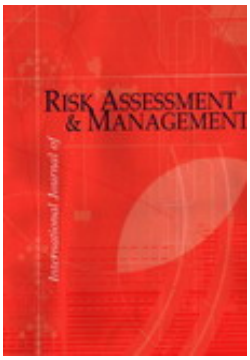

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Event-driven management of quality of economics and the state 'from below'

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Abstract: The scientific problem "Event-driven management of the quality of economics and state from 'below'" is formulated based on artificial intelligence, algebra of logic and logical-probabilistic calculus. Managing the quality of human life is represented by managing the processes of his treatment, education, decision-making. Events in these processes and the corresponding logical variables relate to the behaviour of humans, others, and infrastructure. The processes of a person's quality of life are modelled, analysed and controlled with the participation of the person himself. The paper illustrates this problem only by the examples of one government, one economics. Scenarios and structural, logical and probabilistic models for managing the quality of human life are presented. The relationship between the management of the quality of human life and the digital economics is considered.

Keywords: management 'from below'; economics; state; quality of human life; public opinion; artificial intelligence; event-driven management.

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1 Introduction

The existing theory of economics management is unsatisfactory and has no fundamental achievements. Nowadays economic management is performed without mathematical methods and models, by making amendments and regulating the situation by

'unwritten rules', by 'manual management', by the principle 'give me more money', by advice, promises and measures. We have plenty of economic institutions, committees, boards, economists and managers in government institutions. Their heads and deputy heads bear countless titles. Economics and the state are controlled 'from above' (Aganbegian, 2020; Solozhentsev, 2015a, 2017, 2019a).

Our political leaders do not consider economics a fundamental science. The educational foundation 'Talent and Success' (Sirius, Sochi), under the guidance of the President, provides training in math, computer science, physics, chemistry and biology, ignoring economics. Moscow Schools of Management 'Skolkovo' and HSE are the centers of expertise and attraction of talents, which count on Russia and activities in developing markets. Schools, institutes and management centers study the problems of various economic sectors, provide consultations and develop educational programs. In spite of creating a big infrastructure and inviting famous scientists to teach economics, the economic situation in Russia is not improving.

The problem of event-driven management as an artificial intelligence method for the quality of life processes management is considered for the first time. This is an important problem; its solution has a high theoretical and practical significance. Unlike in the existing approach in economics, we suggest quantitative control, analysis and management 'from below'. We set the problem of improving life quality based on the event-driven management of life quality of a particular person using artificial intelligence, algebra of logic and logical probabilistic calculus (LP-calculus). Life quality is represented as a logical addition of the quality of life processes. The management of the quality of life processes (medical treatment, education and decision-making) is realised with the involvement of an actual person.

We propose a new approach to economic and state management. The stories of hundreds of real people, which can be found in literature and on the internet, can be summarised by public opinion, which can induce governments to deal with unsolved problems, thus improving life quality of common people.

The proposed approach is quite general and applies to many countries. Anyone can share their personal experience of dealing with problems and provide feedback relevant for economics and state management, i.e., management 'from below'.

The proposed approach eliminates dozens of unnecessary actions and billions of roubles invested by the President and the Government. It creates a vast field of application of public opinion, which will assess and summarise the results of many personal studies and commission outstanding scientists, cultural and business luminaries to do research on life processes quality. It should also be pointed out that this approach agrees well with the goals and content of digital economics.

2 Event-driven management as a method of artificial intelligence

Event-driven management of the quality of life of a person, economics and the state is a method of artificial intelligence. Management objects – structurally complex systems, objects and processes in human life, economics and state. Event-driven management is based on artificial intelligence, Boolean algebra of logic and LP-calculus.

The cortege of the system for managing the quality of life of a person, economics and state includes the following components:

$S = \{S_1, S_2, S_3, S_4, S_5\}$ – Objects, Criteria, Knowledge, Tasks, Support. (1)

$S_1 = \{S_{11}, S_{12}, S_{13}, S_{14}, S_{15}\}$ – New objects of managment: ministries, Socio-economic systems, Enterprises and companies, Safe living space, Quality of human life. (2)

$S_2 = \{S_{21}, S_{22}, S_{23}\}$ – Criteria for quality, safety, efficiency (3)

$S_3 = \{S_{31}, S_{32}, S_{33}, S_{34}, S_{35}, S_{36}, S_{37}, S_{38}, S_{39}\}$ – Subjects (who decide): President, State Duma, Federation Council, Government, Banks, Business, Scientists, Public opinion, People. (4)

$S_4 = \{S_{41}, S_{42}, S_{43}, S_{44}, S_{45}, S_{46}, S_{47}, S_{48}, S_{49}\}$ – New knowledge: Methodological foundations, Methodological foundations, New Boolean events-statements, New LP-models, Public opinion, Special Software, Technologies, Probabilities of events, Additional education course (5)

$S_5 = \{S_{51}, \ldots, S_{5i}, \ldots, S_{5n}\}$ – New tasks, $i = 1, n$; $n = 20$. (6)

$S_6 = \{S_{61}, S_{62}\}$ – Support: LP-calculus, a unified set of tools digital economics (7)

Let us write down some elements of the tuple in more detail:

$S_{15} = \{S_{151}, S_{152}, S_{153}, \ldots\}$ – Life quality: medical treatment, education and decision making processes. (8)

$S_{43} = \{S_{431}, S_{432}, S_{433}, \ldots\}$ – New Boolean events-propositions in management about: failure of subjects, failure of objects, signal events in economics and politics, non-validity, conceptual forecasting, danger, validity, groups of incompatible events. (9)

$S_{44} = \{S_{441}, S_{442}, S_{443}, \ldots\}$ – New risk models: structural logical, based on statistical data, hybrid, non-valid, indicative, conceptual, models of development management, quality of management systems, living space, life quality. (10)

$S_{45} = \{S_{451}, S_{452}\}$ – Public opinion: management 'from above', management 'from bottom'; (11)

$S_{46} = \{S_{461}, S_{462}\}$ – Special software: Arbiter, Expa. (12)

$S_{47} = \{S_{471}, S_{472}, S_{473}, S_{474}\}$ – Risk technologies: procedures of building LP-risk models, analysis of models, forecasting on the risk model, risk management (13)

$S_{48} = \{S_{481}, S_{482}, S_{483}\}$ – Assessment of the probabilities of events by non-validity of factors, by the risk model identification on the basis of statistics, non-numerical, inexact and incomplete expert information. (14)

$S_{49} = \{S_{491}, S_{492}\}$ – A further education course: lectures and laboratory works. (15)

Solozhentsev (2015a, 2019b, 2020) discussed in detail the components of the system of management of quality of economics and the state, new knowledge and new tasks to be

solved. The tuple with the components and the tasks of the corresponding level should be used by analogy for the system of management of economics of the region and companies.

