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Editors' Remarks

PARADOX

by Clarence R. Wylie Jr.

Not truth, nor certainty. These I forswore
In my novitiate, as young men called
To holy orders must abjure the world.
'If...,then...,' this only I assert;
And my successes are but pretty chains
Linking twin doubts, for it is vain to ask
If what I postulate be justified,
Or what I prove possess the stamp of fact.

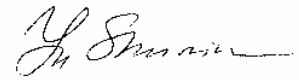
Yet bridges stand, and men no longer crawl
In two dimensions. And such triumphs stem
In no small measure from the power this game,
Played with the thrice-attenuated shades
Of things, has over their originals.
How frail the wand, but how profound the spell!

The offered 11th volume No.2 points out an attention to some computer simulation problems, which are really actually for this day. Some particular tasks in information teaching technologies, transport technologies and applied statistics are also considered.

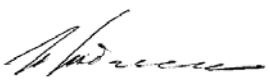
This means that our journal policy is directed on the fundamental and applied sciences researches, which is the basement of a full-scale modelling in practice.

This edition is the continuation of our publishing activities. We hope our journal will be interesting for research community, and we are open for collaboration both in research and publishing.

EDITORS



Yu.N. Shunin



I.V. Kabashkin

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Transport and Telecommunication Institute, Lomonosov 1, Riga, LV-1019, Latvia

FLUCTUATIONS AND CONTROL IN MANAGEMENT

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Goldratt's Game for the simulation purpose in the management course is presented in two different visual forms (Vensim and Excel). The first model is clearly controllable and attractive for classroom. The second one is carefully investigated under the several control rules.

***Keywords**: simulation, fluctuations, control, chain*

1. Fluctuations and Control in Management

The role of fluctuations and its counterintuitive character may be understood by simulation in the appropriate way some supply chain (Goldratt's matchsticks game [1], Beer distribution game [2]). The first model is created in Vensim (Ventana. Systems, Inc.) simulation environment (see Fig. 1) and it clearly shows the nature and role of fluctuations in the simplest matchsticks case. By changing separate dice rules one can model a drum – buffer-rope effects. The picture becomes more complicated if another feedback is included.

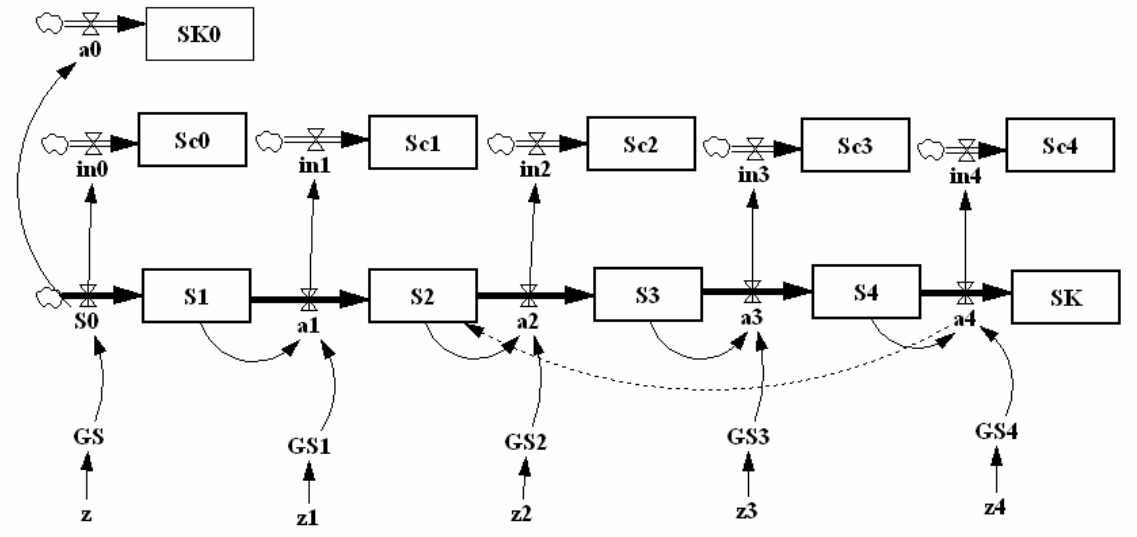

Figure 1. Vensim model

In the second model we introduce a control into the impact and interaction of statistical fluctuations and dependent events on the stylised process flow which consists of 3 separate, defect-free operations with queues (inventory buffers) between them. We use the model described by Johnson [3]. The aim of the article is comparing statistical characteristics of the system, described by Johnson (2002) to those of the system after applying control variable. Both systems are modelled by imitation modelling; each consisting of three operations with number of runs 180 with the time steps up to 32000 for each of the systems. For the second system there is a minor control applied Uk(t) = U = const = 1 c with a fixed constant threshold Pk = P = const = 30 for all the operations of the system at any moment in time 1< = t < = 350.

2. Properties of Initial Model

The initial model has the following block structure (Fig. 2).

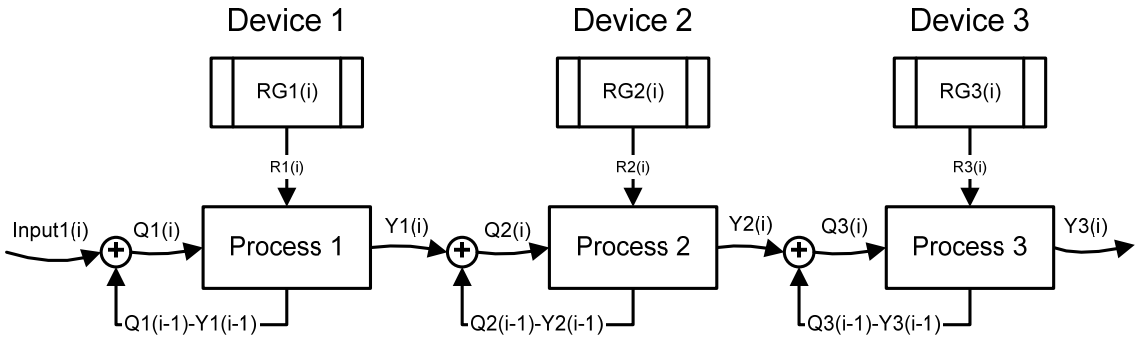

Figure 2. The block diagram of initial model before introduction of control

This model can be used to illustrate many concepts in production management. We use it to reinforce the notation that reduction of variation in processes is more efficient and economical than increasing inventory or work-in-progress in this case. The model simulates a production line with 3 work stations. The product must pass through each of the 3 work stations in order from 1 to 3. We can use pennies to simulate the process. The potential amount of work completed at each station in the given time period is a uniform distribution of 1, 2, 3, 4, 5, and 6. This random potential work is determined each period by the tossing of a die. The actual work forwarded to the next station can be represented by equation (1) below.

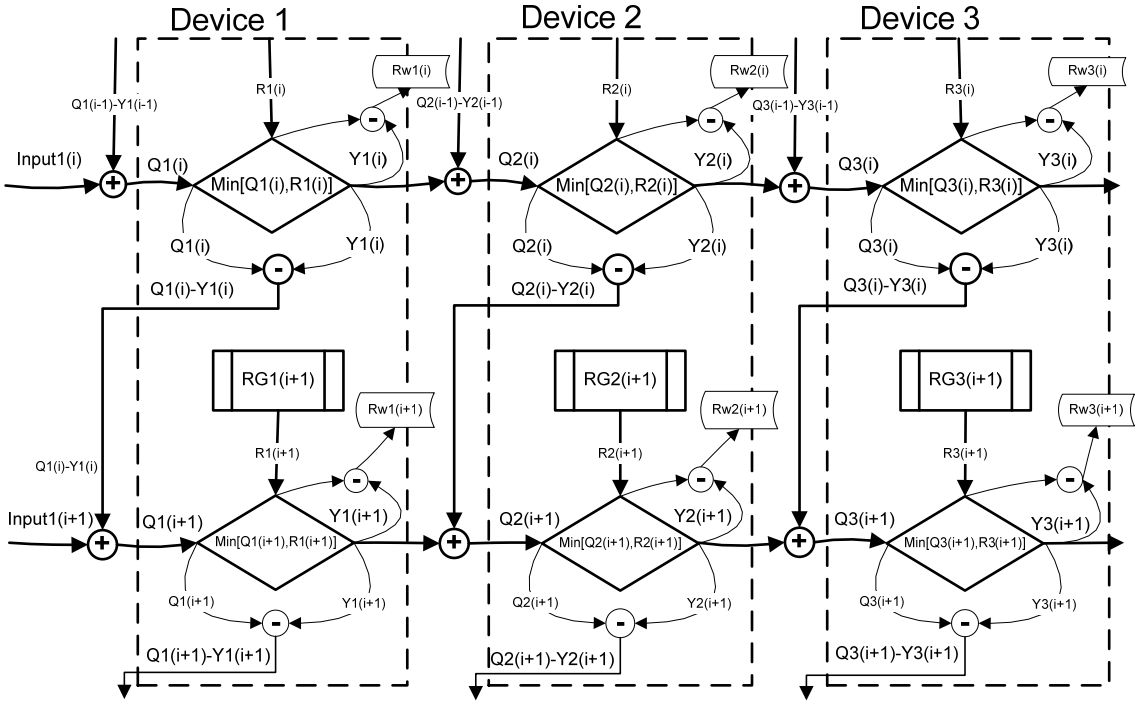

Figure 3. The model structure specification

The model might be formalized as the following equations

$$\mathbf{Q_k(i) = Q_k(i\text{-}1) - Y_k(i\text{-}1) + Y_{k\text{-}1}(i),}$$

$$\mathbf{Y_k(i) = \min\,[Q_k(i), R_k(i)],}$$

$$\mathbf{R_k(i) = RG_k(i),} \qquad (1)$$

where $\mathbf{Q_k(i)}$ – represents the input of k^{th} operation block (k^{th}device),

$\mathbf{Y_k(i)}$ – represents the output of k^{th} operation block (k^{th}device),

$\mathbf{Y_0(i)}$ – is the independent input of the system ($\mathbf{Y_0(i)}$ generates at every step a uniform distributed integer numbers between 1 and 6),

$\mathbf{R_k(i)}$ – is the output of random generator $\mathbf{RG_k(i)}$, which produces an independent uniform distributed integer numbers between 1 and 6, i.e. $\mathbf{1 <= RG_k(i) <= 6}$.

The value $\mathbf{RG_k(i)}$ is the number of resource units available for use at time ***i*** for completing the k^{th} operation according to the equations (1).

$\mathbf{Q_{Kmax}(i)}$ – represents the output of the system (number of units produced) during time cycle ***i***,

k – is the ordinal number of the operation, $\mathbf{1 <= k <= Kmax}$, where **Kmax** – is the maximum number of the operations inside the system,

i – represents the operation step. It is a single time period, $\mathbf{1 <= i <= T}$, where **T** is the maximum time step of observations. $\mathbf{Q_k(0) = 0, 1 <= k <= Kmax.}$

It is assumed that prior to start the system is at null values, i.e. there are no shortages or excess of uncompleted production in progress.

In papers [1–3] the model is investigated only on some dozens of time intervals and with insufficiently explicitly. To estimate influence of control on behaviour of system (1), the detailed and multi-fold study of model dynamics is required.

For the model on Fig. 2 consisting of 3 devices, step by step monitoring all variables entering the equation of model is carried out. In statistical experiments it was revealed, that realizations of queues $\mathbf{Q_k(i)}$, $1 <= k <= 3$ at model have no trend of stabilization, even on rather long intervals of time up to 50'000 steps. Fig. 4 portrays modification of values of queues $Q_1(t)$, $Q_2(t)$, $Q_3(t)$ on an interval in length of 350 steps for 10 realizations.

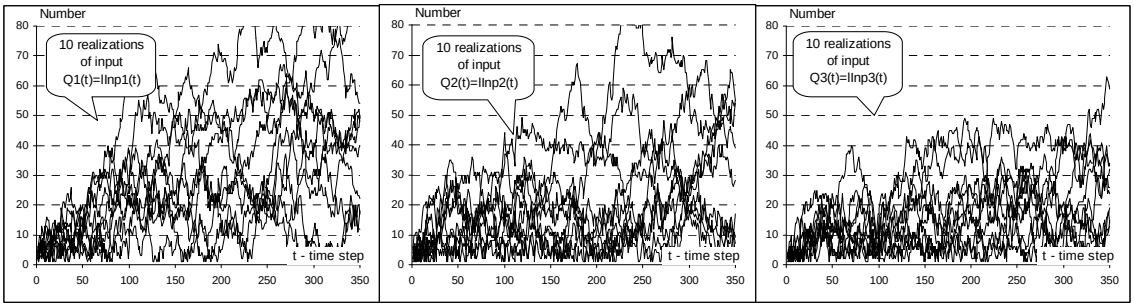

Figure 4. Visualization of 10 realizations for input $Q_1(t)$ (the left-hand side graph), for input $Q_2(t)$ (the middle graph) and for entrance $Q_3(t)$ (the right graph). The trend to increase of amplitudes of queues on entrances of model also is accompanied by increased variance

For deriving statistical conclusions there are performed 180 independent runs of the model. All the varying values of the model are measured and brought in a database on each time step. Thus, for each moment there are available 180 independent measurements of each of the parameters. Fig. 5 illustrates the change of average values of inputs $Q_1(t)$ - $Q_3(t)$ on an interval in length of 350 steps (averaged 180 runs of the model).

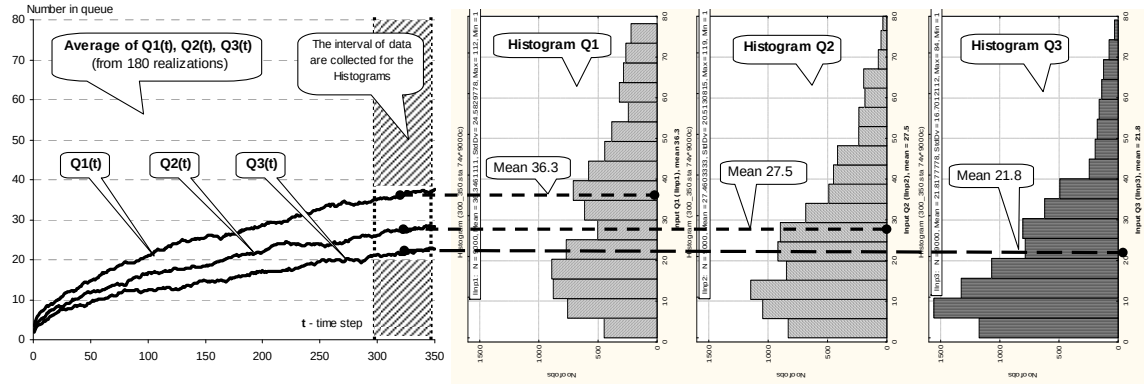

Figure 5. The changing in average values of outputs $Q_1(t)$ - $Q_3(t)$ on an interval of 350 steps (averaged 180 runs of the model). The amount of objects in queue is depicted on the vertical axis. Histograms of the corresponding inputs are arranged in the right side of the figure. Data for histograms are collected on an interval of time from 300 up to 350 steps for 180 realizations, i.e. each of the histograms represents a set of 50*180 = 9000 observations

From the presented graphs follows one important observation: before each operation the amount of unprocessed objects is constantly growing. The sum of inputs $Q_1(t) + Q_2(t) + Q_3(t)$ makes the total number of the objects which have been accumulated by the system at present time "t".

In a running model not all resources are used rationally. From the second equation of system (1) it follows that at $\mathbf{R_k(i)>Q_k(i)}$, a part of resources, which we shall designate as $\mathbf{R_{kw}(i) = R_k(i) - Q_k(i)}$, is not used on a step **"i"** and consequently is irrevocably lost. It is obvious, that with the increasing queues $\mathbf{Q_1}(t)$, $\mathbf{Q_2}(t)$, $\mathbf{Q_3}(t)$ the losses of resources should decrease, as probability of occurrence of queues with number of objects in each of them decreases (which is below 6). Since the use of resources is limited on each time step by an inequality $\mathbf{1 <= R_k(i) <= 6}$ at length of queue $\mathbf{Qi(t) > 6}$ the model should function more effectively as all of the resources should be used.

Let's consider, how the accumulated sum of losses of resources eventually varies (see Fig. 6).

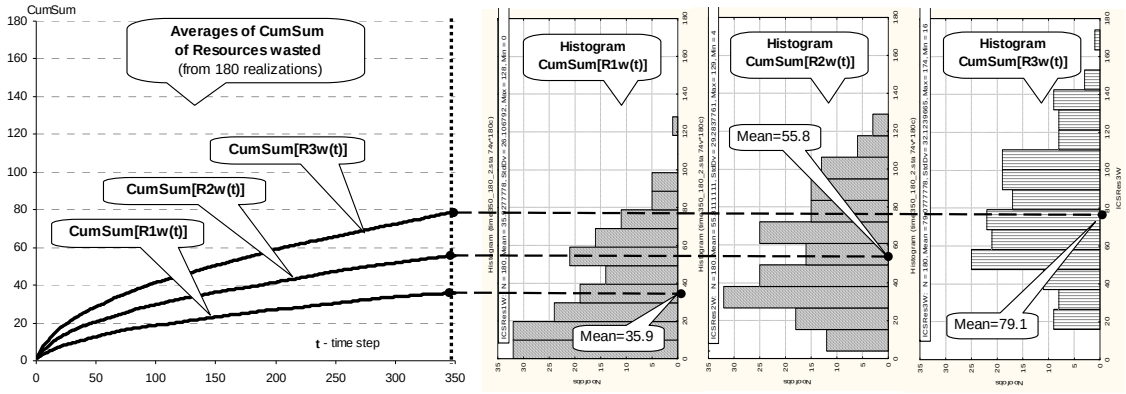

Figure 6. Change of average accumulated sums of resource losses over time (the left graph) and histograms of wasted resources accumulated sums at time = 350 (180 observations)

From graphs on Fig. 6 there can be seen constant increase of average cumsum, the lost resources are visible. Eventually the tendency of increase of resource losses at the subsequent stages of processing in relation to the previous operations is kept. Histograms of distribution of resource losses presented in section t = 350 show very wide and asymmetrical spread of values. The model shows unexpected behaviour as with increase of average size of queues (Fig. 5) average losses of resources (Fig. 6) also increase. As in reality losses of resources grow at increment of average sizes of queues it can mean growth in fluctuations of number of objects in queues. The observed effect will remain, if the probability of occurrence of small queues (up to 5 details) does not aspire to zero with growth of time. Increase expenditures by storage of not completed production $Q_1(t) + Q_2(t) + Q_3(t)$, and expenditures grow on payment of increasing losses of resources $\mathbf{R_{kw}(i)}$, $1 <= k <= 3$ from the point of view of economy**.**

It is obvious that the behaviour of model described by a set of equations (1) is non-rational for modelling productions. The possibility appears to make correcting control with the purpose of possibilities of the best use on resource management. If immediate interference in "process of manufacture" is not possible to use of additional resources can begin one of possibilities change on behaviour of the system.

