and provided within the respective area/subsystem of the management system of the organization. For example, information
security management is detailed and reliably described in the international standards. And this is natural, considering the importance of this
type of security and the fact that information technology lie at the core of almost all organizations. In the meantime however, it is necessary
to go a long way to reach the ultimate goal of improving security of the organizations by developing integrated management systems for
business security. A Security Management System may be considered as that part of the overall management system, based manly of the
quality management system, that provides the structure to enable identification of potential threats to an organization and which establishes,
implements, operates, monitors, reviews and maintains all appropriate measures to provide assurance of the effective management of the
associated security risks.

KEYWORDS: QUALITY; QUALITY MANAGEMENT SYSTEM (QMS); SECURITY; SECURITY MANAGEMENT SYSTEM (SMS);
INTEGRATED MANAGEMENT SYSTEMS FOR BUSINESS SECURITY; SECURITY RISKS.

1. Introduction

Successful companies have found a way to offer something that people want, at a price they are willing pay, in a way that will make
money in the transactions. Highly successful companies offer quality products and services in this exchange, and keep quality high; so that the customer will return the next time he/she wants to
purchase [1].

Quality has been defined as “The totality of features and characteristics of a product or service that bear on its ability to
satisfy stated or implied needs. Not to be mistaken for “degree of
excellence” or “fitness for use” which meet only part of the
definition”. By this definition, security is a component of quality.

Security is defined by the American Heritage Dictionary in their on-line database as:

a) Freedom from risk or danger, safety;
b) Freedom from doubt, anxiety or fear; confidence;
c) Something that gives or assures safety as:
   - a group or department of private guards;
   - measures adopted by a government to prevent espionage, sabotage or attack;
   - measures adopted, as by a business or homeowner, to prevent a crime such as burglary or assault.

These definitions, taken together, can demonstrate that quality is the responsibility of the whole organization and security is a part
of the totality of quality of a system, implicit in customers’
expectations. Security, as a component of quality, must be
addressed throughout an organization, in the definition of strategy, the development of policy and the implementation and monitoring
of both [2].

2. Components of security management system –
discussion

Component 1 – Credibility and Integration of the Personnel

A prerequisite that corporate security personnel come, for example, from military, intelligence or law enforcement background, it is
essential that those with responsibility for security are able to
demonstrate competence not only in all aspects of the security
discipline, but also have an awareness of the contribution security
can make to other aspects of the business, such as Governance,
Strategy, Compliance, Assurance, New Ventures, and other
essential business-related issues. It is the responsibility of the
person with overall responsibility for Security to ensure that
training and development needs arc recognized, addressed and
records maintained. In this way, security may become an integrated
and respected part of the organization; used in business planning,
execution, and decision making. Expectations of security personnel are:

- Professionalism - living the corporate values;
- Expertise - demonstrating a thorough knowledge of the subject;
- Vision - demonstrating an understanding of the wider business
  objectives;
- Teamwork - working closely with other disciplines to understand
  their contributions and aspirations;
- Collaboration - conducting security risk assessments in support of
  specific operations, not in isolation;
- Communication - security considerations to top management in a
clear, concise manner, demonstrating due consideration to all
factors.

Component 2 - Policies, Objectives and Tasks

There should exist a single security policy which outlines the
security architecture, strategy and protocols.

The following sections are addressed:

- Security management objectives;
- Statement of the attitude of the organization to security;
- Description of the security environment;
- Statement of the security risk appetite;
- Security organization, roles and responsibilities;
- Procedures for security risk assessment;
- List of security Standing Operating Procedures (SOPs);
• Security priorities and calendar for coming year.

Component 3 - Threat, Vulnerability and Security Risk Assessment

Security risk assessments should take into consideration a wide range of elements beyond physical security threats. Such elements should include:

• The operating environment and groups/events by which it is characterized;
• The profile of the organization, the footprint and the social impact;
• The strategic, long term objectives of the organization;
• Voluntary Principles of Security and Human Rights;
• Legislation and local expectations;
• Capability and intent of local criminal/terrorist elements;
• Vulnerability and attractiveness of assets to criminal/terrorist elements;
• Availability of resources.

Component 4 – Controls

Examples of security controls may include:

• Physical protection measures (lights, fences, CCTV, barriers, etc.);
• Introduction of security procedures (ID checking, access control, mail screening, etc.);
• Intelligence networking (local social/political leaders/intelligence providers, etc.);
• Electronic security (encryption, password protection, etc.);
• Resourcing (security personnel, equipment, etc.);
• Local integration (CSR programme, local content, etc.);

Component 5 - Security Risk Register

A security risk register should:

• Facilitate ownership and management of security risks;
• Provide an overview of the significant security risks that are faced by an organization;
• Record the results of threat/vulnerability security risk assessment;
• Form an agreed record of those security risks that have been identified;
• Record additional proposed actions to improve the security profile;
• Facilitate the prioritization of security risks.

Component 6 - Planning and Resourcing

Effective planning will answer:

• What are we going to do?
• How are we going to do it?
• When are we going to do it?
• How long do we need to do it for?
• How are we going to coordinate and communicate?
• What do we do if something goes wrong?

Effective resourcing will answer:

• What do we need to do it?
• How do we get it?
• How much does it cost?
• What is our back up if something doesn’t work or isn’t available?

Component 7 - Execution and Control Activities

The execution of a plan is predicated on all of the previous components in the management system:

• The plan has identified all the security risks to the operation;
• All control mechanisms are established;
• The plan has been accordingly and appropriately resourced;
• Any bespoke procedures are documented, approved and validated;
• The plan has been effectively communicated to those with responsibility for its execution;
• Assurance that those with responsibility for carrying out the plan have the correct competencies;
• All correct back up and reinforcement strategies are established and tested.

Component 8 - Monitor and Security Reporting

Monitoring is based on effective two-way communication. Where appropriate, traditional methods are often effective and should be considered:

• Inspections;
• Review meetings;
• Auditing;
• Interviews;
• Workshops.