The management system is presented in the form of a cortege, which in terms of engineering can be called a new platform for managing the economics and the state on quality criterion.

In its own turn, each of the above elements of the tuple includes several items (up to 20), which will be described in the following chapters. Artificial intelligence used in event-driven economic and state management is meant to increase the efficiency of economics and the state.

Event-driven quality management as a method of artificial intelligence is focused on increasing the efficiency of economics and the state. In event management, scenarios of failure are created, LP-models of failure of systems are built, data from monitoring system indicators and signal events about changes in the economy, politics, law and innovation are used to correct the probabilities of events. We use models to quantify, analyse, predict and manage systems and processes, making decisions about allocating resources to change the probabilities of events.

Event-driven management of the quality of the state and economics (systems, objects and processes) is based on events. Invalid events are considered, meaning the deviation of the system parameters from the requirements and norms. Different systems and processes can have common triggering events and this ensures their connection. LP-risk models of different systems can simply be logically combined into one common LP-risk model, on which to solve the problems of assessment, analysis, forecasting and quality management of a large system.

3 Management of human life processes quality

Life quality depends on one's health, success in education and job satisfaction. Life quality determines the success of the state and its economics. Let us represent the categories of life quality by the processes of medical treatment, education and decision making (Solozhentsev et al., 2020). Life, medical treatment, education, decision making, are all examples of processes. The processes of medical treatment, education and decision making presuppose personal involvement. Scenarios of events-propositions about processes are created in order to build models of life quality processes. Events in these processes refer to the actions of other people and the condition of the surrounding infrastructure.

There are several stages in the management of life quality processes. They have their own aims, purposes, communication with colleagues, infrastructure and social life. All these stages with the quantitative assessment of the quality of a stage and the contributions of initiating events are important if the society wants to answer the question whether the drawbacks revealed in economic and state management were eliminated. Simulation, analysis and management at the last stage of the process are of highest importance.

Scenarios, structural, logical and probabilistic models of the quality of the following processes are built: a patient's treatment, a student's education, the process of decision

taking by a minister, the management of a scientist's life quality, the management of a businessman's life quality. It is impossible to obtain general solutions because of a large number of people, diseases, academic disciplines and areas of activities, therefore we are going to describe the mathematical tools, software and examples for real people who developed the models of managing the quality of processes in their lives.

Life quality management is represented via the management of the processes of medical treatment, education and decision making, in which the events in the condition of a person, other people and infrastructure are linked with logical operations *AND, OR, NOT*. The processes of life quality are modelled, analysed and managed by people themselves.

The advantage of the described approach to life quality management is that it allows mobilising the efforts of a person justifiably; as a result, improving the quality of processes in which he/she is taking part. This requires self-control and common sense in spending one's resources.

The event-driven approach to life quality management unequivocally determines the aim and the mathematical tools. In economics the management of production and organisation systems and processes is performed by allocating resources, retraining staff and carrying out reforms. The efforts and resources of an actual person are important in the management of life quality processes. In life quality management the efforts and resources of people matter. The participation of a person in managing his or her life quality presupposes building the model of managing the life process by the quality criteria with the consultations of a doctor, a teacher or a manager.

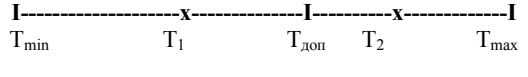
The national project 'Digital economics' is being implemented in the country now. The ministry introduced a big program of measures aimed at creating the infrastructure, but it failed to formulate its goal – which new tasks are solved for economic growth and improvement of life quality. The collection and exchange of data via computer networks can hardly be called digital management in economics and the state, because it does not answer the question why this is being done and which new tasks are being solved. A simple collection and exchange of data will not help solve economic problems.

4 Assessment of the probabilities of events

When treating eye cataract at the first stage a patient is prepared for the operation in the district polyclinic: body temperature is taken, glucose content in blood and blood pressure are measured.

When the doctor sends the patient to the eye operation center, he or she provides the tests results and makes conclusions about each of them. These conclusions are made on the basis of assessing their non-validity. For instance in the assessment of temperature the following factors are taken into account: the lowest possible body temperature value, the admissible value and the highest possible temperature value. The scheme of assessing the possibility of non-validity is presented in Figure 1.

Figure 1 The scheme of assessing the probability of invalidity of a factor



The following parameter identifiers are presented in the figure:

$T_{\min}$ – the lowest possible temperature value;

T_1 – temperature value with the invalidity for minus;

T_{adm} – admissible temperature value;

T_2 – temperature value with the invalidity for plus;

$T_{\max}$ – the highest possible temperature value.

The probability of the invalidity of parameter for minus is:

$$Y_1 = Y_2 \vee Y_3 \vee Y_4 \vee Y_5, \tag{16}$$

The probability of the invalidity of parameter for plus is:

$$Y_2 = Y_6 \vee Y_7, \tag{17}$$

Similar formulae are produced for assessing the probability of the non-validity of the parameters of glucose content in the patient's blood and his or her blood pressure figures.

Objective and subjective assessment of non-validity. Non-validity is an event, after which a system can perform its function, but with a loss in quality. There can be difficulties with assessing non-validity, which can be treated as the deviation from the set requirements by some people, and as no such deviation – by others (Ryabinin, 2007; Solozhentsev, 2015b).

To answer this question, let us recollect the 'technique' which precedes the assessment of the event of interest (i.e., non-validity). One of the ways to describe an object is to make up a list of requirements which it must satisfy. If an object satisfies all the requirements, it is considered to be valid.

Making up a list of requirements to a system is associated with the activity of certain persons, and, consequently, is a subjective act, depending on how well they know a system, their experience and other facts. Mistakes are possible in assigning certain requirements, and some of them can be omitted. These requirements vary in different countries.

In spite of the fact that the completeness of requirements to a system is a relative matter and they are set quite subjectively, we must be able to state a certain set of these requirements, by our attitude to which we can quite objectively judge about non-validity or validity of this system. This is the dialectic of subjective and objective in assessing system invalidity, safety and quality of a system.

Synthesis of the probabilities of events by expert information. The probabilities of events-propositions are assessed by non-numerical, inexact and incomplete (NII) expert information by the randomised aggregates method proposed by Professor N. Hovanov (Hovanov et al., 2007; Solozhentsev, 2021). An expert cannot give an exact estimate of the probability of a single event. He or she will do it with more precision and objectivity, and if he or she assesses 3–4 alternative hypotheses.