3. System with Control of Additional Resources

So, there is a problem how "to improve" functioning model by means of introduction of additional resources in such a way, to increase profit (or other criterion), not rendering influence on statistical properties of initial generators of resources. On Fig. 7 the block diagram of admissible updating of system is presented. We investigate influence of "weak" management, which can be characterized as enough in the big size of a threshold $\mathbf{P_k}$ >> 6 in comparison with a dispersion of a source of the basic resource, and as when it is supposed to use external sources of resources **UGk(i),** which on each step can add no more than one unit **Uk(i) = 0 or 1** for each of **"k"** resources **1 <= k <= 3.**

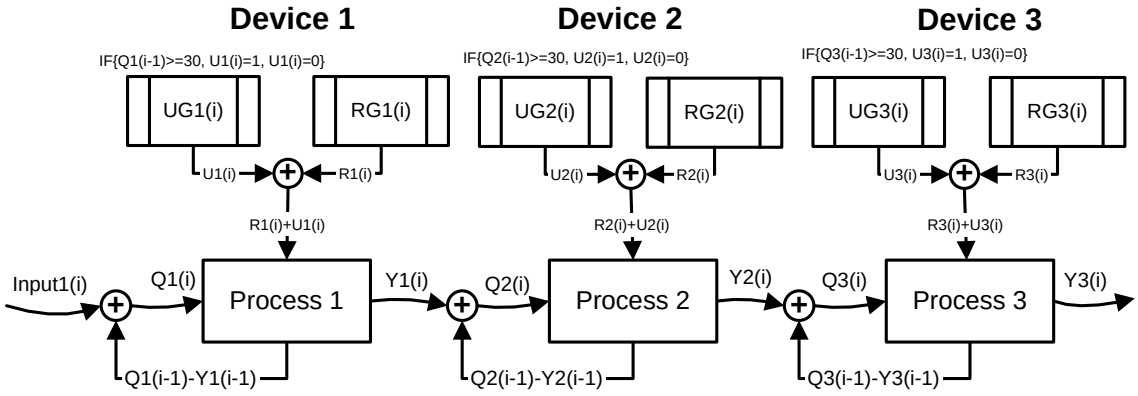

Figure 7. The block diagram of model with control of additional resources

The formal objective is to inset into the system (1) additional number of resource units in accordance to several rules, which we later refer to as *control variables.* The control **Uk(i)** is given separately for each process through a feedback mechanism. The value of control variable **Uk(i)** for $\mathbf{k^{th}}$ operation is determined by the threshold parameter $\mathbf{P_k}$, which in the context of the present article is considered constant for all the operations. If the queue length $\mathbf{Q_k(i)}$ on intake of a $\mathbf{k^{th}}$ operation at a time ***i*** exceeds the value of $\mathbf{P_k}$ then the resource of $\mathbf{k^{th}}$ operation is added a predetermined non-random resource $\mathbf{U_k(i) > 0}$ in the general case. Thus, $\mathbf{k^{th}}$ operation on $\boldsymbol{i^{th}}$ step will be completed with an increased resource $\mathbf{R_k(i) = RG_k(i) + U_k(i)}$. The system with control variable will take the following form:

$$\mathbf{Q_k(i) = Q_k(i\text{-}1) - Y_k(i\text{-}1) + Y_{k\text{-}1}(i),\ Y_k(i) = \min\,[Q_k(i), R_k(i)],\ R_k(i) = RG_k(i) + U_k(i),}$$

$$\mathbf{U_k(i)} = \textit{if}\ \mathbf{[Q_k(i\text{-}1) - Y_k(i\text{-}1)] > P_k},\ \textit{then}\ \mathbf{U_k},\ \textit{else}\ \mathbf{0}. \qquad (2)$$

To the equations (2) there corresponds the block diagram on Fig. 8.

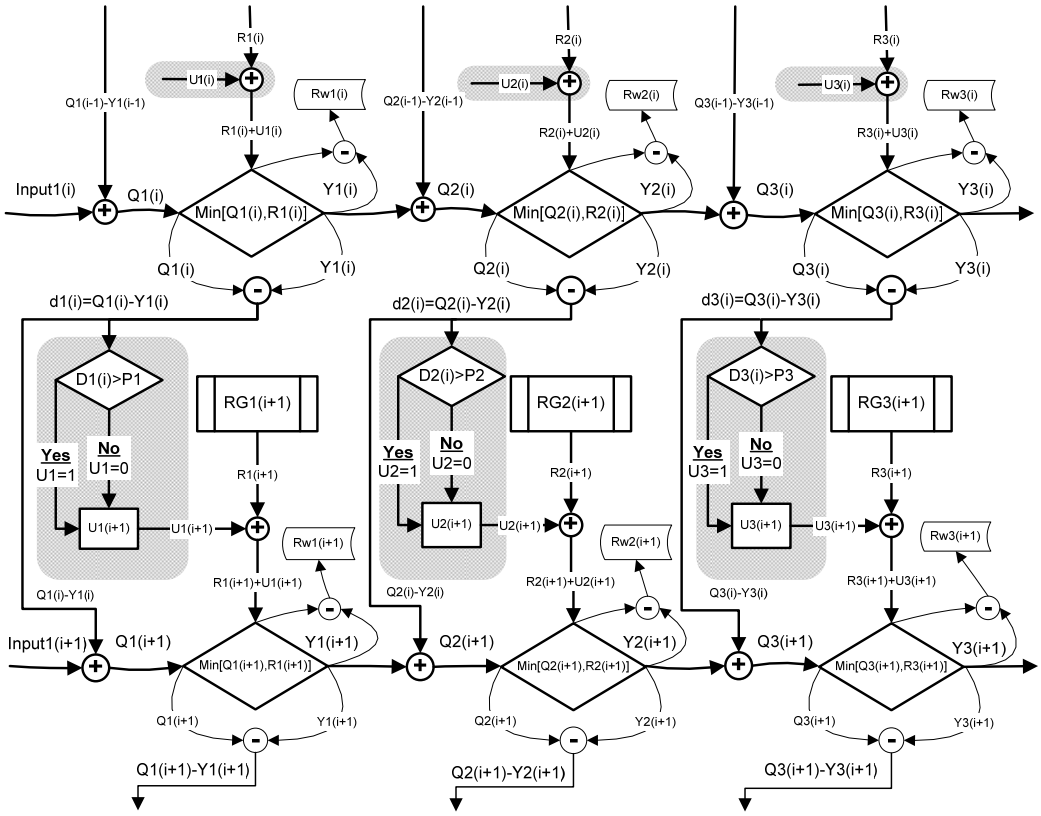

Figure 8. The block diagram of system with discrete management of additional resources according to the equations (2). Monitoring is carried out on value of threshold **Pk** for length of queue **Qk(i)**. Let us consider, as the system will be functioning at threshold **Pk** = 30, which has been chosen heuristically

We would like to discover by means of a simulation modelling as in system with the control described above to receive properties the best, than they are in initial system.

Let us consider, as dynamics of queues will vary at threshold **Pk** = 30, **Uk(i)** can accept values or **0** or **1,** for each of **"k"** resources **1 <= k <= 3**

$\mathbf{U_k(i)} = \textit{if}\ \mathbf{[Q_k(i\text{-}1) - Y_k(i\text{-}1)] > 30}, \textit{then}\ \mathbf{1}, \textit{else}\ \mathbf{0}.$

On Fig. 9 average values of queues and histograms, corresponding them in an interval of time from 300 up to 350 time steps are represented at 180 realizations of model with control.

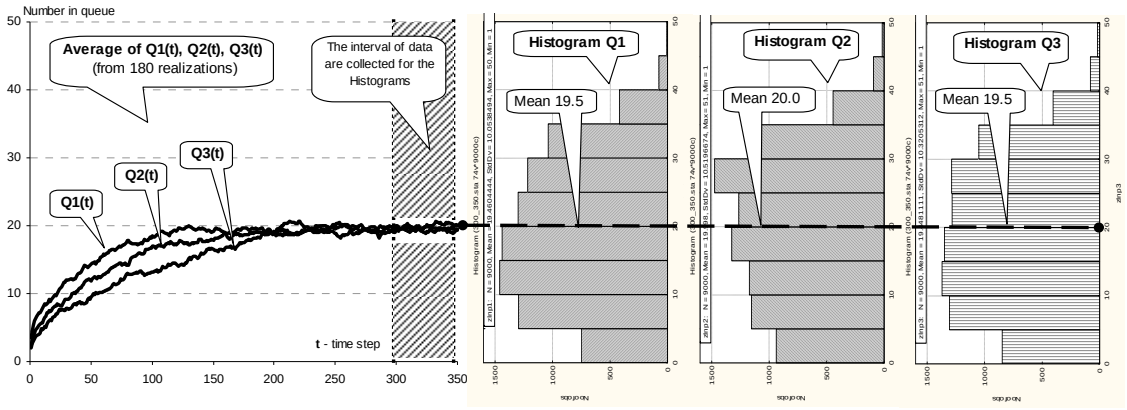

Figure 9. Dynamics of average values of queues (graphs at the left) and corresponding histograms (graphs on the right) in an interval of time from 300 up to 350 time steps at 180 realizations of model with control

Dynamics of queues in model with control essentially differs from dynamics of queues in initial model. Let us note convergence of all average lengths of queues to one value Q(t) = 20. As all thresholds are equal to one number P1 = P2 = P3 = 30 the average lengths of queues come to the same value. We shall note also very big similarity of all histograms of queues Qk(t).

For system 2 the equation of balance for products is true:

$$\sum_{t=1}^{t} Q_0(t) - \sum_{t=1}^{t} Y_3(t) = \sum_{t=1}^{t} Q_1(t) + \sum_{t=1}^{t} Q_2(t) + \sum_{t=1}^{t} Q_3(t)\,. \qquad (3)$$

The difference between number of products **CumSum of Y_0** which have arrived on the system input and number of products **CumSum of $Y_3(t)$**, which have gone out the system, shows common number of the products, which have remained inside the system. **$Y_0(i)$** – is the independent input of the system.

For system with control the number of products inside the system approximately equally **60**, thus the number of not completed products is in equally allocated between operations approximately on **20** units.

Also holds the following equation of balance for resources

$$\begin{aligned}
&\sum_{t=1}^{t} R_1(t) + \sum_{t=1}^{t} R_2(t) + \sum_{t=1}^{t} R_3(t) = \\
&= \sum_{t=1}^{t} R_{1used}(t) + \sum_{t=1}^{t} R_{2used}(t) + \sum_{t=1}^{t} R_{3used}(t) + \sum_{t=1}^{t} R_{1w}(t) + \sum_{t=1}^{t} R_{2w}(t) + \sum_{t=1}^{t} R_{3w}(t) = \qquad (4)\\
&= \sum_{t=1}^{t} Q_2(t) + \sum_{t=1}^{t} Q_3(t) + \sum_{t=1}^{t} Y_3(t) + \left\{ \sum_{t=1}^{t} R_{1w}(t) + \sum_{t=1}^{t} R_{2w}(t) + \sum_{t=1}^{t} R_{3w}(t) \right\}.
\end{aligned}$$

The sum in parenthesis in expression (4) represents all the resources lost by system at moment "t". Let us see how the cumulative sum of the lost resources varies at increasing of functioning time of the system (Fig. 10).

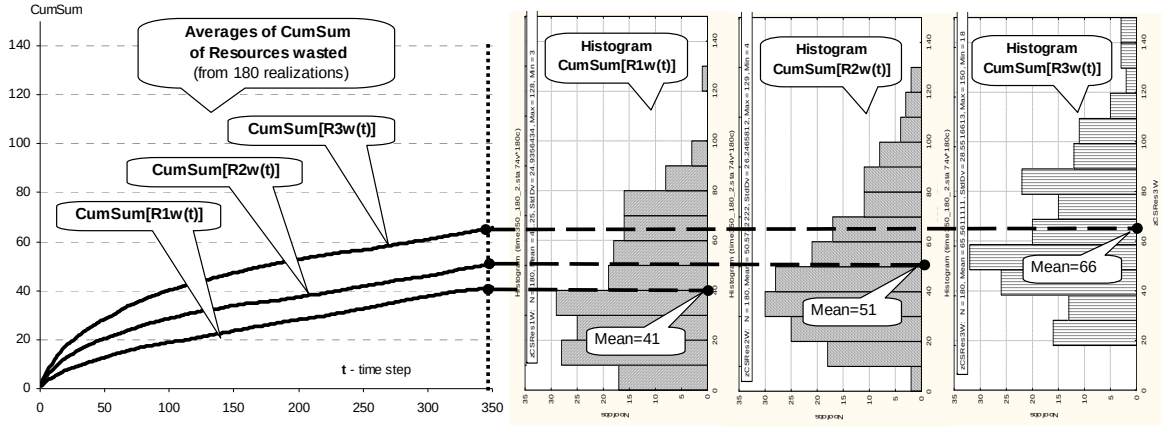

Figure 10. Dependence of average cumulated sums losses of resources on time (the left graph) and histogram of resources wasted at time = 350 (180 observations) for model with control

Constant increase of average CumSum the lost resources are visible from graphs on Fig. 10. Common character of change of processes is the same, as well as for model without control. We shall note distinctions in a velocity of increase of losses of resources for model with control.

For example, average growth rate of losses of resources at last stage of handling "CumSum [R3w(t)]" for model with control (mean = 66, Fig. 10) noticeably below, than for model without control (mean = 79.1, Fig. 6).

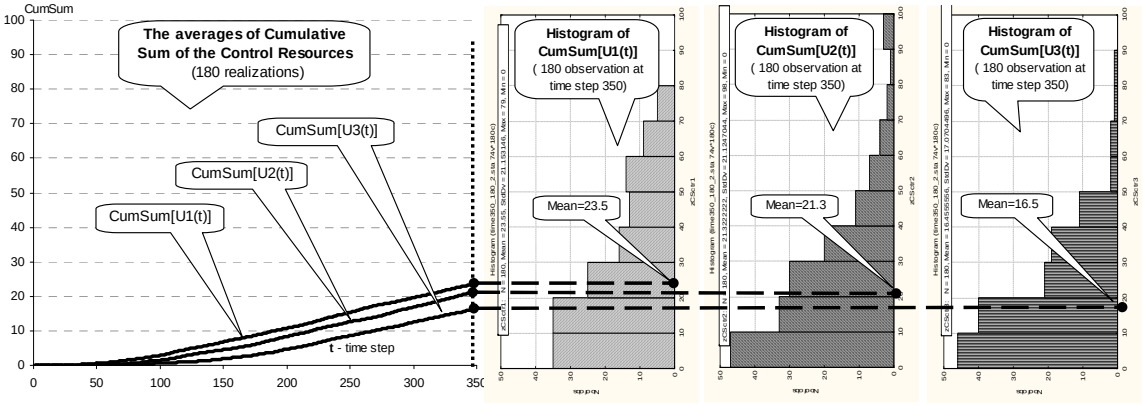

Figure 11. The graph of use of controllable resources. A change of averages cumulated sums (at the left). Histograms of controllable resources cumulated sums at time = 350 (180 observations) for model with control (at the right)

4. The Comparative Analysis of Models

Both models show rather significant dispersion for all observable characteristics. In order for it to be possible to determine more precisely distinctions in behaviour of models, the combined system schematically presented on Fig. 12 has been created. We compared the two models under identical common inputs and identical common recourses flows. The aim of such modelling is quantitative estimation of effect control of system behaviour efficiency.

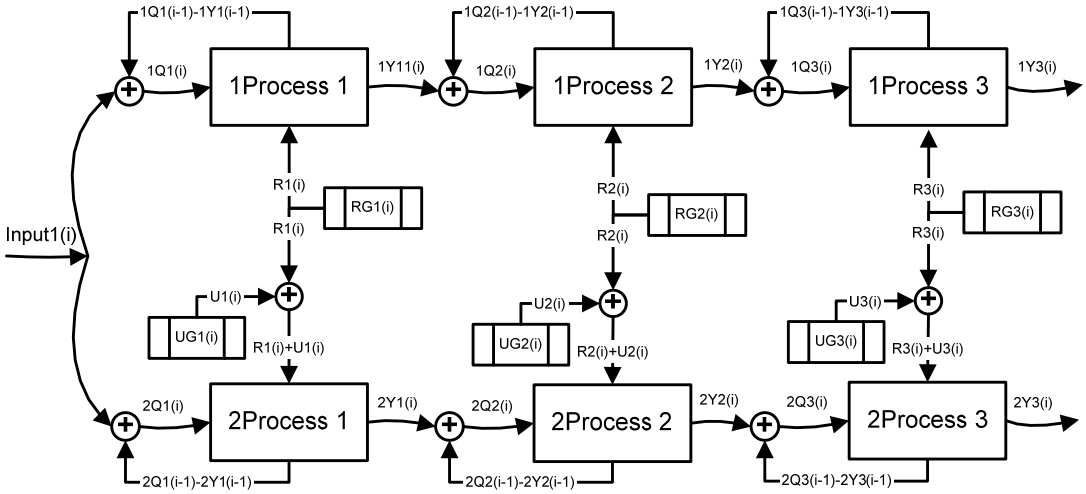

Figure 12. The block-scheme of the combined system for the comparative analysis of models

The combined model allows using identical inputs and generators of all resources for both submodels; therefore distinctions will be shown only due to management. At separate studying models substantial growth of number of experiments would be required to reduce influence of a selective statistical error of supervision. We shall notice, that performance of conditions UGk(t) = 0 or Pk = [big enough number], allow to supervise identity of functioning both submodels.

By means of control the additional resources are introduced into model, which in a considered case with 100% probability are used only for manufacture of products. It is interesting to compare an amount of incomplete products, which have been accumulated in system with control those accumulated in system without control.

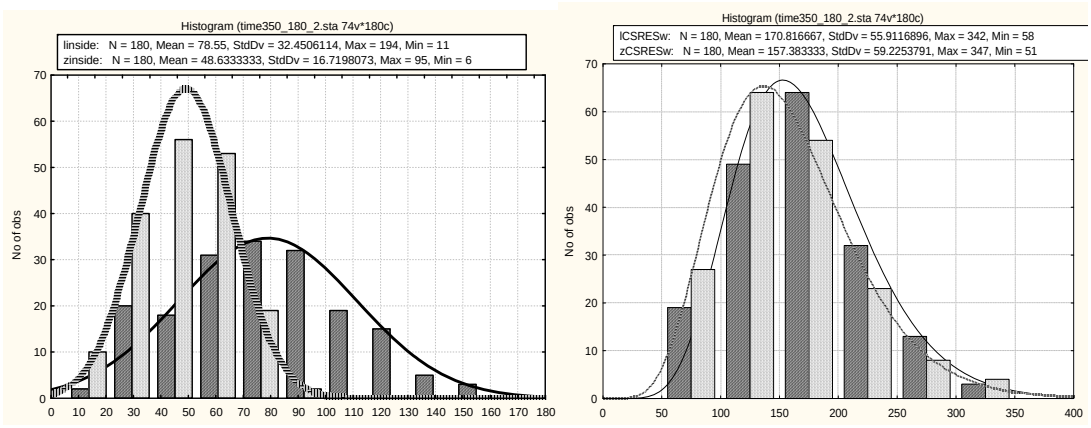

Figure 13. Histograms of unfinished objects, which have been accumulated in two systems at the moment of time t = 350 (at the left) and histogram CumSum of lost resources by the same moment (Figure on the right). Histograms of initial system are shaded; histograms of system with control are shown as a dotted line. The histogram of not ready details in initial systems has parameters N = 180, Mean = 78.55, StdDv = 32.45, Max = 194, Min = 11, the histogram of not ready details in system with control N = 180, Mean = 48.63, StdDv = 16.71, Max = 95, Min = 6. Histogram of cumsum of the lost resources in initial system has parameters N = 180, Mean = 170.81, StdDv = 55.91, Max = 342, Min = 58 and histogram of cumsum of the lost resources for system with control has parameters N = 180, Mean = 157.38, StdDv = 59.23, Max = 347, Min = 51

Pairs of observations on the basis of which there are histograms, are tested on inequality by nonparametric Wilcoxon Signed Ranks Test. If data are continuous, the sign test or the Wilcoxon signed-rank test can be used. The sign test computes the differences between the two variables for all cases and classifies the differences as either positive, negative, or tied. If the two variables are similarly distributed, the number of positive and negative differences will not differ significantly. The Wilcoxon signed-rank test considers information about both the sign of the differences and the magnitude of the differences between pairs. Because the Wilcoxon signed-rank test incorporates more information about the data, it is more powerful than the sign test. The test calculates negative ranks = 111, positive ranks = 59, ties = 10, Z = -5.809, asymptotical significance (2-tailed) = 0.000, therefore the difference is significant. Paired samples correlation is equal to 0.882.

Thus, we can draw an unexpected conclusion that in system with monitoring there are less lost resources than in the initial system.

Accumulation of incomplete production in both systems happens for one common reason; namely, because of shortage of utilized resources. We shall note that an average amount of all resources acting in system, it is equal to average amount raw materials, acting on an input of initial system. If the amount of objects in queue on handling for some reason becomes less, than the resources currently available, then respective unutilised resources become lost irrevocably.