Component 9 – Review

The purpose of the review may be any combination of the following:

• To critically de brief the plan in order to determine strengths weaknesses and areas that could be improved;
• To obtain feedback from those involved in the execution of the plan/ project regarding the manageability of the plan;
• To highlight any competency issues arising from exposure to new challenges;
• To examine how much contribution the operation/task/project brings to the achievement of the organization’s objectives;
• Assurance to top management that security is being managed effectively;
• Enables security management to assess whether established protocols are being effective, and to take action accordingly;
• Highlight examples of good practice.

Component 10 – Learning

Effective processes for learning lessons will enable an organization to:

• Introduce improvements to procedures;
• Introduce improvements in organizational structure;
• Update documentation;
• Implement of new training courses;
• Increase awareness of new threats/update on existing threats;
• Introduce new equipment/technology;
• Better integrate to the wider organization;
• Better understand the organization's objectives;
• Heightened awareness of the contribution of security;
• Improved relationship with/understanding of other business functions;
• Improvements to the management system;

**Component 11 - Reporting to Top Management**

Providing such feedback to top management:
- Offers reassurance that security is being effectively managed;
- Offers reassurance that security understands its role in the achievement of the business objectives;
- Gives confidence in decision-making that all security issues have been given appropriate consideration;
- Reinforces the importance of security considerations in making decisions;
- Reinforces the role of security in protecting the organization's people, assets and information;
- Emphasizes that security operates in support of business operations, and not as a barrier to them.

### 3. Concepts of the security management system – discussions

#### 3.1. Security and Quality Management

A security management system, as with other management systems is based upon the model defined in ISO 9001:2008, Quality Management Systems –Requirements [3]. In a security risk-based, process-driven approach to security, the achievement of security objectives should start with a threat/security risk assessment. Having identified the security risks and planned mitigation measures, a security risk register may be established. The mitigation measures detailed in the security risk register are realized through resource management and security planning, thus arriving at a security solution (product), whether that is hard security measures, procedural requirements or a higher level security solution that supports strategic objectives, such as a crisis management strategy, or establishment of an intelligence gathering network.

#### 3.2. Documentation and Management Systems

A management system, as defined by ISO 9000:2005 [4] is a 'system to establish policy and objectives and to achieve those objectives'. In order to help in the achievement of those objectives, the system needs to be supported; that support comes in the form of approved standards and procedures. An effective management system should be such that it does not necessarily need a discipline expert to implement and manage it.

#### 3.3. Security Management Principles

(a) Customer focus;
(b) Leadership;
(c) Involvement of people;
(d) Process approach;
(e) Systems approach to management;
(f) Continual improvement;
(g) Factual approach to decision making;
(h) Mutually beneficial supplier relationships.

#### 3.4. Security risk Management and Assessment

(a) Definitions

ISO Guide 73:2009 [5] provides the following definitions:

**Term** | **Definition**
--- | ---
- Risk | effect of uncertainty on objectives;
- Risk analysis | process to comprehend the nature of risk and to determine the level of risk;
- Risk appetite | amount and type of risk that an organization is willing to pursue or retain;
- Risk assessment | overall process of identification, analysis and evaluation;
- Risk evaluation | process of comparing the results of risk analysis with risk criteria to determine whether the risk and/or its magnitude is acceptable or tolerable;
- Risk identification | process of finding, recognizing and describing security risks;
- Risk management | coordinated activities to direct and control an organization with regard to security risk;
- Risk tolerance | organization's or stakeholder's readiness to bear the risk after security risk treatment in order to achieve its objectives;
- Risk treatment | process to modify risk.

(b) Security Risk Management Process

The purpose of security risk management may be described as:

"To identify the threats and security risks to an organization and to manage those security risks within the risk appetite of the organization in order to provide reasonable assurance of the achievement of the organization's objectives" [6].

(c) Security risk Registers

There is no prescription for the format of a security risk register, which will vary according to the organization's culture, security risk classification systems, the nature of the project, reporting requirements and so on, but the following components are generally considered key:

• Inherent risk: The level of risk before any control activities have been applied;
• Residual risk: The level of risk that currently exists, taking into account controls that have been established;
• Target risk: The ultimate level of risk that is desired by the organization;
• Controls: Measures implemented to modify risk.

(d) Security risk Treatment

A brief mention should be made of Controls. Controls are those measures which effect the security risk treatment. In simple terms, security risk treatment may fall into four categories:

• Treat: apply controls internally;
• Tolerate: accept that risk is already within tolerance levels; no controls required;
• Transfer: pass the risk on to a third party; usually an insurer or a contractor;
• Terminate: decide that even if controls are established, the risk will remain outside the tolerance of the organization, and so a decision to end the course of action that carries the risk would usually be made by top management.

(e) Analysing Likelihood and Impact

There are a variety of formats; some of the more detailed include other categories such as:
• Time before Impact;
• Duration of Impact.

It is for the individual organizations to define their own policies on security risk register format and management.

3.5. Security Excellence

The European Foundation for Quality Management has recently published the latest version of its Excellence Model [7]. The Excellence Model is a non-prescriptive framework for management systems that has been widely adopted in both the public and private sector. The Concepts of Excellence [8] and the criteria may be adapted for security as follows:

3.5.1. Adding Value for the Customer

Security is often perceived as an unnecessary barrier to progress. One way to overcome this and to embed security into daily business is by understanding, anticipating and fulfilling their needs, expectations and opportunities.

3.5.2. Creating a Sustainable Future

In the exploration phase particularly, winning over 'hearts and minds' is often the key to security. An unhappy community in some parts of the world can create significant security risks. Security input to the Corporate Social Responsibility (CSR) programme is therefore invaluable in advancing the social conditions within affected communities.

3.5.3. Developing Organizational Capability

Managing or creating the ability to change the capability of the security organization will enable it to respond/adapt to the different demands made upon it, whether it be deployment of a guard force with limited notice, provision of executive protection, or carrying out security compliance exercises. The security organization must strive to be multi-facetted.

3.5.4. Harnessing Creativity and Innovation

Often, effective security solutions come from creative thinking. There is no textbook solution to security challenges and so security managers must be open to all ideas at all levels, no matter radical they may seem.

3.5.5. Leading with Vision, Inspiration and Integrity

Upholding the organization's values is as relevant to the security function as it is to every other function. Security is not exempt from the need to inspire through upholding moral values. Upholding the Voluntary Principles of Security and Human Rights (VPSHR) is one area where security has the opportunity to show inspired leadership.