Hypotheses A_1, A_2, ..., A_m are formulated. The weight coefficients of hypotheses are calculated discretely in increments, taking the values in the interval {0, 1}. The weight

coefficients of hypotheses $w_1, \ldots, w_m$ are calculated discretely in increments $h = 1/n$, where n is the number of gradations of the weights of hypotheses

$$P_4 = P_{12} + P_{13}(1 - P_{12}) + P_{14}(1 - P_{13})(1 - P_{12}). \tag{18}$$

A set of all possible vectors of weight coefficients:

$$P_5 = P_{15} + P_{16}(1 - P_{15}). \tag{19}$$

where $N_1, N_2, \ldots, N_m$ is the number of gradations in weight coefficients.

Expert information by weight coefficients is set as ordinal information:

$$-dP_i = P_i / {}_{pi} - P_i / {}_{pi=0}; \quad +dP_i = P_i / {}_{pi=1} - P_i / {}_{pi} \tag{20}$$

and interval information:

$$Y_1 = Y_2 \vee Y_3 \vee Y_4 \vee Y_5 . \tag{21}$$

Naturally, a condition also applies:

$$Y_2 = Y_6 \vee Y_7. \tag{22}$$

Conditions (18–22) specify the area of allowed values of weight coefficients w_1, w_2, ..., w_m. The mathematical expectations of randomised weight coefficients are used as numerical assessments of randomised weight coefficients.

The calculations are repeated for at least three experts. An aggregate table of weight coefficients of all experts' hypotheses is made up. Aggregate assessments of weight coefficients w_1^*, w_2^*, ..., w_m^* of hypotheses $A_1, A_2, \ldots, A_m$ are calculated using the data from the table and the weights of the experts themselves. The hypothesis with the highest assessment of the aggregate weight coefficient is selected.

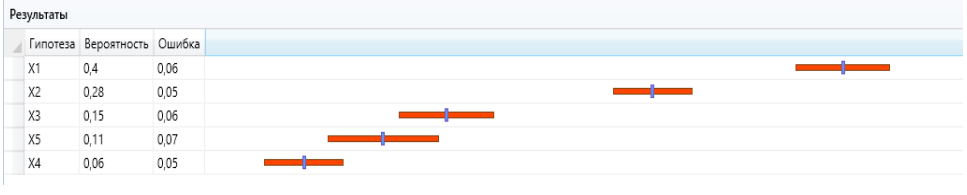
Example. The probability of an event – a statement about a fall in oil prices is estimated. Five hypotheses have been put forward X_1, X_2, X_3, X_4, X_5.

It is assumed that for all hypotheses the interval information $\{Xi\ min = 0, Xi\ max = 0.5\}$, $i = 1, 2, 3, 4, 5$ (as a rule, the interval information is different for different hypotheses and is set so that the intervals have a common area of intersection). Ordinary information for hypotheses is as follows: $X_1 > X_2$, $X_2 > X_3$, $X_3 > X_4$, $X_2 > X_5$.

For a given accuracy $1/n = 0.02$, the total number of different solutions $N = 316251$ and the number of feasible solutions $Nad = 4329$. The results were obtained automatically at Expo: the values of the probabilities of hypotheses are shown Figure 2.

The best hypothesis is X1 with the probability of truth $P_1 = 0.4$ and accuracy 0.06.

Figure 2 Machine document. Synthesised values of probabilities of hypotheses and their errors (see online version for colours)

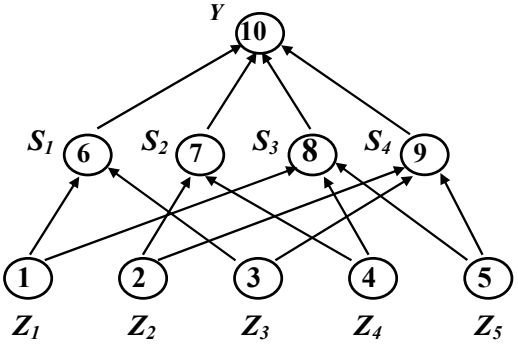


5 Repeated initiating events

Let us consider an example with repeated IEs. There are four processes (ministries) S_1, S_2, S_3, S_4, which are set by IEs of processes: S_1 – events Z_1, Z_3; S_2 – events Z_2, Z_4; S_3 – events Z_1, Z_4, Z_5; S_4 – events Z_2, Z_3, Z_5. Events are included in the process several times (they are repeated). For example, Z_1 is included into S_1 and S_3, Z_5 is included into S_3 and S_4, etc. This results in the L-function for the final event Y (the state) having repeated events. The probabilities of failure of IEs Z_1, Z_2, Z_3, Z_4, Z_5 equal P_1, P_2, P_3, P_4, P_5. correspondingly. The probabilities of the failure of IEs of the internal environment of ministries are supposed to equal zero, therefore these events have not been introduced. In the structural model of the failure of system Y processes S_1, S_2, S_3, S_4 are linked with IEs Z_1, Z_2, Z_3, Z_4, Z_5 by the L-operation (\/) (Figure 3), in which edges with arrows denote the link *OR:*

$$S_1 = Z_1 \vee Z_3;\ S_2 = Z_2 \vee Z_3;\ S_3 = Z_1 \vee Z_4 \vee Z_5;\ S_4 = Z_2 \vee Z_3 \vee Z_5 \tag{23}$$

Figure 3 The structural scheme of the system



The logical model Y_{10} of system failure*:*

$$Y_{10} = S_1 \vee S_2 \vee S_3 \vee S_4 \tag{24}$$

The probability model P_{10} of system failure includes events Z_1, Z_2, Z_3, Z_4, Z_5. However, if these events are not taken into account as repeated, then it is necessary to introduce 10 independent events according to the number of connections from them with the same probabilities.

Let the probabilities of IEs equal: $P_1 = P_2 = P_3 = P_4 = P_5 = 0{,}1$. Let us calculate the risk of losing quality (failure) by the system with and without repeated events, using logical addition.

With repeated events in failure risk we have $P_{10} = 0.4095$. Without repeated events in failure risk we have $P_{10} = 0.6505$.

6 The features and characteristics of event-driven management of quality

The features of event-driven management of the quality of life of a person, economics and state are as follows.

1 Research on event-driven management was carried out at the intersection of technology, economics, artificial intelligence and management, that is, they were complex.

2 Event-driven management makes it possible to model, evaluate and compare different theories and approaches to the development of the country's economics, since they can be presented in the form of events-propositions. This is important due to the presence of a large number of conflicting unreasonable proposals for the development of economics without the use of mathematical models from numerous institutes and research centers.