The comparative analysis of the accumulated losses of resources on right graph of Fig. 13 shows not strong, but explicitly notable shift of histograms which speaks about a drop of an average of losses of resources in system with control. As this distinction has appeared statistically significant in system with monitoring it is for some reason lost fewer resources though average sizes of turns for each of operations constantly increase in system without monitoring. If the turn increases, losses of resources fall. It would be logical to assume, that losses of resources will be less in that from systems, in which lengths of turns it is more. We have the outcome contradicting this logic. This rather strange outcome shows that with introduction in system of additional inspected resources we achieve also more effective use of resources than before introduction of monitoring.

The comparative analysis of statistical distributions of not ready products accumulated in systems shows an essential drop of an average store of products in system with monitoring up to 49 products after enough long functioning. The system without monitoring at the moment of time t = 350 had an average store of not ready production of 79 products, i.e. in one and a half time it is more. In a considered instant the system with control had in 2 times a smaller variance, than initial system. Thus the system with monitoring has more predicted behaviour, than system without monitoring that is illustrated on Fig. 14.

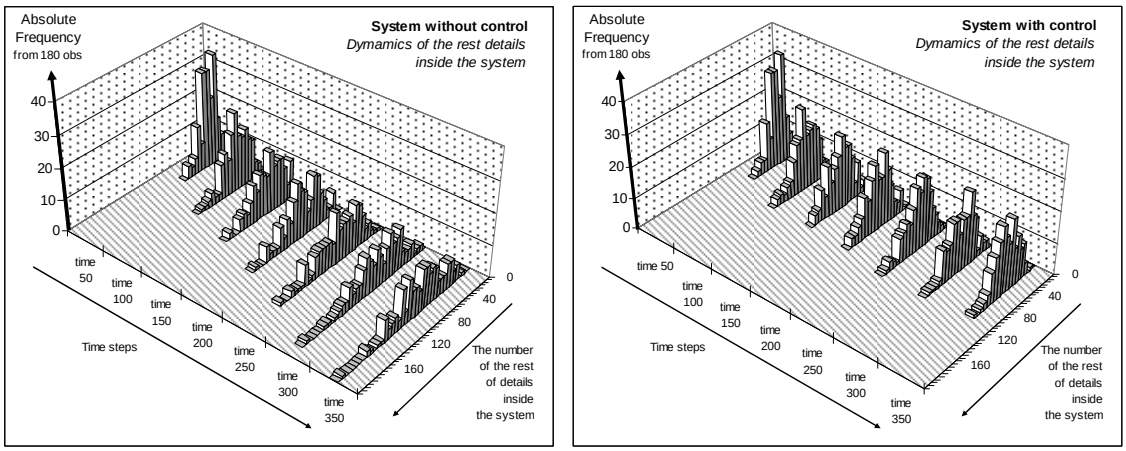

Figure 14. Mean and dispersion of the incomplete items have the tendency to increase their values accorded to time (left graph, initial system). System with control demonstrates stability of such parameters

Let us compare outputs of two systems (Fig. 15)

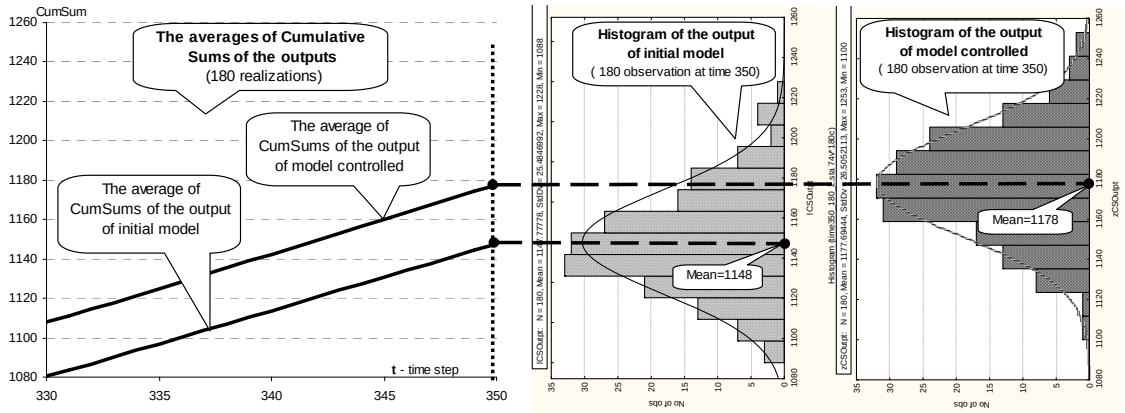

*Figure 15. O*utputs of systems and their statistical properties. For convenience of comparison of histograms the left schedule of dependence of accumulated output is adjusted for the time scale from t = 330 up to t = 350

As the difference between an output of initial system and the output of system with the control has statistically significant value size the system with the control is more productive. The reason is reduction of length of turns due to an expenditure of additional resources, which delivery is provided with a control system, and due to decrease in losses of normal resource amount.

Let us consider the estimation of additional profit, which can be received under certain conditions. As an example we shall take the following sizes. We shall admit that the prices of one unit are equal to the values presented in the Table 1.

Table 1. Costs per unit

	Resource Wasted	Resource Used	Resource of control	Input	Output
Cost, $ per a unit	3	5	7	10	30

Let us notice, that the cost of *Resource of control* is taken at 40% extra of cost of usually spent unit of a resource to compensate charges on management. Besides, expenses for storage of not ready objects, which essentially above at system without the control, here have not considered the graphs of dynamics of the received profit for two systems and the respective histograms, are illustrated on Fig. 16.

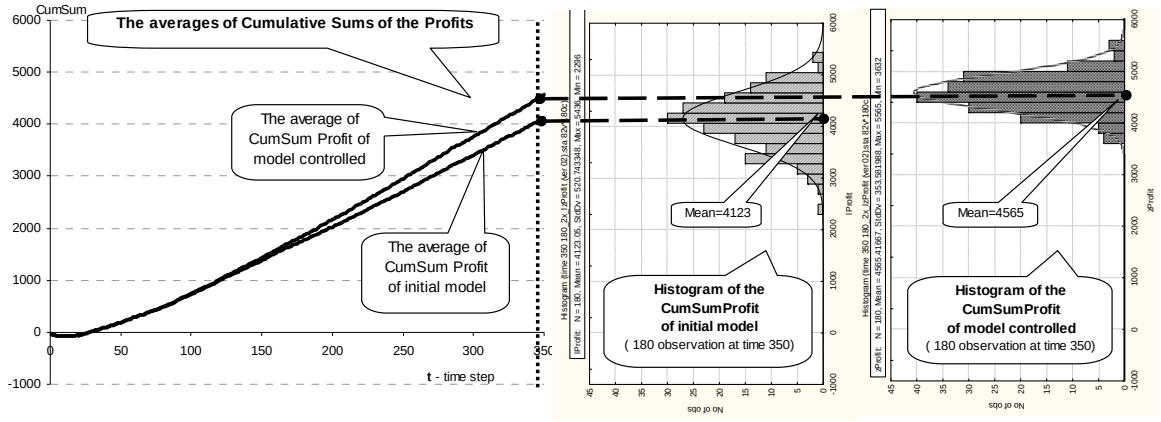

Figure 16. Dynamics of resulting profit for two systems (on the left) and corresponding histograms (on the right)

It is easy to see that the relative gain of profit for the system with the control over time t = 350 makes more than 10% in comparison with initial system, and thus the dispersion of the received profit decreases twice less than a dispersion of profit for initial system.

Thus, insignificant addition of the minimal resources (not exceeding on each step of one resource unit for each operation) at moments of time when the queue length exceeds threshold value leads to cardinal change of dynamics of initial system.

Conclusions

The comparative analysis of two systems shows, that introduction of the control

- leads to stabilization of number of not ready details in system,
- reduces the lost of resources,
- increases speed of an output of finished goods,
- allows at some level of prices for raw material and resources to increase profit 10% and more.

Besides the influence on security resources of each operation probably also influence length of turn before operation. The control system can be constructed so that to accumulate products in special buffers and to start products from buffers on operation on processing when queues become small.

Let us make some remarks on opportunities of control systems. We have considered a control system with allocation of additional resources for each operation on the basis of enough simple

algorithms. Use of the expanded algorithms of resource management and buffers with functions of the forecast allows arriving at the solution for optimum control, common for the given class of models.

The problem appears complex enough because of presence of the big number of optimised parameters and is even more complicated by strong stochastic of model.

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BOUNDED TOKAMAP: A HAMILTONIAN MAP FOR MAGNETIC FIELD LINES IN A TOKAMAK

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A Hamiltonian map is constructed like this in which both the polar axis and the boundary of the plasma cannot be crossed upon iteration. Phase portraits of the new map are quite different comparing with tokamap phase portraits. It is found that differences in the predictions of the tokamap and bounded tokamap might become significant in those cases when processes at plasma periphery are studied.

Keywords: *Hamiltonian map, chaos, computer simulations*

1. Introduction

Magnetic field lines in plasmas can be regarded as trajectories of Hamiltonian systems. For the field line tracing two methods can be applied: i) integration of the trajectory and ii) mapping of the trajectory. The latter is a modern technique for the Hamiltonian system. It is more than an order of magnitude, faster than the integration. A properly chosen mapping procedure always conserves the main flux preserving property of the magnetic field, which is important for a correct reproduction of the long-term behaviour of field lines in stochastic regions. Symplectic maps for many Hamiltonian problems have been extensively used during the last four decades. A systematic theory of these maps with many illustrative examples can be found in the recent book [1]. In this work we address a specific question: what are the consequences of the physical condition that the boundary of the plasma cannot be crossed. To answer this question, we re-examine the so-called tokamap [2–4].

2. Model and Methods

Mappings are constructed as iterative symplectic maps, representing a global picture of a tokamak cross section at the toroidal angle $\varphi_k = 2\pi k \pmod{2\pi}$. The generating function of the mapping is defined as follows:

$$\delta F(\psi_{k+1}, \theta_k) = -\frac{K}{(2\pi)^2} h(\psi_{k+1}) \cos 2\pi\theta_k \tag{1}$$

and the mapping itself is given by the expressions

$$\psi_k = \psi_{k+1} + \frac{\partial \delta F(\psi_{k+1}, \theta_k)}{\partial \theta_k} = \psi_{k+1} + \frac{K}{2\pi} h(\psi_{k+1}) \sin(2\pi\theta_k), \tag{2}$$

$$\theta_{k+1} = \theta_k + W(\psi_{k+1}) + \frac{\partial \delta F(\psi_{k+1}, \theta_k)}{\partial \psi_{k+1}} = \theta_k + W(\psi_{k+1}) - \frac{K}{(2\pi)^2} h'(\psi_{k+1}) \cos(2\pi\theta_k). \tag{3}$$

Choice of the function $h(\psi)$ in the form

$$h(\psi) = \frac{\psi}{1+\psi} \tag{4}$$

yields the following map:

$$\psi_{k+1} = \psi_k - \frac{K}{2\pi}\frac{\psi_{k+1}}{1+\psi_{k+1}}\sin 2\pi\theta_k\,, \tag{5}$$

$$\theta_{k+1} = \theta_k + W(\psi_{k+1}) - \frac{K}{(2\pi)^2}\frac{1}{(1+\psi_{k+1})^2}\cos 2\pi\theta_k\,. \tag{6}$$

The specific form of the map (5) and (6) is known as the tokamap. It is compatible with the toroidal geometry and describes the global behaviour of magnetic field lines in tokamaks.

In form (5), the map is non-linear; it possesses two solutions ψ_{k+1} for given (ψ_k, θ_k). The following choice of the unique root provides the final definition of the tokamap:

$$\psi_{k+1} = \frac{1}{2}\left\{P(\psi_k,\theta_k) + \sqrt{[P(\psi_k,\theta_k)]^2 + 4\psi_k}\right\}, \tag{7}$$

where the function $P(\psi,\theta)$ is defined as

$$P(\psi,\theta) = \psi - 1 - \frac{K}{2\pi}\sin 2\pi\theta. \tag{8}$$

It is easily to check that in this mapping the magnetic flux is a definite positive number: if $\psi_0 > 0$ then $\psi_k > 0$. It should be noted that Eq. (8) violates the global invariance ($\psi_k = 0 \implies \psi_{k+1} = 0$) if $\frac{K}{2\pi}\sin(2\pi\theta_k) < -1$. As a consequence in the tokamap global chaos appears for $K/2\pi > 1$.

The upper limit $\psi \le 1$, which means that plasma boundary cannot be crossed, is not imposed. For this reason the tokamap can be directly used in the ergodic diverter problem [5] where magnetic field lines may go outside the last magnetic surface ($\psi = 1$). Properties of the tokamap and of its various modifications have been studied in detail [1–4]. Several applications, e.g., investigation of magnetic reconnection during the crash stage of the saw tooth instability and stochastic transport of magnetic field lines are known. The question arises what are the consequences of condition $\psi \le 1$, should it be imposed into a mapping in those cases when the physical problem is such that the physical bound really exists, e.g., is given by a limiter or the wall?

3. The Bounded Tokamap

It is rather obvious that the important property of the tokamap, if $\psi_0 > 0$ then $\psi_k > 0$, ("the polar axis cannot be crossed [2]") is related to the boundary condition $h(0) = 0$ following from Eq. (4). By analogy the limit $\psi \le 1$ requires another boundary condition $h(1) = 0$. The two conditions can be simultaneously satisfied if instead of Eq. (4) we take the function $h(\psi)$ e.g., in the following form

$$h(\psi) = \psi(1-\psi). \tag{9}$$

Such a choice yields the following map:

$$\psi_k = \psi_{k+1} + \frac{K}{2\pi}\psi_{k+1}(1-\psi_{k+1})\sin(2\pi\theta_k)\,, \tag{10}$$

$$\theta_{k+1} = \theta_k + W(\psi_{k+1}) - \frac{K}{(2\pi)^2}(1-2\psi_{k+1})\cos(2\pi\theta_k)\,. \tag{11}$$

In form (10), the map is nonlinear. We rewrite it in the following form:

$$\psi_k = \psi_{k+1} + D\psi_{k+1}(1-\psi_{k+1}), \tag{12}$$

where

$$D = \frac{K}{2\pi}\sin(2\pi\theta_k)\,. \tag{13}$$

The following choice of the unique root provides the final definition of the bounded tokamap:

$$\psi_{k+1} = \psi_k \frac{2}{1+D+\sqrt{(1+D)^2 - 4D\psi_k}} \qquad \text{for} \quad D > 0\,, \tag{14}$$

$$\psi_{k+1} = 1-(1-\psi_k)\frac{2}{1+|D|+\sqrt{(1+|D|)^2 - 4|D|(1-\psi_k)}} \qquad \text{for} \quad D < 0\,. \tag{15}$$

Equations (11), (14) and (15) constitute the bounded tokamap. It is easily checked that in this mapping both condition (if $\psi_0 > 0$ then $\psi_k > 0$, and $\psi \le 1$) hold. Moreover, $\psi_k = 0 \implies \psi_{k+1} = 0$ and $\psi_k = 1 \implies \psi_{k+1} = 1$, which means that the two axes $\psi = 0$ and $\psi = 1$ are globally invariant.

4. Phase Portraits

We first reproduce some typical phase portraits of the tokamap and the revtokamap using the known expressions for the winding number

$$W(\psi) = \frac{w}{4}(2-\psi)\left(2-2\psi+\psi^2\right) \tag{16}$$

for the tokamap [2] and

$$W_R(\psi) = w\left[1-a(c\psi-1)^2\right] \tag{17}$$

for the revtokamap [3]. Here

$$a = \frac{w-w_0}{w}, \qquad c = 1+\left(\frac{w-w_1}{w-w_0}\right)^{1/2}. \tag{18}$$

The winding number (16) is a monotonously decreasing function of ψ, while the winding number (17) possesses a maximum, which corresponds to a reversed sheer ($s = [\psi / q(\psi)]dq(\psi)/d\psi$) configuration.

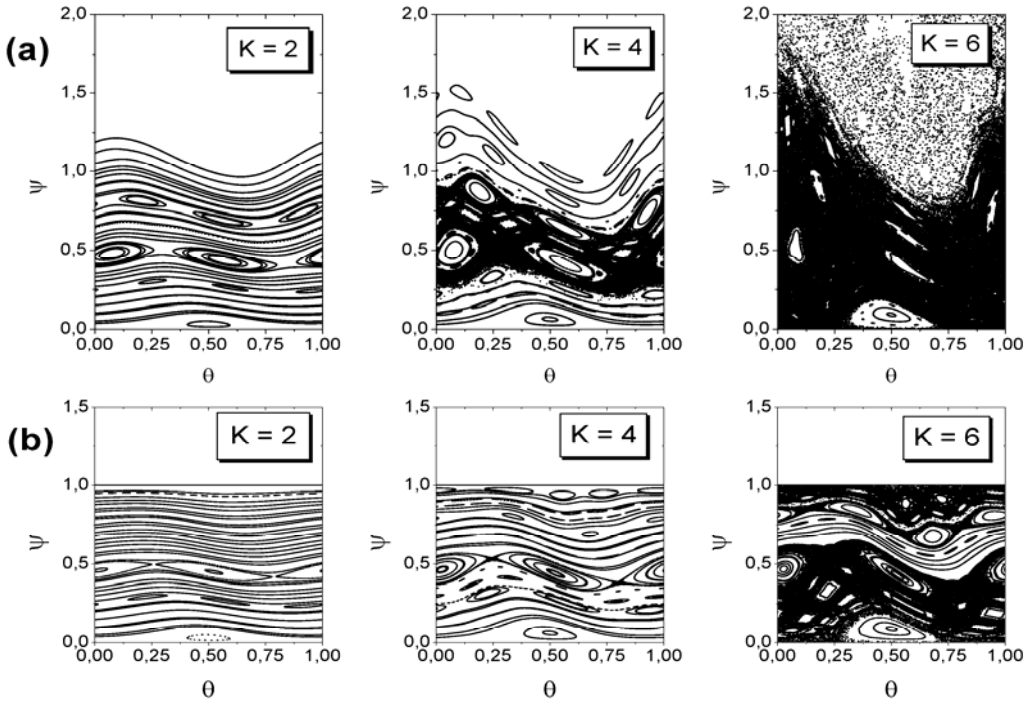

Figure 1. Tokamap (a) and bounded tokamap (b) regular and chaotic orbits. Here the following initial conditions have been used: twenty points along ψ axis and two points along θ axis. The parameter $w = 1$ in Eq. (16) and. the number of iterations N = 5000

Some typical phase portraits of these two maps are shown in Figs. 1a and Figs. 2a respectively. In Figs. 1b and Figs. 2b we show the corresponding phase portraits of the bounded tokamap and bounded revtokamap. In bounded tokamap we observe that stochastization begins at the physical boundaries, as it is clearly seen for $K = 6$ in Fig. 1b. Here two chaotic layers separated by barriers are formed in the vicinity of $\psi = 0$ and $\psi = 1$. This means that there is no global stochastization.