3.5.6. Managing with Agility

Being 'agile' in security means having the ability to effectively and efficiently recognize and respond to threats and opportunities. The notion of a Quick Reaction Force, for example follows this concept.

3.5.7. Succeeding through the Talent of People

Teamwork is key in all disciplines, but arguably more so in security; the ability to stand in for each other seamlessly, be it stepping up or stepping down, and achieving coordination in operations through an understanding of each other’s roles ensures and develops talent and progression.

3.5.8. Sustaining Outstanding Results

In security terms, this translates as providing a 'best in class' support in all areas, and planning now to do the same in the future. Resource and strategy planning for new country entry well in advance is an example where security could sustain an outstanding performance.

Conclusion:

Obviously, the four most important characteristics of any operational management system are:

- Leadership;
- Security risk Management, Implementation;
- Continuous Improvement.

This is consistent with the fundamentals of security management, and so these characteristics also form the hub of the Security Management System (SMS) wheel.

Effective implementation of the SMS will ensure:

- Confidence - that security has the ability to prepare for and react to events that may otherwise present a threat to the organization's people, information and/or assets;
- Optimization - that the most efficient use of resources is made at optimum cost;

In contributing to the organizations overall Confidence levels and Optimization of resources, a SMS will:

- Improve the resilience of the organization;
- Enhance the organization's credibility;
- Introduce a core language and core processes for security risk management;
- Enable an organization to be nimble and flexible in its response to security challenges;
- Continually improve the capacity of an organization to manage security challenges.

Literature:

1. OGP, Operating Management System Framework for controlling risk and delivering high performance in the oil and gas industry;
2. OGP, Processes and concepts in security management;
5. ISO Guide 73009 - Risk management -- Vocabulary
7. EQFM Excellence Model, EFQM Publications, 2012;
1. Introduction

Recently, the issue of trust is becoming more and more interesting for philosophers and psychologists. Trust is one of the fundamental components of effective interaction of individuals, sharing knowledge and experience. Trust plays an important role in the regulation of consciousness and behavior of the individual. At the interpersonal level trust regulates interpersonal relationships, including the function of feedback in the process of self-knowledge, a means of psychological relief, and intensification of relationships. In addition, trust intensifies communication and cooperation, reduces risk and mobilizes the activity of parts of interaction.

Trust accelerates the processes of social exchange, promotes the integration of groups, communities and society as a whole. Trust in society initiates public actions that reflect corporate relationships, including the function of feedback in the process of self-knowledge, a means of psychological relief, and intensification of relationships. Trust brings together social groups and lack of trust divides people.

2. Preconditions and means for resolving the problem

Today there are a large number of scientific studies devoted to the phenomenon of trust in different fields: economic, political, social, legal (including crime) and other areas of life. The phenomenon of trust is studied not only in application to different spheres of human activity, but also for different age groups.

Role and place of trust during professional training at the university has not been researched enough. In our previous publications (such as “Features of trust building between students and teacher at technical higher educational institution”, “The relation of trust and locus of control of students of technical higher educational institution” and others.) we tried to study the issue of trust of students in higher educational institutions, including technical ones.

The next step in researching the features of trust building in studying and educational activities at the technical higher educational institution is the study of the correlation of trust and self-regulation level of students. Thus, the central question of our research is: how are trust and self-regulation of students connected?

The aim of the study is to establish the correlation between the level of social trust and level of self-regulation of the students of technical higher educational institution.

Most dictionaries define trust as confidence in someone’s diligence, honesty, correctness in something (a strong belief in the honesty, goodness etc of someone or something “Longman Dictionary of Contemporary English”). Trust is explained as “mental state due to which we rely on some opinion that seems reputable, and therefore deny an independent research of the issue that can be investigated by us” (F. A. Brockhaus and I. A. Efron).

J. Rotter defines trust in human relations (interpersonal trust) as “generalized human expectations about how you can rely on words, promises, spoken or written statements of another person or group of people”. In turn, the psychological self-regulation is seen as a change of some psychophysiological functions and mental state in general carried out by the subject through specially organized mental activity. Self-regulation is seen as a process of conscious, deliberate planning, construction and transformation of the subject’s own actions and actions in accordance with personally meaningful goals and current needs (M. I. Boryshevsky).

To achieve this goal we have used questionnaire “Style of self-regulation of behavior” (V. I. Morosanova) and “Scale of interpersonal (social) trust” method of J. Rotter (adapted by Dostovalov S. G.).

3. Results of the research

The study has been conducted at the department of instruments and systems of non-destructive testing at National technical university of Ukraine “Kyiv Polytechnic Institute” (Kyiv, Ukraine). 42 students of 1-5 courses, including 12 girls and 30 boys have taken part in the research.

According to the results of the survey we have established: the level of social (interpersonal) trust of students; profile values of self-regulation of students and the general level of self-regulation of students.

According to the method of J. Rotter, the results of social trust vary between 25 (absolute mistrust) to 125 points (absolute trust). The average value is 75 points. According to the survey results overall level of interpersonal trust among students is high and makes up 88.69 points (standard error of the average – 1.956). Thus, minimum value of the specified scale of level of trust is 60, and maximum – 116.

Also, we have set the parameters for self-regulation on separate scales and general levels of self-regulation (according to the method, they range from 0 to 46). The average level of self-regulation is 31, which, according to the conventional division of the scale on the areas can be interpreted as an average one. This variance of values is large enough – from minimum 19 to maximum 43. According to the data obtained by the study typical profiles of self-regulation are built.

To identify interdependence indicators of trust level and self-regulation level a correlation analysis of the obtained data is carried out. The purpose of this analysis is to identify whether there is a significant dependence of one variable on another. The analysis has shown that a significant negative correlation (r = -0.427) is observed between general self-regulation and trust, in other words, with increasing levels of self-regulation of individual the level of trust other people tends to decrease (the level of relevance of the results p = 0.005). To eliminate age factor partial correlations are calculated and they show that the difference in age of respondents has no significant effect on the results of the study.