3 The well-known rule that the accuracy of the initial data (IS probabilities) and the structure of the system (models) determines the accuracy of the result (criterion) is not fair in economics. After calculating the criterion on the LP-model, a quantitative analysis of the contributions of initiating events and structure to the criterion (result) is performed. Based on the results, the LP-model is corrected (improved). The calculations are repeated until the modelling results coincide with the estimates of professional economists.

4 In economics and economic science, we should talk about managing the quality of human life and managing the quality of economics, state, products, etc.

5 Taking into account repeated events in economic systems is necessary to take into account the relationships of subsystems and to accurately calculate the quality criterion of the system. Repeated events are laws, rules and restrictions (infrastructure) of the state that affect the functioning of many systems.

The characteristics of event management of the quality of life of a person, economy and state are as follows:

1 the system the event management system is described by the proposed tuple

2 management due on the LP-model according to the quality criterion

3 quality tasks are solved for any complexity of the logical model of the system

4 event-driven management allows obtaining quantitative assessments of the quality and contributions of initiating events to the values of the criterion

5 operations of logical-probabilistic calculus are performed both with logical variables and with logical functions

6 logical functions of risk (failure) have neither coefficients nor degrees

7 LP-model of invalidity (quality, safety) of the system can be built on the basis of the invalidity of indicators of one of its states

8 Boolean variables become dependent when they fall into the general L-model. To pass to the B-model, the L-model is orthogonalised

9 the dynamism of LP-models of safety and quality is ensured by correcting the probabilities of initiating events in response to signaling events

10 the dependence and connection of various systems (models) ensures the correct accounting of repeated events in the systems included in the general LP-model of the quality of a large system.

7 Management of the medical treatment process

Let us discuss the problem of life quality management on the example of the process of medical treatment of eye cataract. The scenario of the management of the life quality process is developed for specifying initiating events, building the structural risk model and for expert assessment of the probabilities of events (Solozhentsev, 2017).

The scenario description of the medical treatment process is performed by physicians and the patient. At the beginning of the medical treatment process the patient is prepared for the operation in the district polyclinic: the necessary tests are done, glucose content in blood and blood pressure are brought to the norm.

After that the patient is prepared for the operation in the eye operation center. The patient's condition is assessed (test results, age and psychological condition). It is made clear whether the patient can buy a better quality eye lens, expensive medicine and go through additional paid-for expert examination. The patient receives information about the competence of medical staff (the surgeon, the doctor, the nurses), medical treatment technologies and infrastructure of the hospital (comfortable wards, the number of beds, food, equipment for eye examination and the operation).

After that the after-operation period (one month) at home is assessed. Here the physical and mental condition of the patient after operation is taken into account; care, including instillation of eye drops (four different types of drops four times a day); accommodation (separate room, temperature in the room, unwanted sound).

Following that the involvement of the state should be assessed: a sick leave must be obtained the next day after the discharge from the hospital. To do this the patient must visit his or her place of employment and the district polyclinics, but using public transport is not recommended. The state promises to provide the patient with free eye drops, but there are some problems with making an appointment with the doctor two weeks in advance and getting timely free medical help.

The structural model of the medical treatment process quality. Let us build the structural model of the quality of the medical treatment process, using the scenario below and software Arbiter and *Expa* (Hovanov et al., 2007; Solozhentsev et al., 2018; Mozhaev, 2003). The model contains events (Figure 4), which are assigned the numbers corresponding to the subscripts of the corresponding L-variables (Y):

1 – The quality of the medical treatment process as the final event

2– Preparation to the operation in the district polyclinic

6 – medical tests by the instruction of the eye center

7 – bringing glucose content in blood and blood pressure to the norm

3 – Preparation to the operation and the operation itself

8 – the patient's medical condition

9 – the patient's financial standing

10 – competence of medical staff

11 – infrastructure of the hospital

4 – Post-operation period at home

12 –mental and psychological condition of the patient

13 – medical attendance

14 – housing infrastructure

5 – Involvement of the state

15 – filling out the sick leave

16 – free medication.

The logical and the probabilistic models of the quality of the process. Using the structural model, let us write down the logical and the probabilistic risk models of the failure of the process of the patient's medical treatment. Let us introduce the L-variables for events in Figure 2, substituting an event number with variable Y with the subscript of the event number. The logical model of the failure of the medical treatment process:

$$Y_1 = Y_2 \vee Y_3 \vee Y_4 \vee Y_5, \tag{25}$$

$$Y_2 = Y_6 \vee Y_7, \tag{26}$$

$$Y_3 = Y_8 \vee Y_9 \vee Y_{10} \vee Y_{11}, \tag{27}$$

$$Y_4 = Y_{12} \vee Y_{13} \vee Y_{14}, \tag{28}$$

$$Y_1 = Y_2 \vee Y_3 \vee Y_4 \vee Y_5, \tag{29}$$

The probabilistic model of the quality of the medical treatment process will be written down after the orthogonalisation of functions (25–29):

$$Y_2 = Y_6 \vee Y_7, \tag{30}$$

$$Y_3 = Y_8 \vee Y_9 \vee Y_{10} \vee Y_{11} \vee Y_{12} \vee Y_{13}, \tag{31}$$

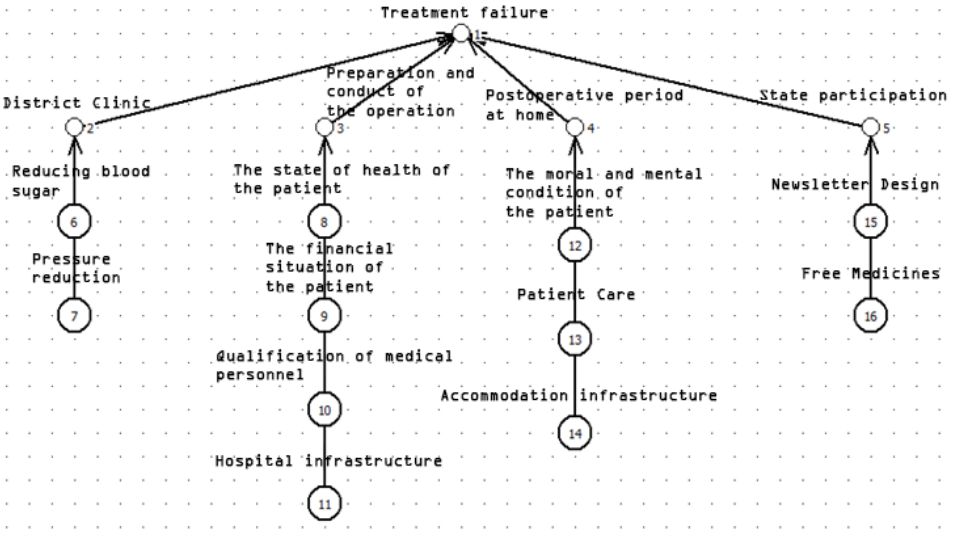
$$Y_4 = Y_{14} \vee Y_{15}, \tag{32}$$

$$Y_5 = Y_{16} \vee Y_{17}. \tag{33}$$

$$Y_1 = Y_2 \vee Y_3\overline{Y_2} \vee Y_4\overline{Y_3}\,\overline{Y_2} \vee Y_5\overline{Y_4}\,\overline{Y_3}\,\overline{Y_2}, \tag{34}$$