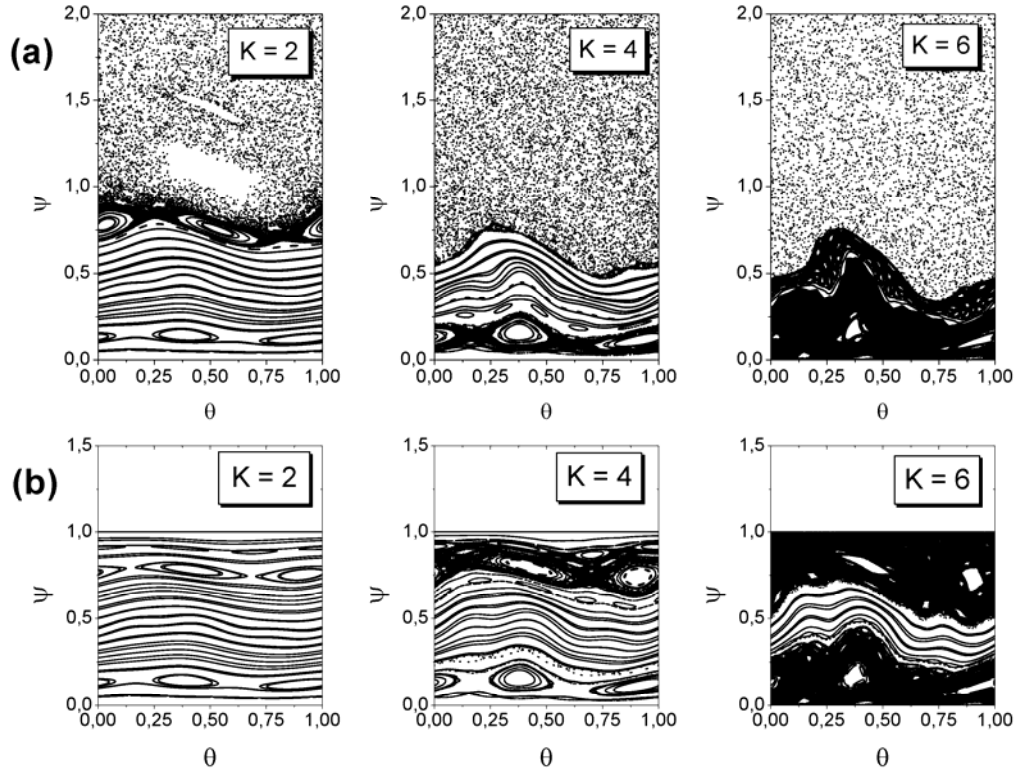

Figure 2. Revtokamap (a) and bounded revtokamap (b) regular and chaotic orbits. Here the following initial conditions have been used: twenty points along ψ axis and two points along θ axis. The parameters $w_0 = 1/3$, $w = 2/3$, $w_1 = 1/6$ in Eq. (17) and. the number of iterations N = 5000

It can be seen that even for small values of the stochasticity parameter K, K=2, in revtokamap trajectories leave the physical region. This is related to the fact that $W_R(\psi)$ changes sign when $\psi > 1$.

It is obvious that the phase portraits of the revtokamap and the bounded tokamap are also quite different.

Summarizing we can say that –

- the tokamap/revtokamap is a Hamiltonian map, depending on parameter K, under which an initially positive radial coordinate ψ remains always positive, and the polar axis is a barrier that cannot be crossed;
- the bounded tokamap/revtokamap is a Hamiltonian map, depending on parameter K, under which radial coordinate ψ may vary only in the physical range $0 < \psi < 1$, and that the two axes $\psi = 0$ and $\psi = 1$ are globally invariant.

Conclusions

We have shown how a simple Hamiltonian map can be constructed in which magnetic field lines are not allowed to cross the plasma boundary. Phase portraits of the new map are quite different comparing with tokamap/revtokamap phase portraits. It is obvious that differences in the predictions of the tokamap and bounded tokamap might become significant in those cases when processes at plasma periphery are studied.

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NARROW PLACES IN GENERAL LOGICAL SYSTEMS WITH UNRELIABLE ELEMENTS

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In this paper models of logical systems with unreliable elements are considered. Definitions of narrow places in these systems are made. The paper is based on asymptotic analysis of a work probability of logical systems in appropriate asymptotic conditions for the work probability of their elements. All main definitions and algorithms are based on the concepts of the disjunctive normal form and conjunctive normal form of a logical function. In this paper a case of low reliable elements, a case of high reliable elements and their mixture are considered.

Keywords: *logical function, unreliable element, normal form*

1. Introduction

In this paper models of logical systems with unreliable elements [1], [2] are considered. Definitions of narrow places in these systems are made. A narrow place is a family of minimal sets of elements for which an increase of their reliabilities (a decrease of their reliabilities) leads to the increase (to the decrease) of reliability of the logical system. The paper is based on asymptotic analysis of a work probability of logical systems in appropriate asymptotic conditions for the work probability of their elements. These asymptotic conditions use Weibull-like distributions of life times of complex systems and their elements [3], [4]. All main definitions and algorithms are based on the concepts of the disjunctive normal form (DNF) and the conjunctive normal form (CNF) of a logical function.

Denote Z the set, which consists of $|Z|$ independent random logical variables, $p_z = P(z=1)$, $p_z + q_z = 1$, $I \subseteq \left\{1, 2, ...2^{|Z|}\right\}$. Consider the logical function A, which depends on logical variables $z \in Z$ and is represented in DNF

$$A = \bigvee_{i \in I} \left[\left(\bigwedge_{z \in Z_i} z \right) \wedge \left(\bigwedge_{z \in \overline{Z}_i} \overline{z} \right) \right]. \tag{1}$$

Here the family $\left\{ \left(Z_i, \overline{Z}_i \right), i \in I \right\}$ consists of the set pairs $Z_i, \overline{Z_i} \subseteq Z$, $Z_i \bigcap \overline{Z_i} = \emptyset$, and for $i \neq j$ $\left(Z_i, \overline{Z_i} \right) \neq \left(Z_j, \overline{Z_j} \right)$.

Denote $\mathbf{A}$ the logical function A with random arguments $z \in Z$ and call $\mathbf{A}$ the logical system.

Suppose that $\forall z \in Z \ \exists c(z)$,

$$c(z) > 0 : \ p_z = p_z(h) \sim \exp\left(-h^{-c(z)}\right), h \to 0. \tag{2}$$

Denote

$$C = \min_{i \in I} \max_{z \in Z_i} c(z), \ I' = \left\{ i \in I : \max_{z \in Z_i} c(z) = C \right\}, \ S_i = \left\{ z \in Z_i : c(z) = C \right\}, \ i \in I',$$

$\mathcal{S}=\left\{S_i,\ \ i\in I'\right\}$, $N\left(\mathcal{S}\right)=\min\left(\left|S_i\right|:S_i\in\mathcal{S}\right)$, $\mathcal{T}=\left\{\left\{z_i\in S_i,\ \ i\in I'\right\}\right\}$, $N\left(\mathcal{T}\right)=\min\left(\left|T\right|:T\in\mathcal{T}\right)$

and let $\mathcal{S}',\mathcal{T}'$ to be the families of minimal (by an inclusion) sets from the families $\mathcal{S},\mathcal{T}$,

$\mathcal{S}''=\left\{S_i\in\mathcal{S}':\left|S_i\right|=N\left(\mathcal{S}\right)\right\}$, $\mathcal{T}''=\left\{T\in\mathcal{T}':\left|T\right|=N\left(\mathcal{T}\right)\right\}$.

2. Main results

Theorem 1

If the formulas (1), (2) are true, then

$$-\ln P\left(\mathbf{A}=1\right)\sim N\left(\mathcal{S}\right)h^{-C},h\to 0. \tag{3}$$

Proof

Rewrite the logical function A as follows:

$$A=\bigvee_{i\in I}\left[\left(\bigwedge_{z\in Z_i}z\right)\wedge A_i\right],\ A_i=\bigvee_{k\in J_i}\left(\bigwedge_{z\in\overline{Z}_i}\overline{z}\right),\ J_i=\left\{k:Z_k=Z_i\right\}.$$

The formula (2) leads to $p_z=P\left(z=1\right)\to 0,\ \ h\to 0$, so

$$P\left(\mathbf{A_i}=0\right)=\prod_{z\in\overline{Z}_k:Z_k=Z_i}p_z\to 0,\ h\to 0.$$

It is obvious that

$$\begin{gathered}\sum_{i\in I}\prod_{z\in Z_i}p_zP\left(\mathbf{A_i}=1\right)-\sum_{i,j\in I,i\neq j}P\left(\left(\mathbf{A_i}\prod_{z\in Z_i}z=1\right)\cap\left(\mathbf{A_j}\prod_{z\in Z_j}z=1\right)\right)\leq \\ \leq P\left(\mathbf{A}=1\right)\leq\sum_{i\in I}\prod_{z\in Z_i}p_zP\left(\mathbf{A_i}=1\right)\end{gathered}. \tag{4}$$

As for $i\neq j$

$$P\left(\mathbf{A_iA_j}=1\right)=P\left(\sum_{k\in J_i,n\in J_j}\left(\prod_{z\in\overline{Z}_k\cup\overline{Z}_n}\overline{z}\right)=1\right)\geq\prod_{z\in\overline{Z}_k\cup\overline{Z}_n}q_z\to 1,\ h\to 0$$

and

$$\sum_{i,j\in I,i\neq j}P\left(\left(\mathbf{A}_i\prod_{z\in Z_i}z=1\right)\cap\left(\mathbf{A_j}\prod_{z\in Z_j}z=1\right)\right)=\sum_{i,j\in I,i\neq j}P\left(\mathbf{A_iA_j}=1\right)\prod_{z\in Z_i\cup Z_j}p_z.$$

Thus from the formula (4)

$$P\left(\mathbf{A}=1\right)\sim\sum_{i\in I}\prod_{z\in Z_i}p_z\sim\sum_{i\in I}\exp\left(-\sum_{z\in Z_i}h^{c(z)}\right),\ \ h\to 0. \tag{5}$$

Denote $C_i=\max_{z\in Z_i}c\left(z\right),K_i=\left\{z\in Z_i:c\left(z\right)=C_i\right\}$.

The formulas $\sum_{z\in Z_i} h^{-c(z)} \sim h^{-C_i}\left|K_i\right|,\ h\to 0$ and (5) give the following:

$$P\left(\mathbf{A}=1\right)\sim \sum_{i\in I}\exp\left(-h^{C_i}\left(1+o\left(1\right)\right)\left|K_i\right|\right),\ h\to 0.$$

Consequently,

$$P\left(\mathbf{A}=1\right)\sim \sum_{i\in I'}\exp\left(-h^{-C}\left(1+o\left(1\right)\right)\left|S_i\right|\right)\sim \sum_{i\in I':\left|S_i\right|=N(\mathcal{S})}\exp\left(-h^{-C}\left(1+o\left(1\right)\right)\left|S_i\right|\right)=$$
$$=\exp\left(-h^{-C}\left(1+o\left(1\right)\right)N\left(\mathcal{S}\right)\right)\left|\left\{i\in I':\left|S_i\right|=N\left(\mathcal{S}\right)\right\}\right|.$$

As

$$\ln\left[\exp\left(-h^{-C}\left(1+o\left(1\right)\right)N\left(\mathcal{S}\right)\right)\left|\left\{i\in I':\left|S_i\right|=N\left(\mathcal{S}\right)\right\}\right|\right]\sim \ln\exp\left(-h^{-C}\left(1+o\left(1\right)\right)N\left(\mathcal{S}\right)\right)=$$
$$=-h^{-C}\left(1+o\left(1\right)\right)N\left(\mathcal{S}\right)\sim -h^{-C}N\left(\mathcal{S}\right),h\to 0$$

thus the formula (3) is true.

Corollary 1

Suppose that $\varepsilon_0=\min\left\{C,\min\left(\left|C-c\left(z\right)\right|>0:z\in Z\right)\right\}$.

1. For any $S\in\mathcal{S}$ and each ε, $0<\varepsilon<\varepsilon_0$, the replacement $c\left(z\right)$ by $c\left(z\right)-\varepsilon$ for all $z\in S$ leads to the replacement

$$C\to C-\varepsilon. \tag{6}$$

2. If a set $\mathcal{S}\subseteq Z$ and satisfies the condition (6), then $\exists\ S_*\in\mathcal{S}:S_*\subseteq\mathcal{S}$.

3. For any $T\in\mathcal{T}$ and each ε, $0<\varepsilon<\varepsilon_0$, the replacement $c\left(z\right)$ by $c\left(z\right)+\varepsilon$ for all $z\in T$ leads to the replacement

$$C\to C+\varepsilon. \tag{7}$$

4. If a set $T\subseteq Z$ and satisfies the condition (7), then $\exists T_*\in\mathcal{T}:T_*\subseteq T$.

Remark 1

Suppose that $\tau\left(z\right)$ are independent random variables equal to life times of logical elements $z\in Z$ and $h=h\left(t\right)$ is monotonically decreasing and continuous function, $h\to 0,\ \ t\to\infty$. Then the asymptotic

$$P\left(\tau\left(z\right)>t\right)=p_z(h)\sim\exp\left(-h^{-c(z)}\right),\ t\to\infty$$

is characteristic for the Weibull's distribution, which is widely used in life time models of complex systems with old and so low reliable elements [3], [4].

Suppose that $\forall z\in Z\ \exists c\left(z\right)$,

$$c\left(z\right)>0:q_z=q_z\left(h\right)\sim\exp\left(-h^{-c(z)}\right),\ \ h\to 0. \tag{8}$$

Consider the logical function A represented in KNF

$$A = \bigwedge_{i \in I} \left[\left(\bigvee_{z \in Z_i} z \right) \vee \left(\bigvee_{z \in \overline{Z}_i} \overline{z} \right) \right]. \tag{9}$$

Theorem 2

If the formulas (8), (9) are true, then

$$-\ln P\left(\mathbf{A} = 0\right) \sim N\left(\mathcal{S}\right) h^{-C}, \; h \to 0 \tag{10}$$

and the corollary 1 takes place.

Remark 2

Suppose that $\tau\left(z\right)$ are independent random variables equal to life times of logical elements $z \in Z$ and $h = h\left(t\right)$ is monotonically increasing and continuous function, $h \to 0, \;\; t \to 0$. Then the asymptotic

$$P\left(\tau\left(z\right) \le t\right) = q_z(h) \sim \exp\left(-h\left(t\right)^{-c(z)}\right), \; t \to 0$$

is characteristic for the Weibull's distribution, which is used in life time models of complex systems with young and so high reliable elements.

Suppose that the sets $X_i, V_i, \overline{X}_i, \overline{V}_i \subseteq Z$ are nonintersecting. For $\forall z \in X_i \bigcup \overline{X}_i$ the formula (2) is true and for $\forall z \in V_i \bigcup \overline{V}_i$ the formula (8) takes place, $i \in I$. So, low reliable and high reliable elements in the system $\mathbf{A}$ are present simultaneously.

Theorem 3

Suppose that

$$A = \bigvee_{i \in I} \left[\left(\bigwedge_{z \in X_i \cup V_i} z \right) \wedge \left(\bigwedge_{z \in \overline{X}_i \cup \overline{V}_i} \overline{z} \right) \right], \tag{11}$$

then for $Z_i = X_i \bigcup \overline{V}_i \neq 0, \overline{Z}_i = V_i \bigcup \overline{X}_i, \; i \in I$, the formula (3) and the corollary (1) are true.

Suppose that

$$A = \bigwedge_{i \in I} \left[\left(\bigvee_{z \in X_i \cup V_i} z \right) \vee \left(\bigvee_{z \in \overline{X}_i \cup \overline{V}_i} \overline{z} \right) \right] \;\; ,$$

then for $Z_i = V_i \bigcup \overline{X_i} \neq 0, \overline{Z}_i = X_i \bigcup \overline{V}_i, \; i \in I$, the formula (10) and the corollary (1) are true.

Conclusions

The corollary 1 allows to call the sets from the families $\mathcal{S}', \mathcal{S}'', \mathcal{T}', \mathcal{T}''$ by narrow places in $\mathbf{A}$.

Remark 3

The statement 1 (the statement 3) of the corollary 1 establishes that an increase of elements $z \in S$ reliabilities for $S \in \mathcal{S}$ (a decrease of elements $z \in T$ reliabilities for $T \in \mathcal{T}$) leads to an increase (to a decrease) of the system $\mathbf{A}$ reliability.

Remark 4

The statements 2, 4 of the corollary 1 establishes that the families S', S'', T', T'' and the numbers $C, N(S), N(T)$ do not depend on a view of DNF (on a view of KNF) of the logical function A.

Remark 5

Suppose that $\forall z \in Z$ the condition (2) or the condition (8) are replaced by

$$\exists c(z), d(z), c(z) > 0, d(z) > 0 : p_z = p_z(h) \sim \exp\left(-d(z) h^{-c(z)}\right), \quad h \to 0$$

or by

$$\exists c(z), d(z), c(z) > 0, d(z) > 0 : q_z = q_z(h) \sim \exp\left(-d(z) h^{-c(z)}\right), \quad h \to 0,$$

correspondingly. Then to obtain the formula (3) or the formula (10) correspondingly it is enough to redefine $|S|$, $S \subseteq Z$ and put (besides of a number of elements in the set S): $|S| = \sum_{z \in S} d(z)$.

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MOBILE DECISIONS OF TRANSPORT AND PUBLIC INFORMATION

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The newly developed remote identification systems for: 1) transport facilities and goods, and 2) passenger transport are presented.

Keywords: *transport means, goods, passenger, GSM*

1. Introduction

A major goal of transport policy pursued by the European Union is the creation of the unlimited unified transport market providing equal conditions for its members to compete with each other. However, the solutions made in the field of national transport are often ineffective because of the lack of information about transport mobility, logistic requirements or unforeseen changes in policy. Decision-making requires the access to the reliable information and statistical data on transport system as well as on the environment and major influencing factors.

Three Lithuanian universities (Kaunas Technological University, Vilnius University and Vilnius Gediminas Technical University) as well as mobile phone operator "Bite GSM" created the programme "Mobile solutions in information and transport" (VITMOS). Based on this development researchers developed an effective system of transport registration and monitoring and a mobile portal for public information associated with transport.

2. Major Decision Making Principles Based on Object Positioning

When a global mobile phone system (GSM) created more than a decade ago became widely used all over the world, a basis for developing a system for positioning objects (GPS) was in place. In a variety of applications, not requiring high accuracy, object positioning may be based only on GSM technology.

A schematic view of object location based GSM decision support system is presented on Fig. 1.

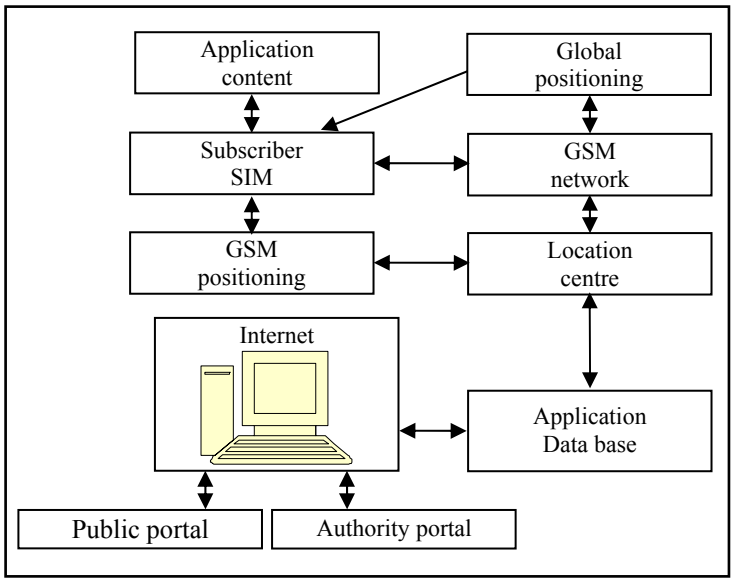

Figure 1. A system of positioning-based GSM solutions

Mobile solutions based on object positioning are made by choosing a particular application content, which is attached to a subscriber SIM. GSM connects the subscriber‘s cell phone to the network. A subscriber telephone is usually positioned by the global positioning or GSM positioning systems. The obtained coordinates of an object are transmitted by GSM network via the signal or GPRS channels, or through EDGE channels. The coordinates are stored in the location centre and then transferred to the application database. Two portals, i.e. the public and the authority portals, are created by using the Internet [1–5]. GSM solutions based on positioning facilitate the provision of location services making them easily accessible. For designing the above services joined effort of the developers of technologies and special equipment, service providers and system developers are required.

3. A Remote Identification System for Freight Transport

In solving the problems associated with vehicles and transportation of dangerous goods, one should always know an exact location of transport facility and the goods transported as well as the places of freight loading, unloading and transfer. The information on the past runs on particular routes should also be studied. This could allow us to effectively control all transport facilities as well as to avoid fire explosions of dangerous goods or other accidents. The information of any deviation from the route and other related data should be recorded.