The establishment of possible correlations between the level of trust and certain aspects of self-regulation has also aroused scientific interest. Thus, the most significant correlation is observed for scales of modeling and evaluation of results (correlation coefficient values of rare about -0.5 and -0.4, respectively).
For scales of planning and programming the value of \( r \) is about 0.3, indicating a weak correlation between values according to these scales and the level of trust \((p < 0.05)\). For scale “independence” resulting value \( r \) is positive, unlike other scales. However, the relevance of results on this scale is much higher than the permissible value \((p > 0.05)\), so the data do not have statistical reliability and are not the subject of interpretation.

In the figure below the diagram of scatter of values of trust and self-regulation levels reflecting their correlation is represented.

![Fig. 1. Correlation between the general level of self-regulation and interpersonal trust](image)

### 4. Conclusions

So, survey of students of the studied department gives the opportunity to research the features of self-regulation of respondents, their social trust and mutual correlation between the expression of these two phenomena.

Thus, it has been found that a fairly high level of interpersonal trust and low level of self-regulation are inherent to the studied group of students. It has been defined that there is a correlation between the studied phenomena: with the growth of the general level of self-regulation of students the level of trust decreases.

Based on the obtained results and taking into account the results of the study of connection between the trust and the level of subjective control conducted earlier, it can be assumed that the development and formation of personality, the formation of ability to regulate activity, responsibility and awareness of own actions significantly affect the expression of social trust in personality. Such a person is more focused on his own strength and mind, less inclined to seek the approval of others, and, therefore, more independent of external circumstances that may limit his development. In terms of educational activities, students with sufficient formation of self-regulation and optimal level of social trust are focused on internal locus of control and on achievement of their own goals (including goals of studying). Such students plan their actions to achieve their objectives, take responsibility for success and failure. That is why the creation of favorable psychological climate with optimal level of trust between students and teacher is important in pedagogical interaction.

### 5. Literature

ETHNICITY, RELIGION, NATIONAL IDENTITY

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Abstract: The processes we designate as globalization tend to provoke resistance, which arises ever more often as an effort on the part of various ethn-cultural and religious traditions to preserve their own identity. In this context, ethnic and religious affiliations become centers of meaning in the striving towards a separate identity in the global debate regarding the quality of human development.

Achieving a national community and building new norms of coexistence under the conditions of ethn-religious variety are becoming a strategic goal of contemporary development. Contemporary civilization faces the need to respond to the critique and resistance of various forms of religious fundamentalism, and especially the critique formulated in the tradition of Islamic fundamentalism.

The problems related to national identity have been far more often described and discussed in the context of nationalist fears of difference than in terms of the effort to overcome the crisis of identity amidst the imposed similarities. Under Bulgarian conditions, ethnic and religious diversity continues to be perceived as an established fact that we must take into account, and not as a resource for nation building. Achieving a national identity should be the result of joint effort. The first and most difficult part of this effort is to recognize that this common meaning exists in a diversity of forms. The coming years will be marked by a search for new grounds of one’s own identity, a search for the spaces that define parts of ourselves. The great challenge facing Bulgaria is to rediscover the values and meaning of the national community. Only thus will our genuine, full presence in Europe become a fact.

Keywords: RELIGION, ETHNICITY, CULTURE, IDENTITY, ISLAM, NATIONALISM, VALUES

The transformation processes in post-Soviet-type post-totalitarian societies have once again raised interest in the question of identity of social actors and their actual potential for development in the course of on-going changes. The need for a new identity, new dimensions and new measures of personal presence in society, has oriented the efforts of “societies in transition” towards defining identities in terms of social parameters that differ from those used hitherto. Collective memory and the capacity for non-constructive integration of the past and present within the framework of the individual biographical perspective has been put to the test.

The problem of identity became recognizable in Bulgarian public space in terms of the question as to the degree in which the different minorities have the right to take part in establishing the general rules. But the real basis of the identity crisis results is a deficit of cultural means for providing a new meaning for the majority. Thus, the problems related to national identity have been described and commented far more frequently in the context of nationalist fears of difference than in relation to the effort to overcome the identity crisis in the imposed similarities. Nationalism is a result of a national inferiority complex. The manipulative fixation of public attention on a nation’s own advantages always involves self-justification by reference to the “bad neighbour”; to external powers hostile towards us, by constant self-pity, which defines the field of our personal self-fulfilment. Nationalism perceives tolerance as weakness; and understanding of difference, as a lack of patriotism. The demonstrative, socially desirable tolerance that most social surveys register actually contains a complex set of limitations and repressed conflictual features. Within the meanings and symbolism of tolerance and toleration, there lies projected a substantial part of the significant transformations of the attitude to the other ethnic group, to the other religion, and to Otherness in general. The negative dynamics of development in the relationship between tolerance vs. toleration (toleration is defined to a much greater degree by reduced possibility of choice than by the culture of tolerance and respect for the difference of others) is characteristic of an unfocussed mass consciousness.

Attempts to substitute patriotism with nationalist slogans are invariably an indicator of deep crisis in the consciousness of national identity. The susceptibility to this type of phraseology usually indicates a significant difference in the way the universal values of human coexistence are perceived and interpreted. In the Bulgarian case, cultural diversity continues to be perceived as something given which we must comply with, and not as a resource for nation building.

Identity is a consciousness of continuity of the self, an awareness that the individual (or the group) is identical with him/herself across space and time, and awareness of the difference of the individual (group) from “others”, from those who are “different”. Identity is built upon several essential fundaments, beyond which we cease to be different and distinguishable from others in public space. The identity crisis that marked the end of the 20th century and continues even now has been accompanied by the painful sense of loss of individuality, of an impaired rhythm of existence, of a “breakdown” of the measure of culture, and ultimately, of a lack of a sufficiently clear connection, within our individual lives, between the past and the present. In our country, the socialization process that was meant to serve a different society, the totalitarian one, has not yet been replaced by a socialization process favourable to recognition of others, those who are different as partners. It is typical for the generation that once lived in a lie that their public speech is always different from their private way of thinking and personal opinion. The real problem of the Bulgarian transition is that it was carried out by people with an initial moral deficit. At the political level, this is related to the quality of politics and political culture. A change of this quality for the better is possible only through an active construction of new socializing practices that might form individuals who act collectively and within the norms, and who work for the cause of real democracy, in which everyone, regardless of his/her social position, political views, ethnic origin, religion or name, will be equal before the law and will have chances for social realization and attaining a European living standard. In other words, these should be individuals who look upon national identity as a synthetic unity of all ethnic groups, religions and cultures living in Bulgaria and characterizing Bulgarian citizenship. The national identity is a synthetic unity of the existing ethnic, cultural, religious variety, a unity in which there is full respect for historical facts relevant to the formation of a national identity.