Probabilities P_6, P_7, P_8, P_9, P_{10}, P_{11}, P_{12}, P_{13}, P_{14}, P_{15}, P_{16} are assessed by non-numerical, inexact and incomplete expert information by the randomised aggregates method (Solozhentsev, 2015a; Hovanov et al., 2007).

Figure 4 The structural model of the quality of the medical treatment process



Analysis and management of the medical treatment procedure. The probabilities of initiating events P_6, P_7, P_8, P_9, P_{10}, P_{11}, P_{12}, P_{13}, P_{14}, P_{15}, P_{16} are presented in column 2 of Table 1. The results of calculation and analysis are obtained automatically by the software complex *Arbiter* by Figure 2. As a matter of fact, the equations above are also built automatically by the Arbiter complex itself and are presented in the *work report* compiled automatically. The probability of medical treatment failure P = *0.028287* was calculated. The contributions of initiating events 6–16 in the risk of medical treatment failure are also presented in Table 1. The contribution of the event for the minus and for the plus is calculated algorithmically on P-models by the formulae:

$$Y_2 = Y_6 \vee Y_7 \overline{Y_6}; \tag{35}$$

Medical treatment management consists in changing the probabilities of the most significant initiating events by their contributions, by making financial investments or retraining staff.

The risk model of the failure of medical treatment process is logically simple, because initiating events are logically linked with the final event only by the logical operation *OR*; in this case the contributions of events are roughly proportionate to the probabilities of events themselves. However, with a different problem setting or in other cases the models can have links *AND*, *OR*, *NOT* and in this case the contributions of initiating events depend both on the values of their probabilities, and on the place in the structural model.

The following drawbacks in the medical treatment process were revealed: A lot of patients have to return to the operation center due to accidents during the post-operation period; some medical treatment options are not free of charge; the state introduced wrong requirements to the time and procedure of sick leave execution and the right to free medication.

Table 1 Characteristics of initiating events in the LP-model of medical treatment failure

Event number	*Event probability, P_i*	*Event contribution for minus, – dPi*
6	0.0003	–0.000292
7	0.0003	–0.000292
8	0.0002	–0.000204
9	0.009	–0.008825
10	0.0011	–0.001070
11	0.008	–0.007836
12	0.0019	–0.001849
13	0.0025	–0.002435
14	0.0029	–0.002826
15	0.0021	–0.002045
16	0.0003	–0.000292

8 Management of students' education quality

Students took a great interest in the laboratory works on event-driven management of education quality done on the Arbiter and Expa software. The course 'Risk Management Technologies' was chosen as an example (Solozhentsev, 2019b; Mozhaev, 2003).

The scenario of the education process in the course 'Risk Management Technologies' is built for specifying initiating events, building the structural risk model and expert assessment of the probabilities of events.

Foundations of mathematical logic are not taught at school or university. There was no such subject, neither was there any infrastructure or special software.

The following infrastructure for the course is available: the computer class and special software, a textbook 'Introduction to risk management technologies in economics' and the guide for laboratory works.

The subject (including lectures and laboratory works) is taught during one semester. Obviously, there are not enough lectures. A teacher can allocate more hours to lectures than to laboratory works, but this does not solve the problem completely.

In the laboratory work the students entered the following initiating events: low stipends and the necessity to work part-time, as a result – missed classes, not enough time for studying the discipline. The students also mentioned the fact that the dormitory is far from the university. There were also doubts about the advisability of fee-paying education.

The structural model of the educational process failure. Let us build the structural model of the educational process failure, using the above scenario and software *Arbiter and Expa.* The model contains the events (Figure 5) which are assigned the numbers of subscripts of the corresponding L-variables:

1 – The failure of mastering the discipline as a final event.

2 – Preparation for the course at school and during the first years at university:

6 – Introduction to mathematical logic,

7 – Work with logical-probabilistic software.

3 –Studying the subject ‘Risk management technologies in economics’;

8 – Infrastructure for the course: computer classes and special software *Arbiter and Expa*;

9 – Textbook ‘Risk management technologies in economics’;

10 – Guide for laboratory works;

11 – The number of hours for lectures and laboratory works;

12 – Small stipends;

13 –Large distance from university to dormitory;

4 – Work at enterprises:

14– Lack of infrastructure;

15 – No new tasks in projects;

5 – Involvement of the state:

16 – The state does not make provisions for the creation of new knowledge and new tasks in the national project ‘Digital economics’

17 – New knowledge and new tasks are not known in real economics at enterprises and state authorities are not familiar with them, either.

The logical and the probabilistic models of the process quality model. Using the structural model, let us write down the logical and the probabilistic models of the educational process quality. Let us introduce the L-variables for events (Figure 3), substituting the event number with variable Y with the subscript equal to the event number. The logical model of the educational process quality:

$$Y_3 = Y_8 \vee Y_9\overline{Y_8} \vee Y_{10}\overline{Y_9}\,\overline{Y_8} \vee Y_{11}\overline{Y_{10}}\,\overline{Y_9}\,\overline{Y_8} \vee Y_{12}\overline{Y_{11}}\,\overline{Y_{10}}\,\overline{Y_9}\,\overline{Y_8} \vee Y_{13}\overline{Y_{12}}\,\overline{Y_{11}}\,\overline{Y_{10}}\,\overline{Y_9}\,\overline{Y_8}; \quad (36)$$

where:

$$Y_4 = Y_{14} \vee Y_{15}\overline{Y_{14}}; \quad (37)$$

$$Y_5 = Y_{16} \vee Y_{17}\overline{Y_{16}}. \; ; \quad (38)$$

$$P_1 = P_2 + P_3(1-P_2) + P_4(1-P_2)(1-P_3) + P_5(1-P_4)(1-P_3)(1-P_2); \quad (39)$$

$$P_2 = P_6 + P_7(1-P_6), \quad (40)$$

Logical functions (22–26) in the equivalent orthogonal form:

$$Y_1 = Y_2 \vee Y_3\overline{Y_2} \vee Y_4\overline{Y_3}\,\overline{Y_2} \vee Y_5\overline{Y_4}\,\overline{Y_3}\,\overline{Y_2}, \quad (41)$$

where:

$$Y_2 = Y_6 \vee Y_7\overline{Y_6}; \quad (42)$$

$$Y_3 = Y_8 \vee Y_9\overline{Y_8} \vee Y_{10}\overline{Y_9}\,\overline{Y_8} \vee Y_{11}\overline{Y_{10}}\,\overline{Y_9}\,\overline{Y_8} \vee Y_{12}\overline{Y_{11}}\,\overline{Y_{10}}\,\overline{Y_9}\,\overline{Y_8} \vee Y_{13}\overline{Y_{12}}\,\overline{Y_{11}}\,\overline{Y_{10}}\,\overline{Y_9}\,\overline{Y_8}; \quad (43)$$

$$Y_4 = Y_{14} \vee Y_{15}\overline{Y_{14}}; \quad (44)$$

$$Y_5 = Y_{16} \vee Y_{17}\overline{Y_{16}}. \quad (45)$$

The probabilistic risk models will be written down by the functions (36–45):

$$P_1 = P_2 + P_3(1 - P_2) + P_4(1 - P_2)(1 - P_3) + P_5(1 - P_4)(1 - P_3)(1 - P_2); \quad (46)$$

where

$$P_2 = P_6 + P_7(1-P_6), \quad (47)$$

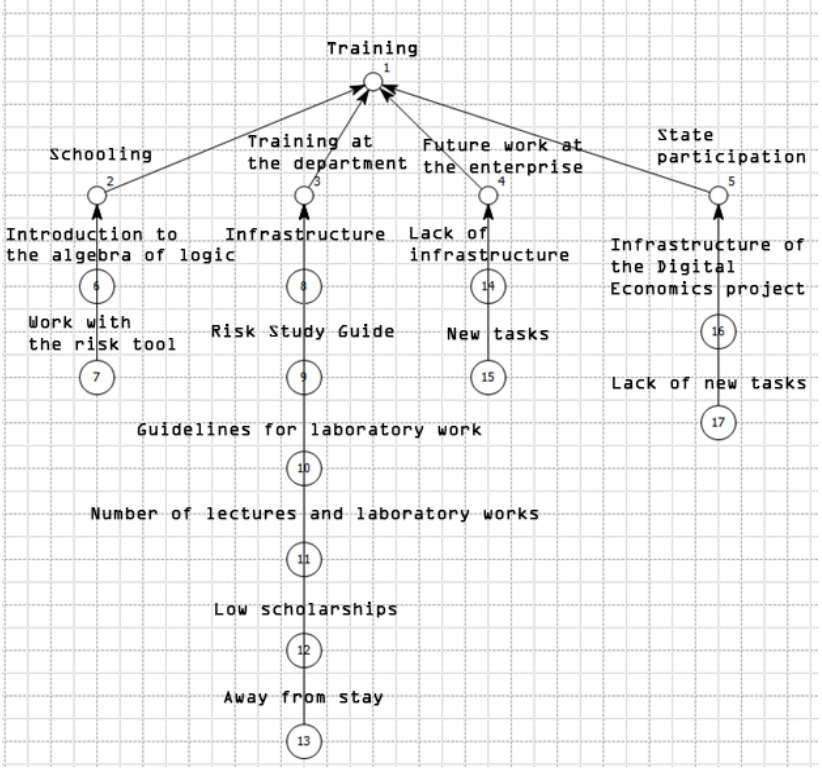
$$P_3 = P_8 + P_9(1-P_8) + P_{10}(1-P_9)(1-P_8) + P_{11}(1-P_{10})(1-P_9)(1-P_8) + P_{12}(1-P_{11})(1-P_{10})(1-P_9)(1-P_8) + P_{13}(1-P_{12})(1-P_{11})(1-P_{10})(1-P_9)(1-P_8), \quad (48)$$

$$P_4 = P_{14} + P_{15}(1-P_{14}); \quad (49)$$

$$P_5 = P_{16} + P_{17}(1-P_{16}). \quad (50)$$

Probabilities P_6, P_7, P_8, P_9, P_{10}, P_{11}, P_{12}, P_{13}, P_{14}, P_{15}, P_{16}, P_{17} are assessed by non-numerical, inexact and incomplete expert information by the randomised aggregates method (Solozhentsev, 2017; Hovanov et al., 2007).

Figure 5 Structural model of the failure of education process



Analysis and management of the education process quality. The logical and probabilistic models, as well as the results of calculation and analysis of the model were obtained automatically by *Arbiter using the structural model*. The probability of education failure and the contributions of events into education failure risk are calculated by simple formulae. Education management is performed by changing the probabilities of the most significant initiating events by their contributions, by making financial investments and retraining staff.

The following drawbacks were revealed. The foundations of mathematical logic are not studied at school or university. Not enough academic hours are allocated for lectures. Low stipends make students work part time and miss classes. The dormitory is too far from the university. New tasks are not known and not solved in real economics.

9 Management of the quality of decisions taken by a minister

The job of a person with a university degree nearly always involves management (decision taking). It can be an engineer or a state official. A 'manager's' life quality depends on their job satisfaction and the success of their work. Let us discuss, for example, the work of a minister who controls the development and implementation of the national project 'Digital Economics' (National Projects, 2019). A 'manager's' personal success also determines the success of a country in solving the problem.

The state of the problem. The high probability of the failure to solve the problem 'Digital economics' is caused by the insufficient competence of state officials and involved experts.

Economic growth and competitiveness in the world are closely connected with digital economics. Developed Western European countries have created 'Digital Economics' programs for increasing competitiveness, attracting clients to the service sector and trade. Russia has also adopted the national program 'Digital Economics'. All these programs lack focus on digital economic and state management, seemingly, because of the lack of corresponding mathematical models. Management is still performed on the basis of ephemeral concepts and aims, by making amendments and regulating the situation by 'unwritten rules', by 'manual management', by the principle 'give me more money', by taking measures, by promises and slogans, appeals and orders.

Collecting and exchanging data via computer networks can hardly be called digital economic and state management, because it does not give the answer which new tasks are solved in this manner. In Russia the improvement of the service of collecting and exchanging data will not improve economic efficiency.

We suggest developing the national project 'Digital Economics' and introducing new knowledge and tasks aimed at increasing the efficiency of economic and state management (Solozhentsev, 2020).

Two aspects: infrastructure and new tasks are considered in the problem of economic and state management.