During goods transportation a carrier (a company) should get the following data relating to:

- the location of the vehicle and whether the goods are being loaded or unloaded;
- the process of crossing the state border by the vehicle;
- the time of the vehicle’s arrival at the terminal;
- observance of work and leisure time by the carrier;
- time of re-fuelling.

Vehicle control and freight monitoring are performed at the control room. A database (DB) is generated on the basis of the obtained information, which can be used for:

- collecting and storing the information on the route;
- coding transport facilities (e.g. loaded, not loaded);
- grouping the vehicles in order to divide the obtained information (messages);
- measuring time for determining the period of MCT activity after shutting down the engine;
- showing 100 previous positions of the vehicle on the map or providing textual information about it;
- providing some additional information about the state and location of the trailer;
- providing the information about the state of the refrigerator (e.g. its temperature, the temperature of re-circulating air and gases).

The main parts (units) of the remote identification system of vehicles and goods embrace: TIP portal, TVIMP portal, content control system (SMS, GPRS), mobile phone, the unit for stating the geographical position of vehicles and goods.

A schematic view of the identification system of vehicles and goods is shown on Fig. 2.

TIP portal is a subsystem aimed at providing the data on vehicles. The users of the portal can obtain the required information there and use the additional portal modules and subsystems. TVIMP portal (i.e. a mobile portal for common information about transport) is a subsystem performing the function of providing open information about transport for the users of the portal.

Purposes and functions of the portals:

TVIMP
Mobile component
Static information component
Dynamic information component
Open statistical data component

TIP
Statistical component
Visualization/location component
User data register and its control component
Component of communication with external systems
LBS

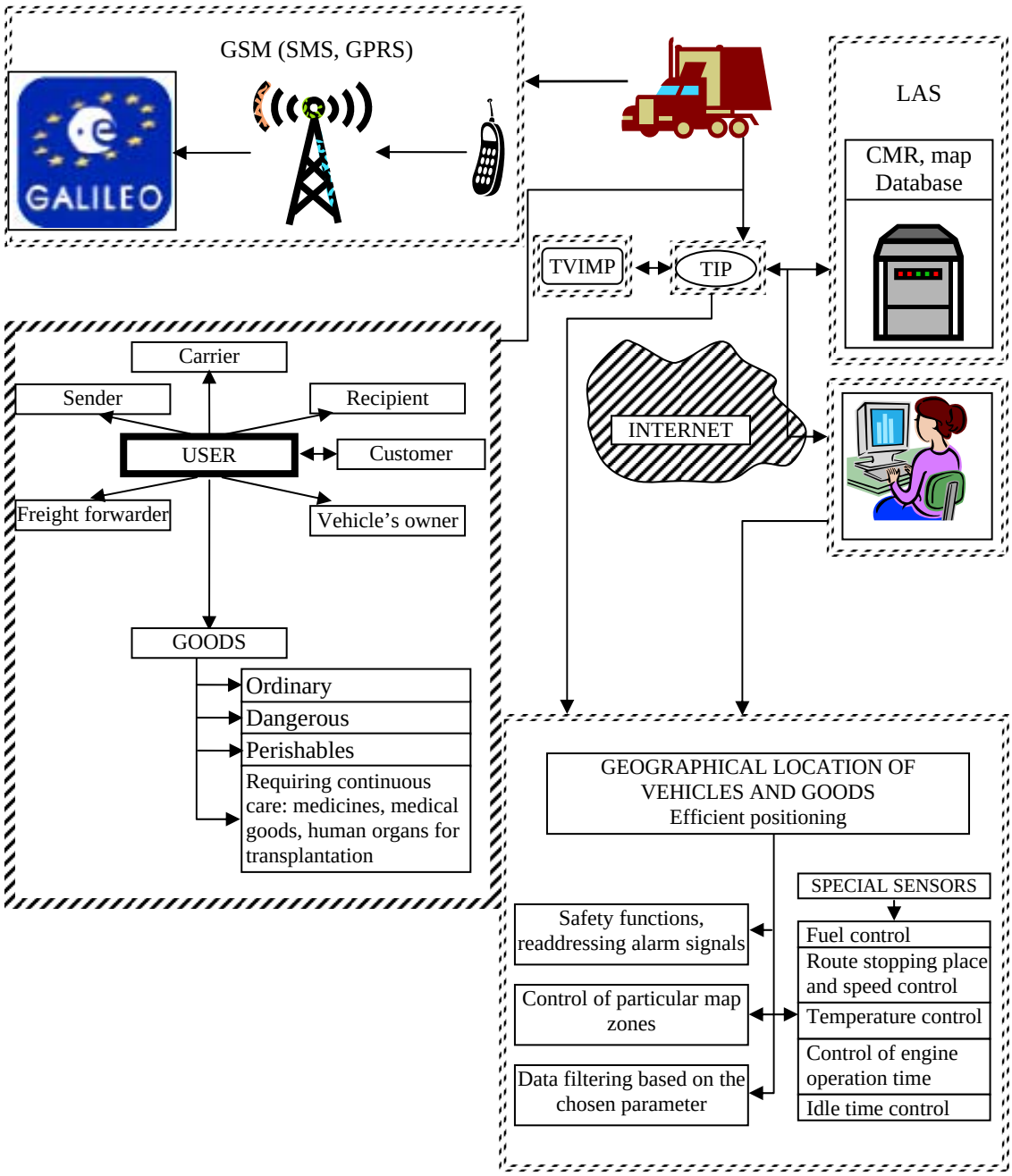

Figure 2. A system of remote identification of vehicles and goods

TVIMP is designed for all users of this portal to perform the following functions:

- A mobile component allows the users to browse through a portal with a cell phone or other devices, using a WWW or WAP browser;
- Static information component collects and automatically updates static data (e.g. documents, links, etc.);
- Dynamic information component provides the dynamic information stored in the portal, i.e. news, messages/announcements from transport companies, services, etc.;
- Open statistical data component provides generalized public statistical data about flows of transport, general use of roads, etc.

TIP is designed for registered users to perform the following functions:

- Statistical component provides statistical data on vehicle and freight traffic;
- Visualization/location component deals with enquiries, providing textual and visual information from the location server (LAS) component about the location of objects;

- User data register and its control component register the portal users, allowing them to input/present the data on the monitored company's vehicles, transported goods, etc.;
- Component for communication with external systems provides the interface for the portal communication with other systems;
- LBS (location-based services) implements and provides various services associated with user location.

Given such flexibility, can be provided to a wide range of users, including large logistics companies as well as individual carriers. Both types of portals have access to highly developed mobile phone lines.

To identify goods at a distance from the containers or packages, disposable sensors can be used. They may be made of paper and attached to packages or containers to be monitored. The sensors should be able to read the information automatically.

Dangerous cargoes require special precautions. Applying the above described system to transportation of dangerous goods, the main tasks are to ensure monitoring and control. Disposable sensors attached to packages can be also used in this case, particularly, when transporting the most or highly dangerous goods (i.e. auto reactive, radioactive materials, organic peroxides), as well as goods transported:

- by vehicles with the mass exceeding 3.5 tonnes;
- by vehicles carrying dangerous cargoes in fixed or removable tanks of the capacity exceeding 1 m^3;
- by a battery of similar transport facilities with the total capacity exceeding 1 m^3;
- by containers, removable containers or DDK, with the capacity exceeding 3 m^3 per vehicle;
- by vehicles, carrying 1st grade materials or products, irrespective of the largest mass of transport facility.

In transporting dangerous cargoes, the route of vehicles should be known and a system for moving objects control should be provided. The latter could ensure the safety of the transported dangerous goods.

This system would also be useful for carrying perishables because their transportation should be controlled.

4. A System of Remote Identification of Passenger Transport

The developing of remote identification system for passenger transport is associated with the solution of the problem of creating a monitoring system to achieve regular bus traffic on international distant and local (urban and suburban) routes. The above system will help to control the carrier's operation on these routes, increasing traffic regularity and improving the servicing of passengers. This will also allow passengers and their relatives to get information about bus traffic, i.e. the arrival of buses on time, too early or too late. By introducing this system, a carrier (a company) will be able to get the relevant information (like an output) about the operation; i.e. the total hours worked, deviations from schedule and other violations, etc.

The main units making a remote identification system for passenger traffic are TIP, TVIMP, vehicles and passengers' unit, LAS, the Internet, GSM (SMS, GPRS), the information stored in bus station databases and the unit for stating the geographical location of passenger transport. Mobile phones are used for the identification of passengers in this system.

A schematic view of the remote identification system for passenger transport is presented on Fig. 3.

The information required by a carrier (a company) on an international route includes these main items:

a) if a bus driver works according to schedule, i.e.:
   - if he crosses the state borders on time;
   - if he arrives at bus stations on time;
   - if he arrives at the destination point on time;

b) if, when arriving at the place of destination, he goes to settle some private affairs.

To get the above information a system of bus monitoring on the route should be created. To achieve this, it is necessary:

- to provide every bus with a mobile telephone number;
- to determine bus identification;
- based on several control runs to make a traffic schedule on the route;
- to determine the control (check) points at as follows:

a) the stations on the bus route;
b) at the points of state border crossing;
c) at the destination points on the route;
d) at intermediate bus stations, if there are no bus stations at each route section of 150–200 km;

– to make a schedule of monitoring bus position, i.e. determining the time when a bus should arrive at the above-mentioned control points;
– when a bus proceeds on a route, to observe and record the time of its arrival at the check points and crossing the border, as well as deviations from schedule (accurate to within few minutes). The deviations from schedule should be registered in the form of tables or graphs.

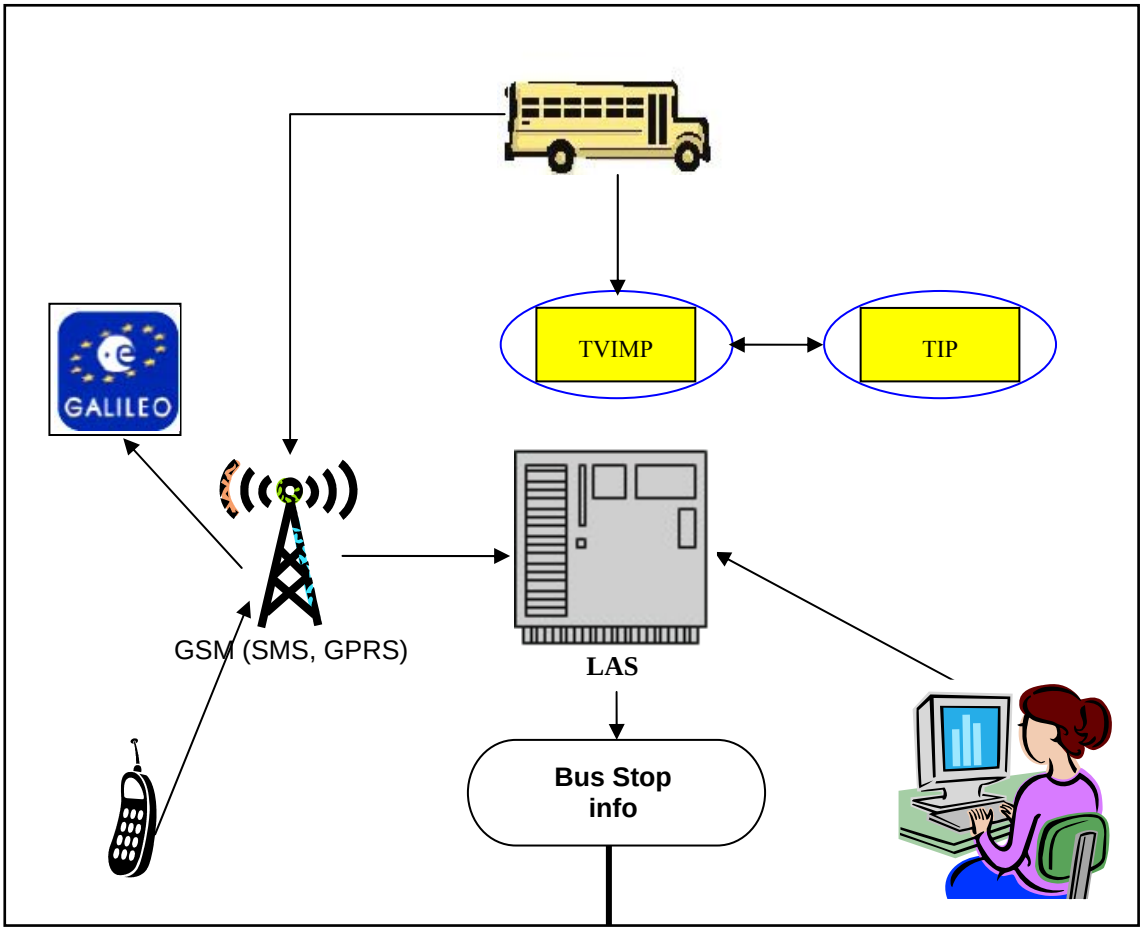

Figure 3. Remote identification system for passenger transport

When a bus is on an international route, GSM communication should be used:
– when a bus is crossing the state border,
– when a bus arrives at bus stations on the route,
– if there are no bus stations on the route sections of 150–200 km it should be used when a bus passes small intermediate stations,
– when a bus arrives at the final station (its destination point),
– for checking 1–3 times if, on arriving at the place of destination, a bus driver uses a bus to settle his private affairs (the number of checks depends on the idle time of the bus at the final station).

The information which should be provided to a carrier (company) on a long route should be similar to this required for an international route, except for the data on the time of crossing the state border (which is not needed).

Other relevant information to be provided to passengers includes:
– the time of bus arrival at the station or small intermediate station according to schedule,
– the information about its actual arrival, when a bus is being late or ahead of schedule.

The relevant information provided to passengers' relatives should include:

– the information about bus arrival at the station or small intermediate station,
– time of actual arrival of a bus if it is being late or ahead of schedule.

The above problems should be solved both for international and long bus routes.

In solving the last two problems, the user himself will pay for GSM services; therefore, the frequency of their use will depend on the needs of the users or their relatives.

On local (urban or suburban) routes the most relevant information is associated with the question if a bus runs according to schedule.

To achieve regular bus traffic on local (urban or suburban) routes, GSM services should be used 3–5 times, depending on the number of check points on the route.

5. Implementing the Mobile User Concept

The mobile user concept is implemented as a part of the portal, i.e. WAP pages, stored in the server. In this way, the access to a portal via WAP browser is provided. Moreover, in realizing a mobile component, JAVA or SYMBIAN OS by user programs, the data are more easily accessed. The user program is either installed or loaded from a page. For this purpose, a special program can also be obtained from service provider.

When a user is connected to a portal, the browser-supported features are identified and a script installed in the page readdresses it to the user's page. The alternative solution is to provide the information requested by the user, sending this page to him without readdressing. In the latter case, the structure of the portal pages is not lost, however, web page scripts are not so easily read and are less comprehensible (PHP, jsp, aspx, or servlets).

It is more convenient to store pages with the same name nearby, extending their names according to the context, like _wap, wap2, xhtml (for example, if a menu is available, php creates an additional file – menu_wap, php, having the same links and elements as an ordinary menu).

In these design methods, a navigation scheme will remain unchanged.

On Fig. 4 some changes in TVIM portal pages made to support mobile clients are shown.

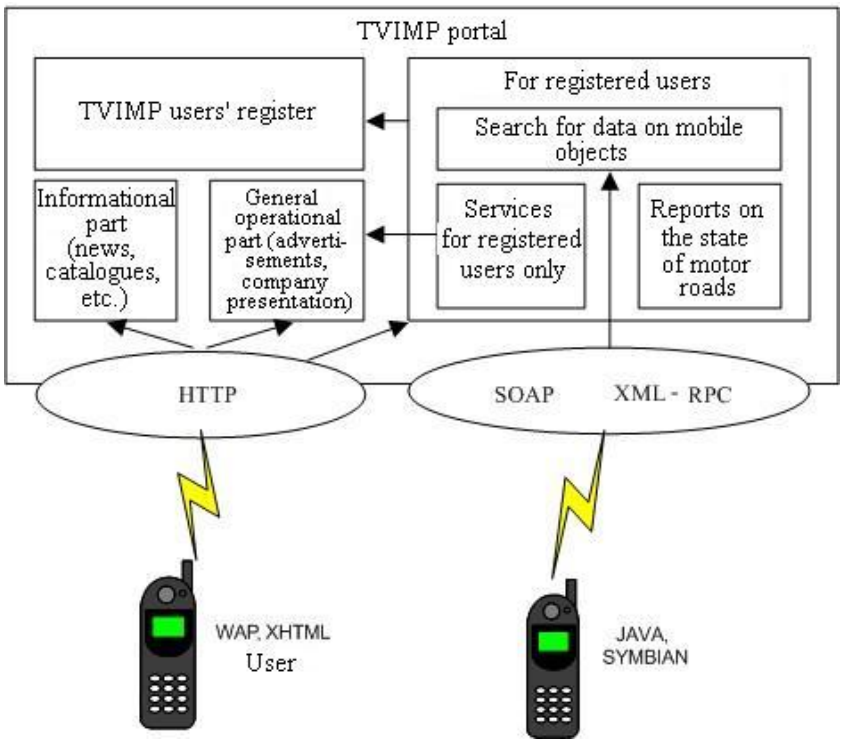

Figure 4. Changes made in the portal pages to support the mobile users

It should be noted that the portal architecture allows for adapting respective software for use in other searching systems of a similar kind, aimed at:

- continuous monitoring of dangerous cargo transportation;
- continuous monitoring of some medicines, biological substances or organs for transplantation;
- performing similar tasks.

These systems usually require updating of data about the mobile objects being monitored to provide the services helping to locate these objects (referred to as LBS – Location-based Services).

The portals, dealing with the positioning of objects in GSM network, should communicate with users' mobile stations. Since the location function at the portals is performed by linking the codes of the searcher and the searched – a telephone number (IMSI), the code of every user can be used as his/her name. The telephone number of a user can also be used for his/her authorizing and for sending messages about the locating operations. A portal should also be accessed via the mobile station WAP interface. Mobile station-portal interface is required to perform one of the four functions given below:

- authorizing, when a WEB portal is used;
- using a portal WAP interface;
- controlling permission/denial via a mobile station;
- sending messages about the location to the searched.

Portals are designed in the way that the data provided by various systems of observation, such as GSM, GPS, WLAN, wireless internet, etc., can be used there. They can also be used for testing, complex evaluation of monitoring functions as well as for providing the data on geographical location of objects, transmitting data to mobile telephones, etc.

Any carrier using a remote identification system of vehicles and goods should:

– provide every vehicle driver with a mobile phone to be able to transmit information to him by sending SMS;
– appoint a person responsible for maintaining the connection with drivers or other participants in the process of transportation.

6. Integration in the EU Transport Systems

To achieve the integration of Lithuanian transport system into the economic community of European and other countries in the shortest possible time, an efficient transport system informational infrastructure should be created, which is perceived rather as a formation of the operational environment for particular enterprise information systems than the development of a single huge computer-aided information system. In developing these projects, the problem of their future integration with the projects of intelligent transport systems being implemented in Europe now should be considered. Lithuanian information systems in transport should be updated, and their compatibility with similar systems in the neighbouring countries should be ensured.

The program VITMOS is the first development towards this end. Mobile VITMOS solutions, based on the created portals, can be effectively used in the context of European development. Transport problems have paid great attention to in the European Union: a strategic directive "e-Safety-Cooperative Systems for Road Transport", which has been implemented for several years now, emphasizes the role of transport efficiency, safety, reliability and comfort in solving these problems. At present, the criteria allowing for the creation of cooperative systems for road transport, such as "automobile- automobile" and "automobile-infrastructure" are considered to be of primary importance. Based on them, the following tasks can be defined for future projects:

- To develop the control systems for transport in order to effectively use the available infrastructure;
- To test the architecture of open interactive and variable scale systems; to design and implement open interactive and variable scale systems allowing for the effective use of modern sensors and integrate their software;
- To test and implement open interactive and variable scale systems, using positioning technologies and sensors, and integrate them into intelligent cooperative systems;
- To integrate open interactive and variable scale systems into transport control systems;
- To develop systems for analysing accidents and their causes in particular, integrating them into the systems providing similar data, which are currently used in the EU states;
- To develop and integrate the web sites "e-Safety Initiative" and "e-Safety Forum", especially, as a basis for creating effective technologies aimed to increase traffic safety.