Achieving identity is a cultural process. It implies preserving certain values, which, regardless of the social environment, continue to define our behaviour and beliefs about the world. Values are a principle of human existence. They are a prototype. Human life is lived in a world of values; it is guided and made meaningful by values. The devaluation of values leads to a crisis in society, for which the only solution is a reassessment of values. And since values are a matter of choice – given that they are not subject to natural causality – the values that are imposed and imputed coercively do not materialize in goods, so that their devaluation is inevitable. The devalued values damage the immunity of the individual/group/society (Fotev 2009: 11-21). In general, values studies indicate a moral decline and deficit of social and national values in Bulgaria. Sociologists explain this negative trend by referring to the transition period, which has put whole generations of people socialized for one type of society, the socialist
one, in new realities requiring a radical elimination of the conflictual areas of a now compromised type of socialization. The process of socialization is compromised both by the idea of a homogeneous Bulgarian nation, combined with inability (or refusal) to understand the multi-ethnic and poly-religious characteristics of this nation, and by the refusal to achieve the kind of shared reinterpretation of the past that would be oriented to the present. The postponed, disregarded and repressed conflicts cannot provide a reliable basis for reintegration in a changing society – a society in which the social and national competence is formed without an active civic education network. Education comprises learning and moral education. Learning includes mastering the scholastic content, acquiring knowledge about certain facts in the surrounding world, while moral education comprises the assimilation of a certain system of values. When education, for instance, in history is pressed to perform consolidating functions, then systematic problems arise, because normally the school’s mission is not to indoctrinate, not to induce and inculcate certain thoughts and feelings, but to build informed people possessing moral competence. The appeals for selecting and presenting scholastic content in a way that is sure to provoke “patriotic” emotions is nothing but a desire to rationalize such emotions, which amounts to ideologization. The past can be presented only in outline, because the details are not all known even by professional historians; yet even this vague outline could be presented truthfully, and not be distorted by heroization and victimization of the Bulgarian people, or by direct or implicit accusations towards other nations. Intervention in, a selective attitude towards, modification of, the scholastic content so as to make it more uniting inevitably leads to a distortion of history, turning it into a half-truth, if not a blatant lie. A history in which the Bulgarian cause is always just, and the cause of others, never; in which Bulgarians are always valiant and heroic, while others are treacherous and underhanded; a history consisting only of brilliant victories and undeserved sufferings, and which ascribes tolerance to the Bulgarians, and intolerance to others, is not an authentic history. A history that is not truthful is not history; it is myth, propaganda, manipulation (Kadrev 2014).

Over the past years, studies on various aspects of the ethnic-cultural situation in Bulgaria, and on the relations between religious communities in the country, have tried to identify trends of growing closeness between ethnic groups and the surmounting of negative stereotypes formed as a result of the model of an ethnically homogeneous Bulgarian nation – the model imposed in the time of the totalitarian regime. Central to these efforts was to define the scope and intensity of social distances, the intensity of negative stereotypes and the effectiveness of the integration process. The results obtained by these studies provided reasons to believe there is growing closeness of the standpoints on national development among different ethnic-religious groups, and that cultural tolerance is being established as the principles of liberal democracy are being asserted in Bulgaria. But events in recent years, and especially the new wave of nationalism which is now structuring a significant part of the spheres of politics and everyday life, make it necessary to reassess not only the all-too-optimistic expectations but also the sustainability (respectively, the validity) of the attitudes registered in the past towards ethnic, cultural, and religious difference. The rate of declarative tolerance is much greater than it seemed in past years; or at least, our desire to discern sustainable processes of social integration regarding cultural difference have dulled our critical sense regarding some of the obtained results. The formal recognition of the right to a different opinion does not yet mean that opinion will be accepted on an equal footing or at least as equally significant and valuable for building a shared idea of reality. Respect for difference must grow into willingness to uphold a personal stance within an expanding space of mutually accepted dialogue, considered necessary. Only then can the existence of different ethnic, cultural and religious communities become a guarantee of the viability and integrity of the national community itself. Building a model of integration based on authentic dialogue is yet to be achieved. There is no reason to assume a qualitative change has come about in the level of knowledge about the ethnic and religious beliefs of the Other. Over a comparatively long period of time, spatial proximity has retained its importance in the everyday existence of cultural diversity. The boundaries of authentic dialogue and tolerance remain strongly dependent on the immediate joint social experience of members of different ethnic-religious groups. Spatial proximity in everyday life reduces the open clash of different “world pictures” that define religious self-consciousness. Neighbourly coexistence, as a universal social network of daily practices, is capable of absorbing some of the tensions, but its impact is limited by the contradiction, present in mass consciousness, between a positive attitude to the individual neighbour of different religious confession and suspiciousness towards that religious community as a whole.

Identity tends to be increasingly less often linked to the nation, and the defining traits of national presence do not directly correspond to the personal strategies of people in their daily lives. The nation is not a stable entity but a dynamic process. Once achieved, the nation does not exist as an institution in time and space. Its value lies in the ability of people to accept their shared past and to live with it in present reality, to share the meaning they invest in certain values and to build their future in accordance with those values. It will be an increasingly rare thing for the nation to seek the grounds of its existence in the state. The significant link between the two lies in something else: the state is an instrument for establishing and reproducing a certain order that does not violate the cultural measure of the national community but ensures its reproduction. Achieving national identity is a joint effort. The first and most difficult part of this effort is to assimilate the variety of forms in which a shared meaning exists. Culture is the creation, dissemination and interpretation of meaning. The sharing of a meaning invested in a certain ritual or monument transcends the limits of a formal attitude to a “cultural monument” and makes of it a shared, common heritage. By changing one’s understanding of the meaning of heritage and of the principles of human coexistence, it is possible to construct a new understanding of community that crosses the boundaries of separate ethnic groups or religions and accepts the traditions and meaning of different cultures as equal in value.