Digital economics can provide wide and fast implementation of the direction in science 'Event-driven digital economic and state management', if we use the unified complex of criteria, knowledge, models, tasks and software for modelling, analysis and management of safety and quality of structurally complex systems, objects and processes.

The national project 'Digital Economics' failed like the attempt of creating a brain model, described above. The government projects 'Economics must be economical', 'The five-year-plan of high quality', 'Acceleration according to Gorbachev' failed, too. They did not lead to economic growth.

The national project 'Digital Economics' was developed without mathematical models. The main task of digital economics – improving economic efficiency and life quality was not formulated. Let us now discuss the topics 'Creation of infrastructure' and 'Development of new tasks' within the framework of the national project

Infrastructure and action items of the national project. The main task to be solved within the framework of the national project 'Digital Economics' was sufficient improvement of economic efficiency and life quality. However, it did not happen. According to the plan of the national project, at first a long list of action items was made, the billion roubles budget was siphoned off (distributed), i.e., the infrastructure of 'Digital Economics' was created, with the involvement of different ministries and institutions (recipients of funds).

The following actions are planned, which are aimed at building the infrastructure of digital economics: several millions of students, specialists, managers and state officials should receive the corresponding training at universities or via a further training course; dozens of accelerated training centers should be created; grants should be awarded to many students and organisations; dozens of training software complexes should be created.

The state officials who control these actions are the deputy ministers of science and higher education, school education, economic development, digital development and mass communications.

In spite of the impressive list of planned measures and the allocation of huge funds, the picture is quite grim and it looks like an imitation of frenzied activity of state officials and the caste of scientists-'grant consumers'. It is not clear which new tasks aimed at the management of state and economic efficiency will be solved.

Wikipedia defines 'measure' as 'step', 'initiative', 'campaign', not as a business plan or a list of new tasks. Digital economics must mainly deal with the management of Safety, quality, economic and state and efficiency. Digital economics must be developed not from 'the above', but from 'the below', with the involvement of scientists and public opinion, with the introduction of new knowledge and new tasks. Unsubstantiated infrastructure brings forth an unreasonably big number of institutes, centers and bureaucrats.

New tasks of digital economics. In order to set the new tasks of increasing economic efficiency we need new ideas, knowledge, models and tasks, which can significantly increase the efficiency of economics and life quality.

The aim of the national project can only be increasing economic efficiency and improving life quality. A single criterion of management should be adopted. Event-driven management as an artificial intelligence method should be used. A unified set of knowledge, models, tasks and software should be created.

We also need a further education course of event-driven economic and state management for economists, managers, students and teachers. The topics of the grants required for the development of the theory and applications should be determined. The issues of the certification of techniques, models, tasks and software should be solved. Public opinion should be involved in the control of research devoted to digital economics.

New tasks aimed at increasing the efficiency of economic management have been formulated in digital economics (Solozhentsev, 2020). The new tasks aimed at improving the efficiency of economic management have been formulated. Now we can make a substantiated list of action items of the national project 'Digital Economics'. At present the situation is quite opposite, therefore many action items of the national project are irrelevant or have to be changed.

The new tasks for the project are as follows: modelling, analysis and management of the quality of one system; modelling, analysis and management of the quality of a big system consisting of several systems; taking into account the effect of repeated events on the assessment of system quality; the analysis of different outcomes of subsystems in a complex system; LP-management of system development; assessment of the quality of management systems; counteraction to bribery and corruption; counteraction to drug addiction growth**;** LP-management of systems by data.

10 Management of a scientist's life quality

A scenario for managing the quality of life processes of one scientist at a sequence of stages has been developed. We will not present the structural, logical and probabilistic models of the quality of the life processes of a scientist, which are written by analogy with the quality management of the processes of treatment and education. The identified shortcomings in managing the quality of life of a scientist are described below.

New trends in Russian science are highly unfavourable. The Bologna process was forced upon economic education in universities, whose curriculum ignored such topics as corruption, bribery, fraud, offshore companies. The Federal Agency for Scientific Organisations deprived Russian scholars of the opportunity of cooperation with their foreign colleagues, by giving them a three-month term to apply for grants and organise international conferences. A foreign scientist wishing to take part in a conference has to book a hotel and plane tickets one year before the conference. The demand to assess scholars' efficiency by the number of SCOPUS publications is purely bureaucratic and harmful. As a result, scientists think not about implementing their results at home, but about publishing them abroad for the benefit of foreign economies and enterprises. Complex problems always have an interdisciplinary character. Any problem can be applied to economics; however, science has degenerated – hundreds of new institutes, departments, committees appeared with their directors general, heads, deputy heads and consultants. A sect of 'grant consumers' appeared. The works of academician V. M Glushkov and the Kiev Institute of Cybernetics are forgotten, in spite of the fact that they have made a big contribution into the creation of automatised systems of production, management and technologies (*CAD*, *CAM*, *CAT*).

Several thousands of plagiarised dissertations in economics and sociology were defended in Russia. Now their authors, the so called scientists, occupy managerial posts, the positions of editors-in-chief of science journals, leading advisors, experts and managers. The suggestions regarding event-driven economic and state management on the basis of artificial intelligence were submitted to high state officials, who, in their turn, submitted them to their numerous institutes, and that was the end of it. Grant applications at the intersection of disciplines received no support.

Applications for grants at the intersection of the sciences of technology, economics, management and artificial intelligence did not receive support.

11 Management of a businessman's life quality

The Russian economy is hiding in quiet offshore harbours. Export of profits and assets to offshores are a real tragedy for Russia. Russia occupies the fourth position in the list of countries by the GDP share kept in offshore accounts: 46% of GDP. According to stock market analysts' estimations, foreign investors own about 70% of the shares of Russian companies. Offshore accounts belonging to stand-ins solve several problems for illegal business. Firstly, significant reduction of taxes. Secondly, your companies are under legal protection in Russia. Thirdly, offshore accounts hide real owners. Fourthly, offshore accounts exclude any persecution of illegal capitals. Economic data enable us to build the models of businessmen's life processes with and without off-shores. The Russian laws in economics do not make the situation clearer. The scenarios, written by Russian entrepreneurs could help solve this problem. The success of running a business will elucidate the solution of this problem for the country. The businessmen who have accumulated money illegally, lovers of offshore accounts, will not do it themselves. Public opinion can do this.

12 Special software for event-driven management

Systems of management in economics and the state have a lot of factors and combinations of possible solutions. The orthogonalisation of the L-function, logical and arithmetic calculations have high computational complexity and for real systems are possible only when special Software is used. Special certified software *Arbiter and Expa* should be used for solving new tasks in economic and state management.