The works performed using the VITMOS program and the experience gained in developing the above projects could make a foundation for future cooperation with the colleagues abroad.

Concluding Remarks

1. A system of remote identification of vehicles and goods allows the carrier to determine:
   - Where the vehicle is located and if it is being loaded or unloaded;
   - How the vehicle is crossing the state border;
   - When the vehicle arrives at the place of destination (terminal);
   - If a vehicle driver keeps up to the scheduled work and leisure time;
   - When the vehicle is refuelled.
2. A system of remote identification of passenger transport allows as follows:
   a) the carrier to observe:
   - if the driver keeps up to schedule on the run;
   - if he crosses the state border on time;
   - if he arrives at the bus station (or small intermediate stations) on time;
   - if a bus arrives at the final bus station on time;
   - if he goes to settle his private affairs on arriving at the final bus station.

   b) the passengers to know:
   - when a bus should arrive at the bus station or a small intermediate station according to schedule;
   - if a bus is being late or ahead of schedule. If so, to learn the actual time of bus arrival.

   c) the passengers' relatives to know:
   - where a bus is at the moment;
   - when a bus should arrive at the bus station or a smaller intermediate station;
   - if a bus arrives on time, and if not, to know the time of its delay or arrival ahead of schedule.

3. Mobile phones are used to identify vehicles, goods and passengers in the system of remote identification.

4. To identify goods at a distance from the containers or large packages, disposable sensors can be used. They may be made of paper and attached (glued) to packages or containers to be monitored.

5. The portals TVIMP and TIP are used to meet the needs of both public and private transport and all interested parties, providing the required services and performing various functions, especially those associated with vehicle monitoring. The portals can provide their users with various kinds of information, including public, legal, statistical, geographical and other types of information, as well as some confidential data based on vehicle monitoring required for the effective company performance.

6. The works performed using the VITMOS program, as well us the experience gained, could make a basis for speeding up the integration of the transport system of Lithuania into the economic community of European and other countries

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TEACHING UNIFICATION OF HUMANITARIAN DISCIPLINES IN THE LIGHT OF BOLOGNA PROCESS

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According to Bologna agreements, the educational systems of all European countries have to correspond to a single standard. The certificates of different universities will gain general acceptance. At the same time, this will lead to a mutual understanding of specialists that have graduated from different countries. Their joint work will provide a more stable and happier life for humanity. In this paper one of the possible ways for unification of teaching in the light of the Bologna process is proposed and discussed. It shows that the inclusion of elements of formal description of the main theoretical propositions in particular with the teaching programs of humanitarian disciplines will lead to significant unification of teaching and improvement of teaching programs.

Keywords*: Bologna agreements, unification of teaching*

1. Introduction

One of the important goals of the Bologna process [1] is the unification of teaching in Europe. Unification of teaching does not solely mean the unification of teaching programs. Even for teaching, the same programs and the same number of hours, teaching can be significantly different. This concerns primarily humanitarian disciplines. In the case of exact and natural disciplines, the formal convergence of teaching programs can provide an identical graduation of students because for these disciplines the definitions and the interpretation of facts as a rule have a synonymous meaning.

In the case of humanitarian disciplines, the situation is different. When a teacher does not use a formal approach, his teaching depends on his world outlook, on his subjective relation to authors of concepts, and on his emotional state. The words themselves cannot be impartial and objective. *The words must be supported by formal (quantitative) reasons.* That is why the unification of teaching in the case of humanitarian disciplines demands formalization and quantization of teaching material.

In this work, we discuss the ways of transforming teaching programs based on mathematical approaches for three disciplines: a) psychology, b) foreign language and c) economics.

a) Mathematical description of psychological processes and computer models in psychology has been known for a long time. Continuum mathematics is used to solve psychological problems [2]. In its turn, an important field of psychology is the psychology of mathematics. Mathematical models of thinking and memory, mathematical description of psychological reactions, and behaviour, are presented in special courses. But on the whole mathematical approaches are almost absent in teaching programs.

b) The next example is the application of quantitative approaches within linguistics. Mathematical linguistics has developed over time [3, 4]. Laws of Zipf that give correlations "Rank – Frequency" and "Quantity – Frequency" allow solving of many actual problems of linguistics. It was revealed the existence of universal characteristics of all human texts independently on the language groups. This field of linguistics is not reflected in teaching programs.

c) Application of quantitative approaches led to signal achievements in economic sciences and in particular to development of a new field of science named econo-physics [5, 6]. The important economic problems are solved on the basis of mathematical models of theoretical physics. Special courses are devoted to these programs of economics. Nevertheless, these achievements in economic science are not reflected in economic education.

Below are given the examples of mathematical approaches in non-mathematical sciences.

2. Mathematical Description of Psychological Phenomena and Computer Models in Psychology

Mathematical descriptions of psychological processes provoke discussions early on during the appearance of this scientific direction [7]. The question arises, if such an approach to psychological phenomena is permissible in principal. Only practical results can give the answer. An example we examine here is a mathematical model of thinking.

According to the model [8, 9] the thinking space (TS) contains discrete elements that are steps of movement towards the solution of the problem. The thinking steps are thinking elements (TE) in TS. TE are divided into three groups: effective elements (EE), wrong elements (WE), and intermediate elements (IE). EE create a trajectory towards the solution of the problem. Usually a person digresses from the direct route; his trajectory includes WE and IE. The problem is solved when the critical number of EE is accumulated in TS. Using the physical ideas, the conclusion can be found in a phase transition to the new state in TS. WE correspond to erroneous steps. IE correspond to steps that can be further used for formation of EE. The numbers of EE, IE and WE are denoted consequently N_1, N_2 and N_3. Numbers N_i are functions of time and can be found from a set of equations. Below one can see the first equation:

$$\frac{dN_1}{dt} = I_1 + a_i N_1 + b_i N_3^k - c_i N_2 \,. \tag{1}$$

Coefficients of this equation are considered as parameters of thinking. They have the following meaning: parameters of intuition (I_1), logic (a_i), and volume of thinking space (k), associative thinking (b_i), and critical thinking ($1/c_i$).

The solution of Eq. (1) includes all numerated parameters. We use this solution to determine them. To achieve one's aim we create a special computer game that allows finding experimental functions $N_i(t)$. The last step is to find the best approximation of experimental function $N_i(t)$ by theoretical solutions of Eq. (1). The practical result is a creation of computer tests for testing thinking. Validity, reliability, and representative properties of tests satisfy all requirements. Comparison of new tests with well-known tests of Torrance [10] shows the coincidence of the testing results. At the same time, new tests give more information about mechanisms of thinking.

3. Quantitative Description in Linguistics

Language sciences include a wide range of directions and problems. Mathematical linguistics solves many of them [3, 4]. New achievements in language sciences are caused by the development and application of Zipf's laws. New fundamental results have been obtained in such fields as origin of languages, peculiarities of different language groups, deciphering of ancient texts, theory of translation, and information searching. These results are partly reflected in special courses. But nowadays mathematical approaches in the numerated fields of linguistics lead to a new level of understanding of important questions in linguistics. We claim that teaching programs have to be improved and widened to include the mentioned questions. The main ideas of Zipf's laws [4] and the ways of their applications are described.

3.1. The first zipf's law

The first law is the definition of frequency, ω for the given word if this word is repeated in the text ω times. The frequencies ω_i for all words must be found (i = 1, 2 …n, where n is the total number of words in the text). Therefore for some text:

$$\omega_1 > \omega_2 > \omega_3 \ldots > \omega_n \,. \tag{2}$$

For frequency ω_k the parameter k is named as a rank of the frequency ω_k. It is found that:

$$\frac{k \cdot \omega_k}{n} = Const \,. \tag{3}$$

The result is that inside of each group of languages this constant is the same for any text. For example, within English texts this constant is 0.1 and for Russian texts it is 0.06–0.07.

3.2. The second zipf's law

In the first Zipf's law, different words in the text that can have the same frequency ω are not accounted for. In this case, m words in the text have the same frequency ω_k. It is shown that there is a universal link between the parameters of m and ω_k. This link is the second Zipf's law that can be expressed by formula:

$$\ln m = \chi \ln \omega_k \,. \tag{4}$$

This is a linear dependence. This dependence is true for all language groups! The differences are observed only in the values of the coefficient χ. It is reasonable to note that Zipf's laws are true not only for language sciences. For example, a number of cities depend on the number of their population in accordance with Zipf's laws. Ratings of Internet sites also satisfy these laws. Now scientists come to conclusion that Zipf's laws reflect the human origin of the object.

Some very old manuscripts are investigated using Zipf's laws. It is unclear if these materials are texts in principal. The investigations answer this question positively. Computer programs allow the basis of Zipf's laws to differentiate between women's texts and men's texts and to solve many of the corresponding psychological problems.

4. Physical and Mathematical Modelling in Economics

The development of econo-physics illustrates a high effectiveness of application of methods of theoretical physics in economics [5, 6]. Adrian A. Dragulescu claimed [5] that "in a closed economic system the total amount of money is conserved. Thus the equilibrium probability distribution of money P (m) should follow the Boltzmann-Gibbs's law $P(m) = Ce^{-m/T}$. Here m is money, and T is an effective temperature equal to the average amount of money per economic agent…"

Within the next few years some physics and economics departments will design a basic course teaching the essential elements of both physics and biophysics; (see Physics Today, March, 2005). Physics will continue to contribute to economics in a variety of different directions, ranging from macroeconomics to market microstructure, and that such work will have increasing implications for economic policymaking [6].

5. Discussion and Conclusions

"Apud me, omnia in mathematicas fiunt" (Latin). Of course, it should be noted that all disciplines are not to be transformed into mathematical disciplines. Only the following is to be stressed:

- Many modern directions in humanitarian sciences are linked to the application of mathematical and quantitative approaches.
- The corresponding teaching disciplines will not reflect the modern level of science without including these new fields of science.
- At the same time one of the important ways to achieve the unification of teaching in the field of humanitarian sciences is the partial introducing of methods of exact disciplines.
- This process demands the transformation of teaching programs in all European universities.

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LEARNING CURVE MODEL FOR PROFESSIONAL COMPETENCES DEVELOPMENT

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Complex historical processes have generated national identities conditioned by sharing a common language, traditions, ethnic roots and often religion. Historical processes going on at present are generating a new identity – European identity, which is possible only on the grounds of sharing common characteristics – the language, in the first place, as a means of communication and cooperation. Language is not only a major aspect of culture, but also a means of access to different cultural manifestations; it is an imperative arising out of the needs, ties and interrelationships of people entering the "interdependence age" within a new space – the integrated European society. The status of English as a 'Language for International Communication' is no longer in dispute and rarely attracts the kind of critical scrutiny. Unfortunately, talking about citizenship and European identity, we often ignore the fact that not all the European citizens are English-speaking people. Consequently, in developing European identity, serving educational message and teaching English in particular, is a form of stakeholder involvement [1]. Pragmatic external world – employers, market – dictate the needs and demands for education, hence its influence on the higher educational system, which responds to these, supplying learners with the ordered qualities, knowledge and skills which are forged by means of various academic disciplines and courses. Needs and demands of individuals are formed under the needs and demands of the competitive global marketplace and the job market – the society – the system which guarantees its citizens the main rights for education and employment.

Keywords: *professional communicative competences, English teaching, European identity*

1. Plugging the Language into the European Society

The responsibility of contemporary educational providers is to yield to the new imperative of interdisciplinary connectedness of knowledge and skills, to work out educational modules which are in compliance with the tasks and demands of employers, particular businesses and the European job market. Integration of the European society very much depends on what instruments we will apply to promote the unity of science through improving the communication among young specialists to enhance cooperation and co-creation of a unified sustainable society. Integrated trans-disciplinary module cycles aim to ensure learning and assessment on the basis of the System approach so that individuals could understand and be given the competency, creativity and confidence to cope with the urgent professional tasks and changes, problem-solving and situation-specific reactions not only within the European society but also globally.

Information Systems Management University (ISMU), accredited by Education USA TC as an authorized testing language centre of Test of English for International Communication (TOEIC) in Riga (Latvia), has a certain experience in developing such interdisciplinary modules, as well as, in quantitative analysis of the testing results of the TOEIC modular sections within the framework of Business English, when educational language environment serves as the basis for trans-disciplinary cooperation in Management and Information Technologies [2, 3, 10]. On the basis of the System approach the authors have worked out the criteria and quantitative indices of interim and final results of students' achievement in the target language acquisition in the course of trans-disciplinary modular learning. Using these data the authors have calculated and worked out the Learning Curve for the TOEIC test at Information Systems Management University, reflecting the necessary time and content modules to achieve higher levels of language proficiency.

2. The System Approach in Developing Language Communicative Competence

The General System Theory (GST) developed by Ludwig von Bertalanffy in 1940s [4] gives primacy to interrelationships, emphasizing shifts from constituent parts to the organization of parts. It is from these dynamically managed communicative interrelationships that new properties of a learning system (a group of learners) emerge [3]. An example is the properties of these letters which, when put in order, can give rise to meaning which does not exist in the letters by themselves. This further explains the integration of tools, like language, that helps create a vibrant and innovative competence-based educational system – a system where students develop high-level competences, which include initiative, leadership, managerial ability, and the ability to communicate effectively.

The System Approach ideally serves language acquisition – developing language communicative competence – since it views a language user primarily as a 'social agent', i.e. a member of society who has tasks to accomplish in particular circumstances, in a specific environment. The GST, in its integrative role, brings together principles and concepts from general human competences (knowledge of the world, socio-cultural knowledge) with a more specifically language-related communicative competence (linguistic, socio-linguistic, pragmatic competences). Still, communication can not be about nothing. In its trans-disciplinary function it encompasses a lot of domains – historical, geographical, social, political, economic, cultural, environmental, and many others, demanding a certain amount of knowledge and awareness. In our case, the English language is the instrument for developing socio-cultural and occupational competences in international tourism, business, and management and computer technologies.

3. English for International Communication in the European Speech Community

Any education begins with the language. In the process of integration and citizenship education in Europe, our main aim as educational providers is to ensure every individual the ability to use English for international communication to guarantee everyone his share in the stakeholder involvement – education and employment in that country which one has consciously chosen to identify with the future profession or interest (sports clubs or societies for protecting environment) and not obligatory in the country that they themselves have not chosen to belong, depending on the place of birth and parents. Such multiple possibilities enhance the sense of European identity.

For English language educators the most problematic aspect of defining English as an international language remains the notion of competence for EIL. It is clearly inappropriate to teach language that is only applicable in limited situations in a target culture that may never be visited by students. It is obvious that what makes 'appropriateness' in international communication cannot be defined in terms of a single speech community. Still, there is no a European speech community so far. In this early stage of the development of our European speech community, it is clear that there has to be an agreed body of standard international English to be learnt or taught for competent European communication. The notion of 'communicative language competence' has to be re-considered for the teaching of English for international communication. It cannot be reduced to a single, limited, mono-cultural concept.

'International' communication seems to require a set of interdependent competences that reinforce each other – linguistic competences (include lexical, phonological, syntactical knowledge and skills) sociolinguistic competences (refer to the socio-cultural conditions of language use, especially between representatives of different cultures – rules of politeness, norms governing relations between generations, sexes, classes and social groups, certain fundamental rituals in a community) and pragmatic competences (focus on achieving mutual understanding – intelligibility in spoken or written texts, concerning, as well, the mastery of discourse, cohesion and coherence, irony and parody) [5]. Strategic competence is also highlighted as an important component of 'communicative competence' [6, 7].

4. The System Approach in Piloting the TOEIC Test for European Workplace

From the point of view of language teaching-learning and in the persistence of chronic lack of fixed norms of a standard EIL, the internationally recognized TOEIC test proves to be a good example of the System approach to language acquisition, since the test helps to define the competences on seven parameters required for a variety of types of work and to measure these competences effectively and fairly applying state-of-the-art assessment systems that meet professional testing standards. On the basis of the System approach the authors have worked out the criteria and quantitative indices of interim and final results of students' achievement in the target language acquisition in the course of trans-disciplinary modular learning. An empirical study was used to analyse the results of the English language Olympiad at Information Systems Management University (Latvia), where twenty-nine learners were offered the materials worked out on the basis of the TOEIC test – a two-hour, multiple-choice test that consisted of 200 questions divided into two separately timed sections – Listening and Reading [8].

We got the results on seven types of task corresponding to certain communicative language competences and compared them with each other.

1. Phonological-Associative Competence. Involves skills in the perception of the sound units and their realization in particular context.
2. Micro-Functional Competence. Knowledge of and ability to use the spoken discourse and written texts in communication for particular functional purposes.
3. Pragmatic-Discourse Competence. Listening comprehension of authentic spoken English.
4. Functional-Propositional Competence. Authentic examples of spoken English from workplace, travel and leisure situations. They vary in level of formality and include announcements, short speeches, and advertisements.

5. Lexical-Semantic Competence. Knowledge of and ability to use the vocabulary of the language and grammatical forms (of words and sentences).
6. Grammatical Competence. Knowledge of and ability to assemble language elements into meaningful messages and sentences using grammatical recourses.
7. Pragmatic-Design Competence. Knowledge of and ability to control the ordering of sentences. Knowledge of design conventions, how information is structured, how written texts (formal letters, memos, advertisements, faxes, invitations, notices, schedules, e-mails etc) are laid out, signposted and sequenced.

5. Main Characteristics, Indices and Descriptors for Managing the Levels of Knowledge

We have introduced a set of key indices such as:

$$IC = \frac{n_p}{n} - \tag{1}$$

the Index of Competence, where n_p is the number of the correct answers, n is the total number of the test questions;

$$IOC_i = \frac{\sum_{j=1}^{m} IC_i^j n_j}{\sum_{j=1}^{m} n_j} - \tag{2}$$

the Index of Overall Competence, where ***i –*** is a student index, ***j*** – is the test part index, ***m*** – is the total number of the tested competences (***m*** = 7, in our case), n_j is the total number of questions in the test part, then

$$n = \sum_{j=1}^{m} n_j \tag{3}$$

is the total number of the test questions, and

$$AS_j = \frac{\sum_{i=1}^{N} IC_i^j}{n_j} \tag{4}$$

is the average score of a particular test part, N – is the number of students involved,

$$SD_j = \sqrt{\frac{\sum_{i=1}^{N} (IC_i^j - AS_j)^2}{n_j}} \tag{5}$$

is the corresponding standard deviation of a test part results,

$$MIC_j = \frac{AS_j}{n_j} \tag{6}$$

is the mean index of competence of a corresponding test part *j*,

$$RI_j = \frac{SD_j}{AS_j} \tag{7}$$

is the risk index of a test part, which characterizes the degree of reliability on the average score AS_j. This also means that the higher RI_j the lower is the level of homogeneity of results in a tested group.

The results on seven parameters allowed us to make measurement scales showing each student's level of competence and compare students with each other, as well as, to compare the levels of competences with each other. However, the format restrictions of this paper do not permit us to illustrate all the results obtained. The purpose of this paper is to let you know what we are doing and give you a global impression of the students' achievements and the ways of coordinating the educational process.

We calculated the average score of the group's task performance – *AS*. It gave us the possibility to define the mean index of communicative language competence – *MIC* (the ratio of the average score to the number of tasks). This is a very important parameter since it reflects not only how successfully students managed to cope with the task, but also the level of their competence in a particular language area. On the one hand, the average scores (*AS*) might demonstrate the level of the group's particular language competence. On the other hand, the AS on its own can not be considered as totally objective since it does not reflect the scope of results dispersion in the group, which might result in neglecting weaker students in the educational process. This would turn up a major pedagogical and methodical mistake. To get the objective evaluation, it is vital to take into consideration the standard deviation – SD. If the index of the standard deviation is reasonably low, the homogeneity of results in the group is sufficiently high. Our pedagogical and methodical objective is to secure the decrease of the results deviation – *SD* – and the increase of the average score – *AS*, demonstrating the students' group performance.