Research has distinctly confirmed the hypothesis that the attitude to ethnic, and especially religious, difference is largely mediated and defined by the issue of power. Concrete cases in the Bulgarian political environment demonstrate the strong connection and mutual dependence between the forms and intensity of ethnic and religious separation and the available access to resources of power. That is why every attempt at taking a partisan approach to the problem, or using it for current political purposes, essentially intensifies the feeling of difference perceived as unequal status, and hence strengthens the internal cohesion within the community and stimulates the search for new grounds of public differentiation (Bosakov 2010).

In what sense is it possible to assert once again that religious faith is capable of reintegrating the daily representations of people regarding the extent of their own difference from others? Is it possible for the postmodern situation to create a new need for affiliation to the total identification field of religion? If so, how is the idea of religious difference constructed? To what degree is the attitude towards the Other’s religion articulated in terms of comparability vs. opposition? Survey results indicate that for the larger share of Muslims in our country, religion is an integral scale of value on which other values are positioned and acquire meaning. Religion, as an integral value system, structures the attitude towards the other spheres of individual or public life. The religious ethics of Islam affects to a definitive degree the attitudes to other values. At the same time, commitment to secular values remains relatively unstable. While we may say that Bulgarian society in general is rethinking its attitude towards religion, this is true to a much greater degree for Muslims. The set of mediating factors that most probably accelerate certain processes of consolidation of the religious community is linked to its partial social isolation, to the profile of professional, civic, and political activity of its members. The risks arising in this specific situation might be related to the formation of negative attitudes towards ethnic, religious, and
cultural difference and also to the increase of already existing social distances (Bosakov 2015).

The integration of modern Bulgarian society cannot be considered only in terms of coexistence or of attraction of smaller cultural communities to the dominant behaviour model of the majority. In countries like Bulgaria, where religions and ethnic groups have lived together for centuries, dialogue is, now more than ever, the only means of effective integration and consolidation of the national community. The view that integration amounts to unification or assimilation based on acculturation, on partial rejection of the cultural grounds of difference, is more than ever leading to the opposite results.

In certain cases, ethnic and national identity overlap to a great degree, but in today's global world, their overlap is continuously decreasing. This does not refer only to the fact that people are free to choose their citizenship. They increasingly more often choose their national affiliation as well, and if the latter is at odds with their ethnic identity, the latter is pushed to the margin due to its negative meaning for personal identity (negative, for the value orientation of the individual). Unlike ethnic identity, national identity is acquired not only through socialization deriving from the national institutions, but also as a personal choice, due to the importance of national identity for the individual.

At the historical level, there are two European models of construction of the nation. The two paths of forming the nation differ in their orientation: the French model goes from political unity to cultural assimilation (downwards), while the German goes from cultural unity to political unification (upwards). These two paths are reflected in two corresponding definitions of nation. The first type of definition – the modernist one – is philosophically based on the universalist idea of the social contract between reasonable people who have equal “natural” rights. The stress here is on the subjective aspect, i.e., the will of the citizens to establish a political community in the framework of an already existing state. In the second type of definition, the categories stressed as “natural” are common origin, language, religion, culture, perceived as “objective” factors that unite people and legitimate the creation of a national state (Nedina 2011).

The fundamental component of the concept of nation that distinguishes it from the concept of the state is the former’s spiritual-cultural foundation, i.e., whether the nation’s culture has been formed before or after the appearance of the state. Culture is what mostly creates the rational and emotional ties uniting society, and is the spiritual foundation of social life, including the political sphere. The stereotypical contrasting of the civic-political (Western) model of nation vs. the ethno-cultural (Eastern) model has frequently been criticized in comparative historical studies. According to the well-known expert on ethno-cultural problems Anthony Smith, every nationalism, even the extremely civic-based and political variety, upon closer scrutiny is seen to refer to ethnicity and language (Smith 1998). Although ethnic affiliation and national cultures are historical phenomena, the laws of their evolution are more complex than Ernest Renan’s popular formulation, “The existence of the nation is a daily plebiscite”, would suggest. The spiritual aspect of national life is manifest not only through the individuals who represent the nation at a given time but also through the whole legacy of the past, which exists as a relatively autonomous reality subject to reinterpretation, in some cases to oblivion, but which is invariably present and – in its non-material part – indestructible (Sivov 2003). Sivov’s view is, in any case, debatable.

To conclude, Bulgarian national identity is incomplete; the Bulgarian finds him/herself somewhere between the ethnic and the national frame of reference, and continues to think of his/her nation in ethnic and cultural terms, not in civic-political; he/she thinks of it mostly as related to a shared past, rather than as a common project for the future and a “daily plebiscite”.

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1. Introduction

Often we deal with images constructed by our mind, rather than based on information coming from the environment. People can easily construct mental images of objects that had never seen before. Everybody can imagine, for example, a flying pink elephant or a dog with six feet.

People use mental images and diagrams also for planning actions and for problem solving. In addition, the mental images often are not static but dynamic – whole situations can be played mentally, including movements, actions, and their result.

Many evidences point out that part of the representations of our own real actions and their mental pictures share same areas in the visual and motor brain zones. For example, Kosslyn et al. (2001) demonstrated that one and the same brain zones in the primary motor cortex are active if people actually perform concrete actions or if they imagine themselves doing them. When people are reasoning or planning actions, they manipulate objects in their visual mental images in the same way as being actual objects (Shepard & Cooper, 1982). When people observe human faces or places, the same zones of the visual cortex are active, as if they imagine these faces or places (O’Craven & Kanwisher, 2000). Those findings are in congruence with the idea that mental imagery share same neural substrate involved in perception (Kosslyn et al., 2001).

Using Positron Emission Tomography (PET), Parsons (1995) demonstrated that people find it difficult to imagine body parts to be moving in an unnatural manner, because the participants implicated their own experience with their body and the way they move it. Motor strategies are used not only for mental rotation of body parts, but for non-bodily objects as well (Cohen et al., 1996; Carpenter et al., 1999).