Therefore, to control the quality of student achievement and verify the dynamics of its progress, another component – risk index – *RI* – has been introduced (a ratio of the standard deviation to the average score – *SD/AS*), which demonstrates the degree of confidence in the average score – to what extent this figure is objective and reliable. If *RI* is relatively low, approaching → 0, it means that the level of mistakes dispersion is rather low and the average score might be quite high and reliable. Thus, relying only on the average score might lead to tough pedagogical mistakes, which, in fact, constitute risk. It might turn out that half of the group showed very good results and another half demonstrated rather low results, but the average score appeared to be quite satisfying. Therefore, if test results in a group are approximately homogeneous, risk function – *RI* – will be relatively low, which presupposes that the average score might be considered quite objective, worth confidence and the applied teaching methods work efficiently.

Table 1. Empirical results of TOEIC test

Variant (or student) number	**Phological-Associative Competence, 20 items**	**(Micro) Functional Competence, 30 items**	**Pragmatic-Discourse Competences, 30 items**	**(Macro) Functional-Propositional Competence, 20 items**	**Lexical-Semantic Competence, 40 items**	**Grammatical Competence, 20 items**	**Pragmatic-Discourse Competences, 40 items**
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	18	26	29	16	25	13	17
2	14	21	28	11	28	8	17
3	18	21	20	12	22	9	21
4	19	26	17	15	29	9	18
5	19	21	25	13	26	8	19
6	16	20	10	11	24	8	19
7	20	30	29	19	36	18	40
8	19	30	29	20	35	17	37
9	19	29	27	16	33	19	37
10	17	29	25	19	35	17	36
11	18	29	25	17	29	16	34
12	14	18	14	9	25	7	17
13	5	18	10	10	17	8	7
14	13	16	8	13	21	11	14
15	18	30	24	17	30	15	25
16	14	21	23	10	23	12	19
17	18	27	28	17	28	12	31
18	17	29	20	14	28	14	24
19	18	29	23	18	27	13	25
20	9	13	7	6	7	3	15
21	16	24	9	10	27	7	11
22	17	20	18	9	23	6	5
23	11	14	12	10	4	7	12
24	13	21	22	13	20	7	9
25	20	28	24	18	34	11	35
26	16	27	30	19	31	16	32
27	19	27	25	14	29	15	25
28	15	20	15	9	27	13	18
29	16	22	16	7	23	14	23
	16,099	**23, 5862**	**20, 4138**	**13, 5172**	**25, 7241**	**11,5**	**22, 1379**

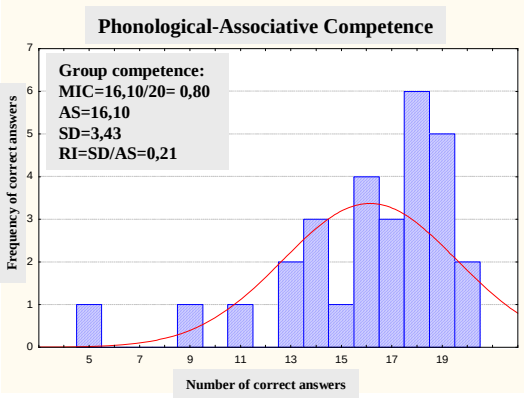

Figure 1. Phonological-Associative Competence: Answers Distribution Density in comparison with the normal density distribution function

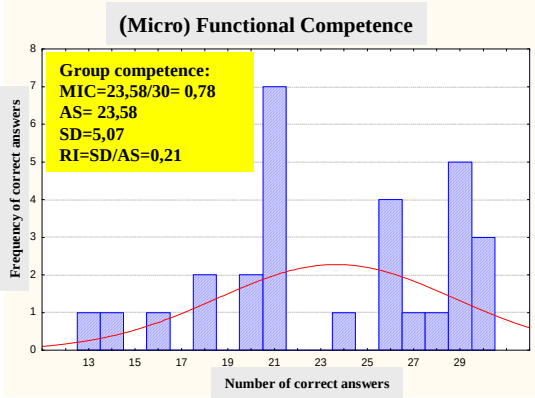

Figure 2. Micro Functional Competence: Answers Distribution Density in comparison with the normal density distribution function

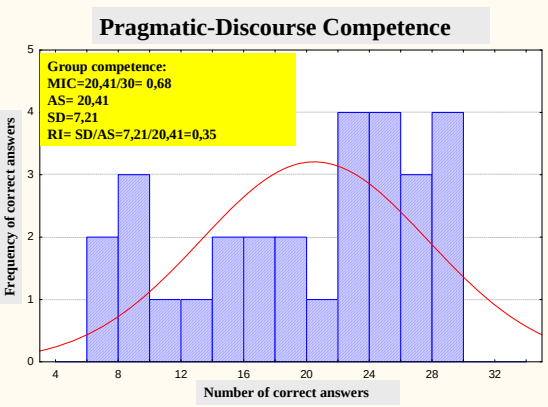

Figure 3. Pragmatic-Discourse Competence: Answers Distribution Density in comparison with the normal density distribution function

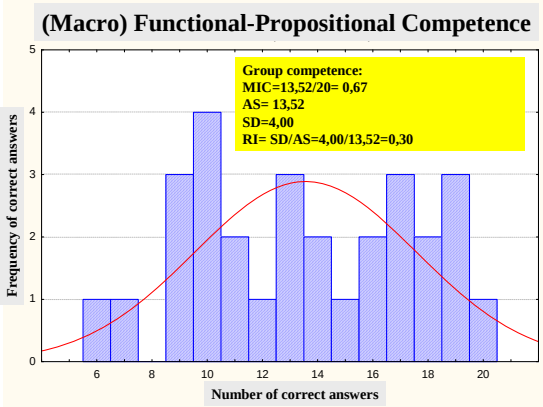

Figure 4. Macro Functional-Propositional Competence: Answers Distribution Density in comparison with the normal density distribution function

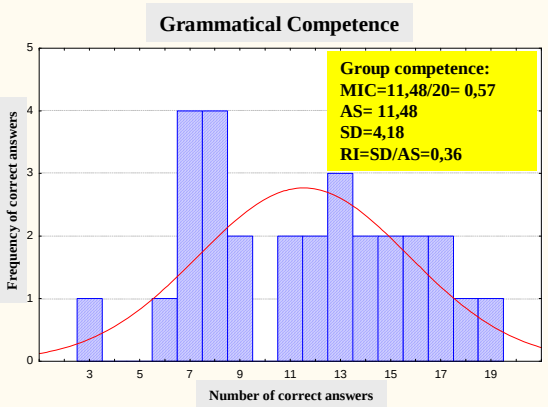

Figure 5. Grammatical Competence: Answers Distribution Density in comparison with the normal density distribution function

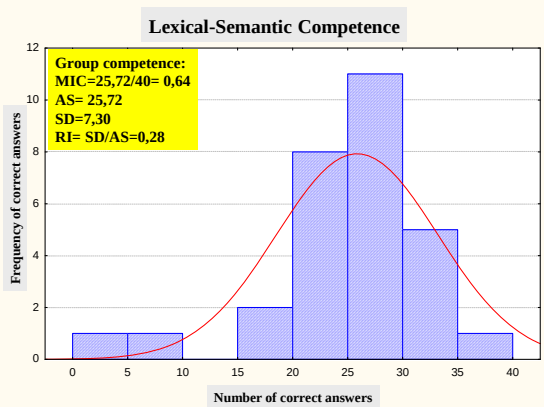

Figure 6. Lexical-Semantic Competence: Answers Distribution Density in comparison with the normal density distribution function

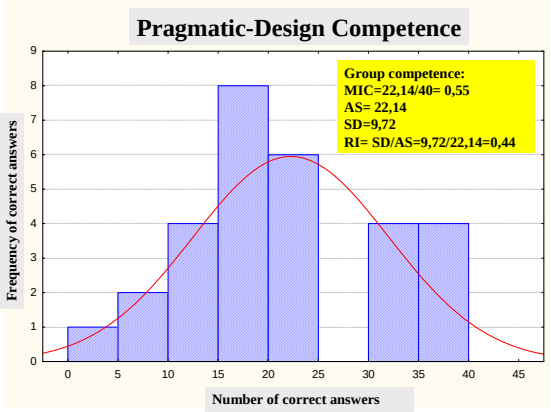

Figure 7. Pragmatic-Design Competence: Answers Distribution Density in comparison with the normal density distribution function

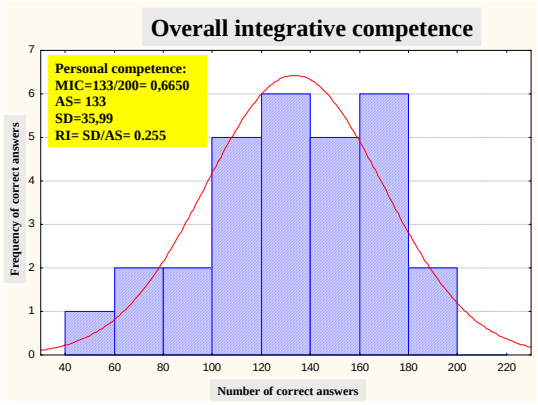

Figure 8. Overall Integrated Competence: Answers Distribution Density in comparison with the normal density distribution function

To teach groups with a high risk coefficient and a small risk coefficient demands different methods, otherwise more successful students will move rapidly forward in language acquisition, while weaker students might fall out of the process due to inability to succeed in coping with high-level tasks. As an example, the bar graph above shows the Phonological-Associative Competence: Answers Distribution Density in comparison with the normal density distribution function. The total number of tasks is 20, the mean index of competence MIC = 0,80 (80%), the average score AS = 16,10, the standard deviation SD = 3,43 and the risk index RI = 0,21 (see Fig. 1).

If we consider that the given set of answers has a normal distribution, we see the graph where most of the answers are close to the average index – AS. SD shows how the answers are distributed in relation to the AS. We know that about 68% of answers are found within one SD and about 95% within two SDs. Thus, knowing the average index – AS, we can interpret individual results. Analogically, the graphs were drawn corresponding to the rest six competences. They showed different levels of students' competences, but more importantly, they demonstrated different degrees of mistakes dispersion – SD. The most problematic competences appeared to be the 4th – *Functional-Propositional Competence*, the 6th – *Grammatical Competence* and the 7th – *Pragmatic-Design Competence*. The analysis of the obtained data helped the authors to work out educational modules with a special emphasis on problematic areas (e.g. modal verbs, conditional sentences, phrasal verbs, prepositions).

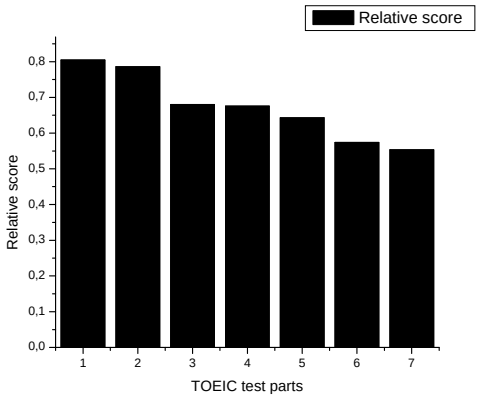

Figure 9. Overall communicative competences

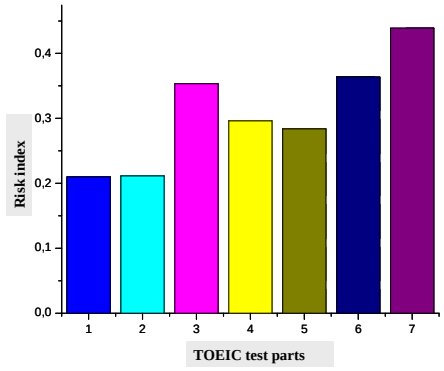

Figure 10. Risk index via type of competence

Fig. 9 shows overall communicative competences demonstrated by the students involved. We can observe a strong tendency to decreasing towards the reading tasks. The results for Listening Comprehension are better than for Reading English. About 73% of the spoken questions have been solved by more than 80% of the students. Understanding written English is more difficult: the main part of the questions has been solved by 40%–50% of the students. There might be possible objective and subjective

reasons for the situation observed. Most of the time during the classes is spent regularly on exercises for listening spoken English and speaking it. 95% of instruction is given in English. In addition, lots of Latvian students listen to music, watch TV channels, especially musical ones, in English. They often are highly motivated to understand those messages. Understanding written English is given less attention.

Fig. 10 shows the risk index in connection with the tested type of competence.

Fig. 11 shows the upper descending line of the group Competence Index and the lower ascending line of the Risk Index. It can vividly assure us that with the decrease of the AS and MIC, the risk index – RI increases, revealing no trust in the AS. Fig. 3 shows the total competence values for the tested group where the MIC index is less than 70% which does not correspond to the predetermined goal (80%–90%) and the RI is more than 20% (paying attention to Pareto's principle). This is an alarming signal which demands a critical analysis of the adequacy of the materials, the methods of teaching, and other components of the educational process. At the same time, the main problem area mentioned concerns the link between the English classes in the secondary school and higher educational institutions. Most Latvian university teachers feel that the knowledge that students gain at secondary school is not sufficient for a higher educational institution. Students come from different regions of the country from schools which are sometimes very poorly equipped, where there are almost no special teachers of English and lots of teachers have had no special training in teaching English.

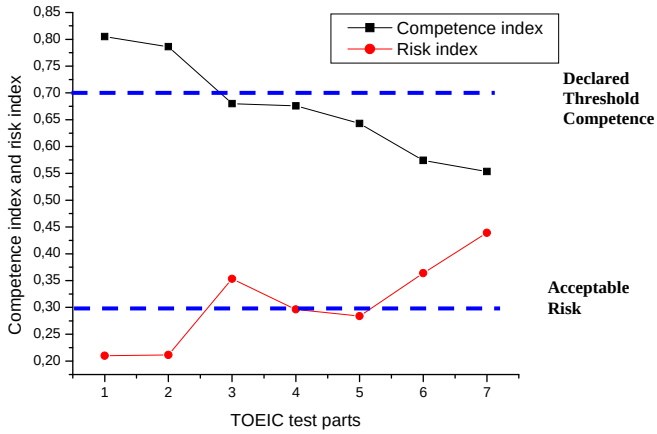

Figure 11. Comparison of Competence Index and Risk Index for different TOEIC test parts

6. Learning Curve Model for the TOEIC Test

The suggested Learning Curve Model which has been worked out by the authors at ISMU for the TOEIC test is acceptable and applicable for a variety of domains to control and manage the development of any professional qualities and competences using the Index of Competence [9]. Fig. 12 shows the model of competence augmentation via modular trans-disciplinary cycles where educational language environment serves as the basis for developing and mastering occupational competences in international tourism, management and information technologies. It presupposes a sequence of study activities – *1) teaching thinking strategies using background knowledge, 2) practical implementation of strategies within various disciplines, 3) generating new cognitive strategies for new circumstances*. Thus, the model of competence development involves **Knowledge + Skills + Experience + Attitudes = Competence**

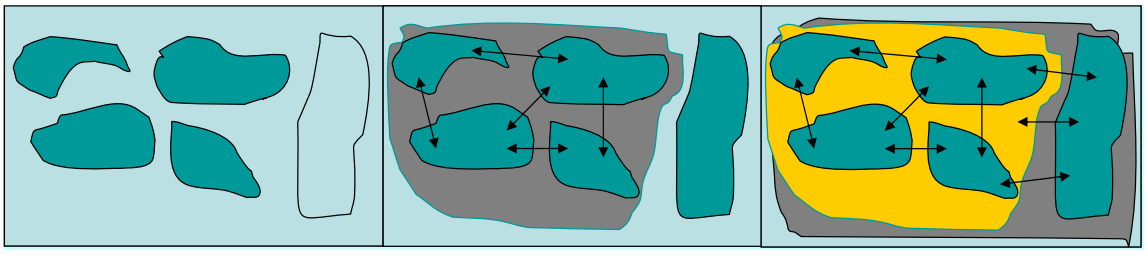

Figure 12. Competence augmentation via modular trans-disciplinary cycles

Competence-Oriented Modular Program for Autonomous Students (COMPAS) has been worked out at ISMU. The program encompasses a wide spectrum of skills and forms of activities, including general skills of problem-solving, reading strategies, the strategies of test writing, creating a positive mood, as well as, general meta-cognitive strategies – as monitoring the acquired knowledge. The intermediate aim of the program is to help students become autonomous learners, able to control and coordinate their own cognitive resources and forms of activities and develop their affective resources.

Modular cycles include three stages:

1. The first stage – **assimilation** (a reaction to educational information on the basis of the existing language experience) – is devoted to teaching thinking strategies. The main elements include:
   - *Motivation*: since to process a great amount of information, a student has to be initially predisposed to the process.
   - *Modelling of strategies*: scanning, skimming, highlighting and underlining the texts, decoding sound messages.
   - *Ensuring memorizing and practical exercises with feedback*: associative thinking, logical hooks to internalise new vocabulary, idioms, terminology, grammar structures.
   - *Evaluation of the material acquisition*.

The aim of this stage is 'meta-cognitive empowerment' of students.

2. The second stage – **accommodation** (changes in mental structures in reaction to the received experience) – implies practical implementation of strategies, the ability to evaluate their efficiency as well as to adopt and apply in different new situations within various disciplines (subject areas) – transference learning.

3. The third stage – **adaptation** (understanding what to do with the acquired knowledge to make them suitable for new needs) – presupposes generating of new cognitive strategies, transformation and modification of knowledge on the basis of the received experience in the context of trans-disciplinary integrated systems thinking. The process is controlled and managed mostly by students themselves. The method is – cooperation.

Every stage comprises ten educational modules of six hours each. Each module begins with the section *Focus In*, which introduces the topic and allows using your background knowledge. Next is *Listen/Read* section which uses new professional vocabulary, idioms, business terminology, and grammatical structures in the context of a story or dialogue. Then *Clarify* comes, a multiple-choice quiz which focuses on the meaning. After that, *Follow IT UP* section – an individual resource page for every vocabulary item (terminology, phrasal verbs, idioms or grammatical structures). And finally, *Your Turn* section which provides practice with all the material in context where you have the opportunity to write original messages with what you have learned or/and use it in conversations, discussions arranged in a pleasing atmosphere of practical business games.

To control the dynamics of communicative competence development, the authors have worked out the Learning Curve model:

$$C(t) = C_0 + (1 - C_0)(1 - \exp(-\lambda t)) \ , \qquad (8)$$

which encompasses the initial level of a relative competence C_0, the rate of the learning progress λ, as well as, permits to define the characteristic time necessary for the achievement of a target competence level $\frac{1}{\lambda}$. Thus, if we know the initial level of a competence and the characteristic rate of the learning progress (according to the model), we can define the necessary time to attain the target (predetermined) level of competence (see Fig. 15).

6.1. Learning Curve Analysis

The authors have worked out a typical, chronologically applicable set of educational modules, including methodical materials, which allow to start the educational process at any level of competence, as well as, to control the interim results and the quality of student achievement after each module to guarantee each learner tangible, efficient results in language acquisition.

Table 2. Learning Curve Model for Initial Competence (see also Fig. 13)

Study Time, t	0	2	4	6	8	10	12	14	16	18	20
Competence Level, C(t)	0,3	0,4	0,5	0,6	0,65	0,71	0,77	0,79	0,82	0,83	0,87

Taking into account the Learning Curve Model basic formula (8) it is reasonable to give an interpretation of some characteristics, namely, $C(t)$ is a purposeful, pre-determined competence, C_0 is the initial competence, $(1-C_0)$ is the lack of competence to be overcome, $(1-\exp(-\lambda t))$ is the cumulative character factor of incompetence liquidation.
Thus, the calculation of λ looks as follows:

$$\frac{1-C(t)}{1-C_0}=\exp(-\lambda t),\ \ln\left(\frac{1-C_0}{1-C(t)}\right)=\lambda t,\ \ln(1-C(t))=\ln(1-C_0)-\lambda t,$$

$$\lambda=\frac{1}{t_\infty-t_0}\ln\left(\frac{1-C_0}{1-C_\infty}\right)=\frac{0{,}81-(-0{,}85)}{20-0}=\frac{1{,}66}{20}=0{,}083\ .$$ See also Fig. 14.

The calculation of the characteristic time τ for competence acquisition gives: $\tau=\frac{1}{\lambda}=\frac{1}{0{,}083}=12{,}04$ time units.

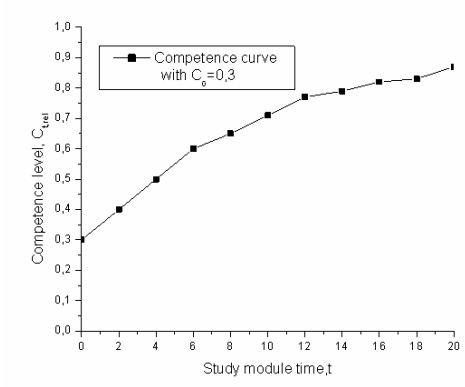

Figure 13. Empirical competence curve for initial competence C_0=0.3

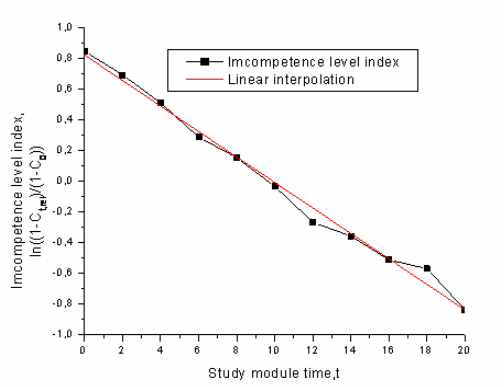

Figure 14. Evaluation of the characteristic study rate λ

Fig. 15 demonstrates professional competence augmentation with different initial conditions, namely, $C_0=0.3$ and $C_0=0.5$, taking into account a desirable conventional competence 0.8. Figure allows estimating the difference of the study time (approx. 5 time units).

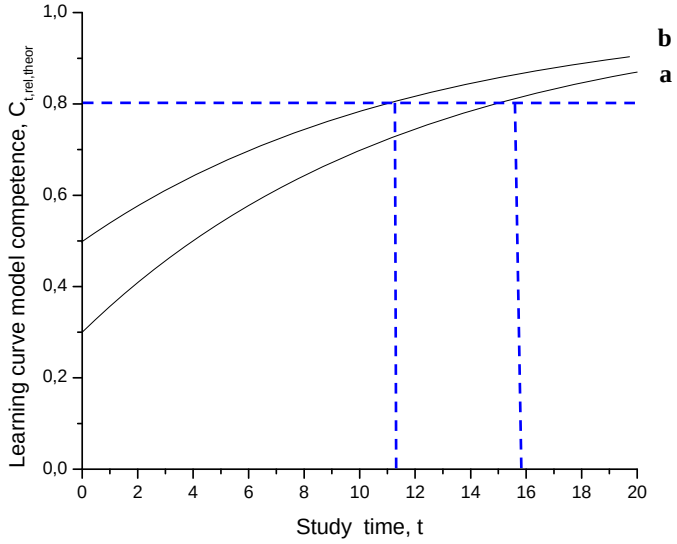

Figure 15. The typical Learning Curves based on the data of educational experiment. The initial levels of a relative competence C_0=0,3 (a); C_0=0,5 (b); the rate of the learning progress λ=0,084 (experiment); a characteristic time for the target level attainment ~ 12

Conclusions

The comprehensive System approach to language acquisition not only provides a scaling of overall language proficiency in a target language in the course of trans-disciplinary modular learning, but also a breakdown of language use and language competences which makes it easier to specify objectives and describe achievements of the most diverse kinds in accordance with the varying needs, characteristics, resources of learners and demands of the European job market.

The quantitative indices worked out by the authors on the basis of the System approach allow controlling the quality of student achievement. The Learning Curve model gives the possibility to coordinate the dynamics of communicative competence development helping students become skilful manipulators, synthesizers and creators of knowledge.

A language is part of the identity of anyone who is able to use it and the level of competence reveals the degree of this 'sameness'. The new paradigm of the European society brings to the agenda the new paradigm of language education. This new paradigm envisages that language teachers become pluri-cultural mediators promoting constructive solutions to overcoming the barriers to effective communication among young professionals on the way of co-creating a successful and functioning model for harmonious integration and common European identity.

The new paradigm of the European society brings to the agenda the new paradigm of language education. This new paradigm envisages that language teachers become pluri-cultural, trans-disciplinary mediators promoting constructive solutions to overcoming the barriers to communication among young professionals arising from the different cultural backgrounds in Europe.

The comprehensive System approach to language acquisition not only provides a scaling of overall language proficiency in a target language, but also a breakdown of language use and language competences, which makes it easier to specify objectives and describe achievements of the most diverse kinds in accordance with the varying needs, characteristics and resources of learners.

The quantitative indices worked out by the authors on the basis of the System approach allow to dynamically manage and control the quality of student achievement and give the possibility to coordinate the progress of communicative competences development helping students become skilful manipulators, synthesizers and creators of knowledge.

The Learning Curve reflects not only the current level of student achievement, but also the purposeful level of attainment which can be achieved. It is a dynamic view on the potential of learning, a certain 'cognitive map' of a learner, aiming to develop the general intellectual level and a wide spectrum of communicative competences via trans-disciplinary modules.

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CUMULATIVE INDEX

COMPUTER MODELLING and NEW TECHNOLOGIES, volume 11, No. 2, 2007

(Abstracts)

Yu.-R. Kalninsh, V. Bardacenko. Fluctuations and Control in Management, *Computer Modelling and New Technologies*, vol. 11, No 2, 2007, pp. 7-17.

Goldratt's Game for the simulation purpose in the management course is presented in two different visual forms (Vensim and Excel). The first model is clearly controllable and attractive for classroom. The second one is carefully investigated under the several control rules.

Keywords: s*imulation, fluctuations, control, chain*

V. N. Kuzovkov, O. Dumbrajs. Bounded Tokamap: a Hamiltonian Map for Magnetic Field Lines in a Tokamak, *Computer Modelling and New Technologies*, vol. 11, No 2, 2007, pp. 18-22.

A Hamiltonian map is constructed like this in which both the polar axis and the boundary of the plasma cannot be crossed upon iteration. Phase portraits of the new map are quite different comparing with tokamap phase portraits. It is found that differences in the predictions of the tokamap and bounded tokamap might become significant in those cases when processes at plasma periphery are studied.

Keywords: *Hamiltonian map, chaos, computer simulations*

G. Sh. Tsitsiashvili. Narrow Places in General Logical Systems with Unreliable Elements, *Computer Modelling and New Technologies*, vol. 11, No 2, 2007, pp. 23-27.

In this paper models of logical systems with unreliable elements are considered. Definitions of narrow places in these systems are made. The paper is based on asymptotic analysis of a work probability of logical systems in appropriate asymptotic conditions for the work probability of their elements. All main definitions and algorithms are based on the concepts of the disjunctive normal form and conjunctive normal form of a logical function. In this paper a case of low reliable elements, a case of high reliable elements and their mixture are considered.

Keywords: *logical function, unreliable element, normal form*

N. Batarlienė, A. Baublys. Mobile Decisions of Transport and Public Information, *Computer Modelling and New Technologies*, vol. 11, No 2, 2007, pp. 28-35.

The newly developed remote identification systems for: 1) transport facilities and goods, and 2) passenger transport are presented.

Keywords: *transport means, goods, passenger, GSM*

A. E. Kiv, Ye. P. Sedov, N. V. Yablonskaya, M. V. Yakovleva. Teaching Unification of Humanitarian Disciplines in the Light of Bologna Process, *Computer Modelling and New Technologies*, vol. 11, No 2, 2007, pp. 36-38.

According to Bologna agreements, the educational systems of all European countries have to correspond to a single standard. The certificates of different universities will gain general acceptance. At the same time, this will lead to a mutual understanding of specialists that have graduated from different countries. Their joint work will provide a more stable and happier life for humanity. In this paper one of the possible ways for unification of teaching in the light of the Bologna process is proposed and discussed. It shows that the inclusion of elements of formal description of the main theoretical propositions in particular with the teaching programs of humanitarian disciplines will lead to significant unification of teaching and improvement of teaching programs.

Keywords: Bologna agreements, unification of teaching

Yu. Shunin, T. Lobanova. Learning Curve Model for Professional Competences Development, *Computer Modelling and New Technologies*, vol. 11, No 2, 2007, pp. 39-48.

Complex historical processes have generated national identities conditioned by sharing a common language, traditions, ethnic roots and often religion. Historical processes going on at present are generating a new identity – European identity, which is possible only on the grounds of sharing common characteristics – the language, in the first place, as a means of communication and cooperation. Language is not only a major aspect of culture, but also a means of access to different cultural manifestations; it is an imperative arising out of the needs, ties and interrelationships of people entering the "interdependence age" within a new space – the integrated European society. The status of English as a 'Language for International Communication' is no longer in dispute and rarely attracts the kind of critical scrutiny. Unfortunately, talking about citizenship and European identity, we often ignore the fact that not all the European citizens are English-speaking people. Consequently, in developing European identity, serving educational message and teaching English in particular, is a form of stakeholder involvement [1]. Pragmatic external world – employers, market – dictate the needs and demands for education, hence its influence on the higher educational system, which responds to these, supplying learners with the ordered qualities, knowledge and skills which are forged by means of various academic disciplines and courses. Needs and demands of individuals are formed under the needs and demands of the competitive global marketplace and the job market – the society – the system which guarantees its citizens the main rights for education and employment.

Keywords: professional communicative competences, English teaching, European identity

COMPUTER MODELLING and NEW TECHNOLOGIES, 11.sējums, Nr.2, 2007

(Anotācijas)

Yu.-R. Kalninsh, V. Bardacenko. Svārstības un kontrole menedžmentā, *Computer Modelling and New Technologies,* 11.sēj., Nr.2, 2007, 7.–17. lpp.

Goldrata simulācijas spēles nolūks menedžmenta kursā tiek piedāvāts divos dažādos vizuālos veidos (Vensim un Excel). Pirmais modelis ir pilnīgi kontrolējams un piemērots klasē. Otrais tiek rūpīgi izpētīts ar vairāku kontroles likumu palīdzību.

Atslēgvārdi: modelēšana, svārstības, kontrole, ķēde

V. N. Kuzovkov, O. Dumbrajs. Ierobežots *tokamap*: hamiltona karte magn; ētiskā lauka līnijām *tokamak* vidē, *Computer Modelling and New Technologies,* 11.sēj., Nr.2, 2007, 18.–22. lpp.

Hamiltona karte tiek uzbūvēta sekojoši: abas polārās asis un plazmas robeža nevar šķērsot viens otru iterācijas rezultātā. Jaunās kartes fāzes izskats ir pilnīgi atšķirīgs salīdzinot ar *tokamap* fāzes izskatu. Ir noteikts, ka atšķirības starp *tokamap* un ierobežotas *tokamap* prognozēm var kļūt svarīgas tikai tajos gadījumos, kas tiek pētīti procesi plazmas perifērijā.

Atslēgvārdi: Hamiltona karte, haoss, kompjūtermodelēšana

G. Sh. Tsitsiashvili. Šaurās vietas vispārējās loģiskās sistēmās ar nedrošiem elementiem, *Computer Modelling and New Technologies,* 11.sēj., Nr.2, 2007, 23.–27. lpp.

Autors šajā rakstā izskata loģiskās sistēmas modeļus ar nedrošiem elementiem. Tiek izveidotas šo sistēmu šauro vietu definīcijas. Rakstā autors pamatojas uz loģisko sistēmu atbilstošos asimptotiskos apstākļos darba varbūtību asimptotisko analīzi, kas paredzēts to elementu darba varbūtībai. Visas galvenās definīcijas un algoritmi tiek pamatotas uz konceptiem par loģiskās funkcijas disjunktīvo normālo formu un konjunktīvo normālo formu. Šajā rakstā autors izskata zemi nedrošu elementu un augsti nedrošu elementu gadījumus, kā arī to sajaukuma gadījumus.

Atslēgvārdi: loģiskā funkcija, nedrošs elements, normālā forma

N. Batarlienė, A. Baublys. Transporta un publiskas informācijas mobilie lēmumi, *Computer Modelling and New Technologies,* 11.sēj., Nr.2, 2007, 28.–35. lpp.

Darbā tiek parādītas nesen izstrādātās attālās identifikācijas sistēmas: 1) transportam un precēm; 2) pasažieru transportam.

Atslēgvārdi: transporta līdzekļi, pasažieri, GSM (globālā mobilā sistēma)

A. E. Kiv, Ye. P. Sedov, N. V. Yablonskaya, M. V. Yakovleva. Humanitāro disciplīnu apmācības unificēšana saskaņā ar boloņas procesu, *Computer Modelling and New Technologies,* 11.sēj., Nr.2, 2007, 36.–38. lpp.

Saskaņā ar Boloņas vienošanās visu Eiropas valstu izglītības sistēmai jāatbilst vienotam standartam. Dažādu universitāšu sertifikāti iegūs vispārēju akceptu. Tanī pašā laikā tas radīs speciālistu savstarpējo sapratni, kuri ir absolvējuši dažādās valstīs. Viņu vienotais darbs nodrošinās stabilu un laimīgāku dzīvi cilvēcei.

Rakstā autori piedāvā vienu no iespējamiem unificēšanas veidiem saskaņā ar Boloņas procesu, kā arī sniedz par to izvērstu diskusiju.

Atslēgvārdi: Boloņas vienošanās, apmācību unificēšana

Yu. Shunin, T. Lobanova. Līknes modeļa izpēte kompetenču profesionālās attīstības nolūkā, *Computer Modelling and New Technologies,* 11.sēj., Nr.2, 2007, 39.–48. lpp.

Sarežģītie vēstures procesi ir veidojuši nacionālās identitātes ar kopīgas valodas, tradīcijām, etniskām saknēm un bieži vien arī ar reliģijas palīdzību. Vēsturiskie procesi šobrīd veido jaunu identitāti – eiropeisko identitāti, kura ir iespējama tikai, pamatojoties uz kopīgiem raksturojumiem,

i.e. pirmām kārtām, valodu, kā līdzekli savstarpējai komunikācijai un saziņai. Valoda nav pats galvenais kultūras aspekts, bet ir kā līdzeklis dažādu kultūras izpausmju pieejai.

Angļu valodas statuss – valoda starptautiskai komunikācijai – vairs nav diskutējams jautājums. Runājot par eiropeisko identitāti, mēs sastopamies ar tādu īpatnību, ka Eiropā daudzas tautas nerunā angliski. Līdz ar to rodas nepieciešamība mācīties angļu valodu, lai attīstītu eiropeisko identitāti. Indivīdu vajadzības un prasības veido kompetentā globālā tirgus un darba tirgus vajadzības un prasības, resp. sabiedrība, sistēma, kas garantē to pilsoņiem galvenās tiesības uz izglītību un darbu.

Atslēgvārdi: profesionālās komunikatīvās kompetences, angļu valodas apmācība, eiropeiskā identitāte

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*Book***:** author, title (in Italics), location of publishers, publishers, year
Example: 2. Kayston M. and Fried W. R. *Avionic Navigation Systems.* New York: John Wiley and Sons Inc, 1969.

Conference Proceedings: author; title of an article; proceedings (in italics); title of a conference, date and place of a conference; publishing house, year, pages.
Example: 3. Canales Romero J. A First Step to Consolidate the European Association of Aerospace Students in Latvia (Presented by the Munich Local Group). In: *Research and Technology – Step into the Future: Programme and Abstracts. Research and Academic Conference, Riga, Latvia, April 7–11, 2003, Transport and Telecommunication Institute.* Riga: TTI, 2003, p. 20.

19. ***Authors Index***
Editors form the author's index of a whole Volume. Thus, all contributors are expected to present personal colour photos with the short information on the education, scientific titles and activities.
20. ***Acknowledgements***
Acknowledgements (if present) mention some specialists, grants and foundations connected with the presented paper. The first page of the contribution should start on page 1 (right-hand, upper, without computer page numbering). Please paginate the contributions, in the order in which they are to be published. Use simple pencil only.
21. **Articles poorly produced or incorrectly formatted may not be included in the proceedings**.

TSI

The K. Kordonsky Charitable Foundation

The 8th International Conference

RELIABILITY and STATISTICS in TRANSPORTATION and COMMUNICATION (RelStat'08)

15-18 October 2008. Riga, Latvia

PURPOSE

The purpose of the conference is to bring together academics and professionals from all over the world to discuss the themes of the conference:

- Theory and Applications of Reliability and Statistics
- Reliability and Safety of Transport Systems
- Rare Events and Risk Management
- Modelling and Simulation
- Intelligent Transport Systems
- Transport Logistics
- Education Programmes and Academic Research in Reliability and Statistics

DEDICATION

The Conference is devoted to the memory of Prof. Kh.Kordonsky.

OFFICIAL LANGUAGES

English and Russian will be the official languages of the Conference.

SUPPORTED BY:

Transport and Telecommunication Institute (Latvia) and
The K. Kordonsky Charitable Foundation (USA) in co-operation with:
Latvian Transport Development and Education Association (Latvia)
Telecommunication Association of Latvia (Latvia)
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DEADLINES AND REQUIREMENTS

Submission of abstracts:	**15 May**	**2008**
Acceptance of abstracts:	**28 May**	**2008**
Submission of final papers:	**3 July**	**2008**
Acceptance of final papers:	**4 September**	**2008**

Abstracts submitted for review should be about 600 words in length, should present a clear and concise view of the motivation of the subject, give an outline, and include information on all authors (the full name, affiliation, address, telephone number, fax number, and e-mail address of the corresponding author).

Submitted abstracts and papers will be reviewed. Accepted and invited papers will be published in the electronic proceedings of the conference and in the journal "Transport and Telecommunication".

Instruction for papers preparing can be found on the conference WWW page: RelStat.tsi.lv.

INVITED SESSIONS (workshops)

Proposals for invited sessions (workshops) within the technical scope of the conference are accepted. Each proposal should describe the theme and scope of the proposed session. The proposal must contain the title and theme of the session and a list of paper titles, names and email addresses of the corresponding authors. Session proposals and paper must be submitted by ***21 May 2008***.

REGISTRATION FEE

The registration fees will be **Euro 100** before 10 September 2008, and **Euro 150** after this date. This fee will cover the participation in the sessions, coffee breaks, daily launch, hard copy of the conference abstracts with conference proceedings on CD ROM, hard copy of the journal with papers from conference (the journals will be mailed to the delegates after the conference).

VENUE

Riga is the capital of the Republic of Latvia. Thanks to its geographical location, Riga has wonderful trade, cultural and tourist facilities. Whilst able to offer all the benefits of a modern city, Riga has preserved its historical charm. It's especially famous for its medieval part – Old Riga.

Old Riga still preserves many mute witnesses of bygone times. Its old narrow streets, historical monuments, organ music at one of the oldest organ halls in Europe attract guests of our city. In 1998 Old Riga was included into the UNESCO list of world cultural heritage.

ACCOMMODATION

A wide range of hotels will be at the disposal of participants of the conference and accompanying persons (http://eng.meeting.lv/hotels/latvia_hotels.php).

FURTHER INFORMATION

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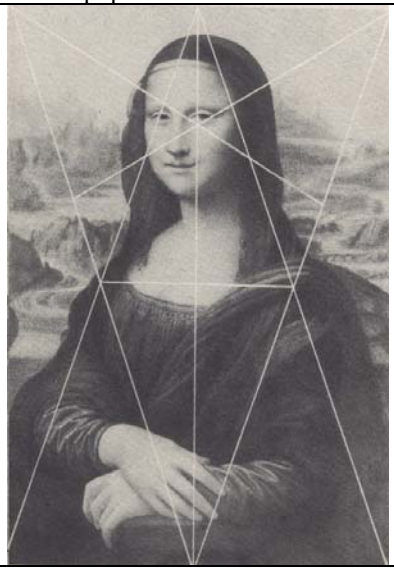

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