In parallel with the brain imaging studies, many behavioral experiments show converging results. The time needed to imagine an action correlates with the time needed to perform it actually (Decety & Michel, 1989; Landauer, 1962). Moving hands from resting posture to another posture takes equal time as to imagine those movements (Parsons, 1994). However, the imagination seems to be restricted from our attitudes as well. If people expect that a certain task would be easier if using a tool, then in an imagery task of the same problem, they imagine performing an action to take less time than it took them actually (Osiurak, et al., 2014). In addition, it is found out that we can act in a previously studied environment even with blind folded eyes using the mental representation of the environment (Decety et al., 1989). A lot of research supporting the embodied view of the mental representations is in accordance with the idea for shared representations of real and imagery actions; for example, people perceive a certain distance as longer if they are with a heavy backpack on their back (Proffitt et al., 2003).

2. Mental rotation of pictures of easily and hardly for actual rotation objects

In their classical study, Sheppard and Metzler (1971) demonstrated that the speed of mental rotation of objects is linearly proportional to the angle that the objects should be rotated. However, Flusberg & Boroditsky, (2011) assume that depending on the instruction distinct processes take part in mental rotation task. The results of their empirical study usually are interpreted in favor of necessity to assume that dual processes (and hence dual representations) exist in human cognitive system. We conducted an experiment that confirms the hypothesis that different strategies, not different processes underlie the results of Flusberg & Boroditsky, (2011).

Nevertheless that the topic may seem too specialized, it supports the embodied view to human cognition. In this way, the findings have not only theoretical merits, but can be of high interest for education planning. Studying the effects of the body on the mind contributes the education planning and has an increasing role in mathematics education and problem solving issues in high school, college and beyond.

Keywords: EMBODIMENT, MENTAL ROTATION
However, when the instruction was to imagine the rotation performed by an external engine, there was not such activation.

These differences in results, depending on the instruction only, show that motor and visual imagery can be pulled apart. People’s preceding motor experience is involved when they imagine performing an action (moving an object) themselves, but does not matter if they imagine the action is realized on its own (Flusberg & Boroditsky, 2011).

However, is it possible a representation of an image to rotate on its own? We could say that objects never rotate themselves on their own. Maybe participants find it easier to rotate the representation of the whole illustration of the image (paper or a computer screen) when the instruction has been to imagine that objects move by themselves. However, the weight of the paper or the computer screen is constant and does not depend on the image on it. Maybe people still do the mental rotation of the image representation but they probably manipulate it as a representation of a paper (or a computer screen) with the image on it. This strategy could be used if according to the instruction there is no need of performing explicit imaginary rotation of the object.

Thus, maybe the results obtained by Flusberg & Boroditsky (2011) do not necessary mean that motor and visual imagery can be pulled apart. Maybe people use different strategies depending on the instruction but both strategies include imaginary motor rotation. However, depending on the instruction, people either rotate the object itself, either the whole image on the screen. In the first case, the reaction time would depend on the weight of the object; in the second case – on the weight of the screen (equal for all stimuli).

We designed an experiment to test this possibility using instruction that does not assign any strategy to use for mental rotation when performing the task. As an attempt to avoid the potential possibility of mentally rotating the representation of the computer screen, instead rotating the representation exactly of the object on the image, we decided to put additional stimulus next to the computer screen, instead rotating the representation exactly of the object itself, either the whole image on the screen. In the first case, the image until it fits to the left part. Instead, we expected that the tree was to hinder the participants to rotate the whole right part of the image representation but it is either the same one, or mirrored one (see Figure 1). There was a distance between the left two objects and the right ones, thus the whole picture consisted of two pairs. In the right half of the right pair either the same (not mirrored) stimulus as the one in the right half of the left pair appeared or mirror-reversed copy of it, all rotated on different degrees - 60°, 120°, 180°, 240°, 300° clockwise (Figure 1). On the right side of the left pair was presented non-rotated 0° stimulus. Next to each (on left) of both objects was an “anchor” stimulus, which is an image of a tree. The purpose of the tree was to hinder the participants to rotate the whole right part of the image until it fits to the left part. Instead, we expected that the tree would foster the people to rotate mentally the test stimulus only.

Each participant solved 400 trials (5 angles x 40 objects x 2 conditions – mirrored or not). The order of trials was randomized for each subject. In the beginning of the experiment, each subject completed ten training trials.

Fig. 1 An example of the stimuli used in the experiment. The target object – the lorry – was from the subset of the heavy ones. The correct response for this trial was “yes”, because the rotated lorry (rotated on 120°) was not mirrored.

Two keys of Response time button box device were marked with “Yes” and “No” labels.

Individuals were instructed to answer as quickly as possible by pressing the “Yes” button if the pair of images in the right part of the screen is the same, even if some stimuli are rotated, as the pair of images in the left and to press button “No” if they are different. In those cases when the rotated stimulus in right was mirror-reversed the right answer should be “No”. If this stimulus is rotated but not mirror-reversed the right answer would be “Yes”. Each subject gave consent to participate in the experiment by signing a form.

Reaction times for the responses were coded automatically.

Results

The first 10 trials from every subject were training and were removed. Then, the wrong answers (16%) were removed as well. The correct “No” responses were not analyzed. We took only the correct responses with answer “Yes”.

The results were aggregated by median for each subject, each angle, and each weight of the mobile object.
Not surprisingly, there was a large significant effect of the angle: $F(4, 116) = 73.217$, $p<0.001$, $\eta^2 = 0.716$. It was, however, also a significant effect of the weight: $F(1, 29) = 7.391$, $p=0.011$, $\eta^2 = 0.203$. There was not a significant interaction: $F(4, 116) = 1.669$, $p=0.162$, $\eta^2 = 0.054$.

The difference of RT’s for the heavy and the light stimuli for each angle was 136.097ms.

The results are visualized on Figure 2:

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{fig2.png}
\caption{The median of the reaction times for light objects (blue line) and heavy objects (green line) for each angle of rotation.}
\end{figure}

4. Experiment for controlling the speed for recognition of the stimuli

In order to test what is the eventual effect of the time needed for recognition of the stimuli, we conducted a control experiment. We exposed the same stimuli that were used in the main experiment to other thirty participants (17 males and 13 females). Subjects were asked to answer, as quickly as possible, with a “Yes” button if the objects on the left of the screen are the same as those in right and with “No” button if they are mirror-reversed. There were not any rotations. Each of the previously used stimuli was presented not rotated with its either same or mirror reversed copy, with the immobile anchoring stimulus (the three) to the left of each stimulus.

All of the participants in the experiment were right-handed with a range of ages from 19 to 33.

Each subject agreed to participate in the study by signing a form.

The reaction times of the responses were automatically coded.

Results

Following the same procedure like in the main experiment, we removed 6.4% wrong answers, took the right responses “Yes” only, and aggregated the medians of the RTs by subject and weight.

The aggregated median of the RTs for the light objects was 1142.72ms; for the heavy objects it was 1027.10ms. The difference was on account of the light objects and was significant ($t(29) = 2.605, p = 0.014$).

Actually, we expected that the difference between the stimuli would be not significant. In addition, we hoped that the confidence interval for the difference would be much smaller than the effect of the first experiment. Other results were realized. There was a difference in reaction times for the light and the heavy objects without any rotation. However, longer time was demonstrated for the light objects. Not just that the heavy objects were not harder for recognition, but exactly on the opposite – they were easier. Thus, the aim of this control experiment was achieved: the effect, obtained in the first experiment cannot be due to any differences of the recognition time of the stimuli.

5. Discussion

Flusberg and Boroditsky (2011) found that depending on the instruction, people use different processes for mental rotation. When they receive an explicit instruction to imagine how they grasp and rotate the objects with their hands, then people mentally manipulate slower the objects, which are heavier for actual manipulation. However, when the instruction was to imagine that the objects rotate by themselves, then the effect disappeared.

However, the object cannot rotate by itself, with a magical engine. Thus, we supposed that maybe people use different strategies, not different processes for mental rotation. Maybe people are able to imagine how they manipulate the objects on the screen; or they are able to imagine how they rotate the whole screen or a part of it too.

We conducted an experiment, trying to avoid the possibility for the participants to rotate mentally just a part of the screen. We added an immobile anchoring object to the left of the test stimuli. Of course, theoretically, again it is possible people to manipulate mentally a small fraction of the screen only; however, it is much more difficult.

Thus, we tested whether even if there is no explicit instruction to the people to imagine how they manipulate the objects with their hands, they will react to a mental rotation task for the heavy objects slowly than for the light ones.

Contrary to the results of Flusberg and Boroditsky (2011), we obtained a significant difference in the reaction time needed to mentally rotate heavy objects then light ones, regardless of the neutral instruction. Our explanation of both the results from this experiment and the findings of Flusberg and Boroditsky (2011) is that people may use different strategies for mental rotation but not different processes. Depending on the instruction, people may try to mentally rotate either the objects on the picture, or the entire picture.

There was an alternative explanation of the results from this experiment. Regardless that many stimuli were used (20 heavy and 20 light ones), maybe just the mean time for recognition of the heavy stimuli was higher. In order to control this, we obtained a second experiment, in which there was no rotation required. People should just say whether the two pairs of pictures are the same or one of the pictures from the pair was mirrored. We hoped to find that there were not differences. More precisely, that the confidence interval for the difference is so small, and the effect of the first experiment cannot be explained by any differences of the stimuli. Surprisingly, we found a difference in the reaction times but it was in the opposite direction. The light stimuli appeared to be harder for recognition that the heavy ones. Thus, the effect of the first experiment should be thought even higher.

One more interesting finding was that there was not an interaction between the angle of rotation and the weight of the stimuli. This was in congruence with the results, obtained by Flusberg et al. (2009). The authors suggest that it takes more time for the people to start rotating mentally the heavier objects but once people start, there is no matter the angle of rotation (Flusberg, Jenkins & Boroditsky, 2009). Additional theoretical suggestions and empirical evidences should light more this question.

6. Conclusion

A huge number of empirical evidences for the interaction between the mental and motor representations emerge during the last decades. The concept of embodiment combines a broad range
of theoretical views. The theory of grounded cognition suggests that our physical experience with the world affects the way we think about it. The human’s body is an everyday living tool and each single movement is recorded in the memory not just as a computational operation but as a complex knowledge which can be used on a later stage even in our imagination. People unconsciously implement their physical experience with the environment when they imagine doing things and that imposes a restriction in the fantasy. The grounded cognition leads people to search the easiest way of performing an imagery task, as they would do if performing it actually. People can change their existing belief about the arrangement of objects in space depending on the size of the objects and their movability. In an experiment, subjects preferably changed the position of small objects rather than the large objects and also relocated the easy to move objects faster than the hardly movable objects (Nejasmic, Bucher & Knauff, 2013).

Studying the embodied knowledge shifts the idea that the cognitive processes are not only abstract symbolic manipulations but they are grounded in the motoric and perceptual, even the emotional, experience (De Vega, Garesser, & Glenberg, 2008).

Shepard and Metzler (1971) found that people mentally rotate the representations of objects when solving problems. Those findings are of critical importance for the study of embodiment.

If the cognition is embodied then the question if things that are more difficult to physically manipulate are also hard to mentally manipulate (Flusberg & Boroditsky, 2011) is reasonable. In our experiment participants mentally rotated representations of an images of real objects, there were not drawings of body parts (Paesons, 1995) or angular figures (Shepard & Metzler, 1971) but there were photographs of actual objects used. Those were objects that we use in our daily life, or at least we have met. According to the evidence of motor imagery, that we elicited from the memory our physical experience with the world affects the way we think (Flusberg & Boroditsky, 2011), our results are interesting. It is possible that in our mental imagery we are influenced of the knowledge that we have about the world that we act in. If the only difference between mental and actual movements is the motor output, so maybe mental manipulation could be based on the knowledge about some properties of the environment around us and the objects that we have deal with as well as the motor experience is. We used stimulus of objects, some of which people could not manually manipulate. We suggest that in those cases some embodied cognition could be involved based on what we know. We would think and know of some object that it is very heavy and nobody could lift it. For instance one would probably mentally rotate and manipulate a representation of a truck slower than some light object based on his knowledge that the truck is very heavy and on the representation of how it would be to manipulate it. It would be an interesting initiative to investigate those ideas in more details in future.

Nevertheless that the topic may seem too specialized, it supports the embodied view to human cognition. In this way, the findings have not only theoretical merits, but can be of high interest for education planning. Studying the effects of the body on the mind contributes the education planning and has an increasing role in mathematics education and problem solving issues in high school, college and beyond. The physical activity seems to be helpful in developing different learning skills.

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