Arbiter is used for automatised modelling of the quality of structurally complex engineering and economic systems (Mozhaev, 2003). It employs the technique of automatised structural logical modelling of complex systems.

It received the license of the Federal Service for Environmental, Technological and Nuclear Oversight of Russia in 2007. *Arbiter* is used by over 30 organisations in Russia, including 12 universities, which can buy with a discount its network version for 15 users.

Expa is used for automatised synthesis of probabilities of events-propositions. The probabilities of events-propositions are assessed by non-numerical, inexact and incomplete expert information, using the method of randomised aggregates (Hovanov et al., 2007; Solozhentsev et al., 2018; Mozhaev, 2003; Karaseva, 2016). An expert cannot give an exact assessment of the probability of a single event. It can be done more accurately and objectively if 3–4 alternative hypotheses are assessed.

13 Digital economics and life quality management

Event-driven management has a complex, interdisciplinary character, new mathematical tools, high arithmetic and logical computational complexity and special software.

Naturally, there are certain difficulties in adopting it by economists. Digital management eliminates these problems via automatisation and unification. It ensures the large-scale solution of new tasks of economic and state management (Solozhentsev, 2020; Solozhentsev and Karasev, 2020; Karasev and Solozhentsev, 2016, 2021; Raworth, 2017; Raworth, 2017).

Event-driven management, as an artificial intelligence method, changes the technique of development and the content of annual and long-term state and regional programs.

Management of the quality of life processes makes it necessary to sum up the results of separate studies devoted to medical treatment, education and decision making. These studies reveal the drawbacks of economic and state management. The public opinion represented by opposition, democratic institutions, TV, etc. can summarise the results of studies. It controls state authorities and business and can make them work for public good. The state cannot cope with this problem alone. Any study devoted to the management of life quality of even one person (medical treatment, a student's education, a minister's, a scientist's and a businessman's decisions) allows us to make conclusions about the drawbacks of the system of economic and state management. Only public opinion can summarise the conclusions of a lot of studies.

14 Implementation of research results

The further education course "Event-driven digital management of safety and quality in economics and the state" was developed for economists and teachers. Laboratory works are done on special software. The course has been tested in teaching students of the Faculty of Economics of SUAI for five years (Solozhentsev, 2015a, 2021).

Topics of lectures:

1 Economic management and dealing with the crisis
2 Event-driven management as method of artificial intelligence
3 Data from logic algebra and LP-calculus
4 Foundations of event-driven management in economics
5 New criteria and objects of management in economics
6 New knowledge in economics management
7 Event-driven management of the quality of system development to overcome stagnation
8 New problems in economics management
9 Management of life quality processes
10 Management of medical treatment quality
11 Management of university education quality
12 Management of decision making to scientists
13 Management of the quality of the minister's decisions

14 Management of the quality of the businessman's decisions

15 Special software for economic management

Topics of laboratory works at Arbiter and Expa:

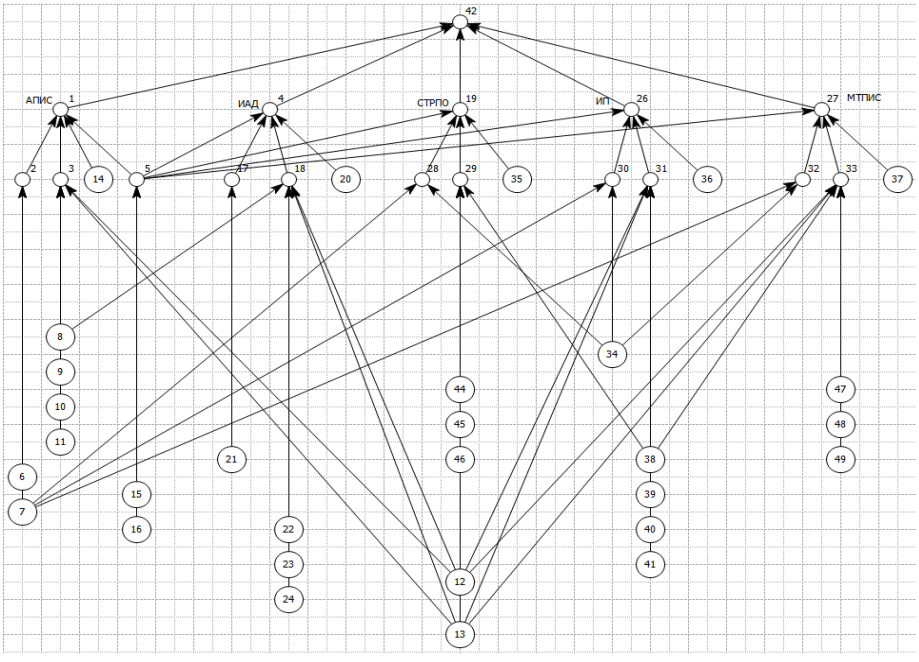
- modelling of one system
- modelling of systems from several subsystems
- failure of presidential elections
- failure of counteraction to corruption
- failure of counteraction to drug abuse
- failure of the ministry of education
- failure of the ministry of healthcare
- failure enterprises or companies
- assessment of the ratings of cars, computers, universities, etc.
- risk of currency exchange rate fall
- risk of the fall of oil prices
- failure of graduating from university
- risk of political instability in the country
- risk of economic instability in the country
- synthesis of probabilities of events by one and several experts
- management of a director's life quality
- management of a student's life quality
- management of a patient's life quality
- management of an innovations system.

Event-driven management of the quality of development and staff motivation. We investigate the event-driven management of the quality of human life on the example of three employees of the company: tester, developer and analyst. Events are introduced into the event-driven management model, the probabilities of which are synthesised from non-numerical, incomplete and inaccurate expert information. Arithmetic and logical calculations of great complexity are performed using a special certified software *Arbiter*. The results of studies of the quality of life of the above employees separately and together with and without taking into account repeated events are presented. It has been established that in event management of the quality of development and motivation of the organisation's personnel, repeated events must be taken into account.

Event-driven management of the quality of student teaching in five disciplines. We investigate for the first time, the quality of student learning processes in several disciplines. The probabilities of events are defined as invalid or synthesised from

non-numerical, incomplete and inaccurate expert information. The corresponding structural, logical and probabilistic models have been built for the criterion of the quality of training using special certified software *Arbiter and Expa* (Figure 6). The effect of repeated events in the processes of teaching disciplines due to the same infrastructure has been investigated. A large difference has been established in the quality criteria of a system of several disciplines with and without taking into account repeated events. Management of the system 'from below' based on the results of assessing the quality of life processes of many people is more effective. Presumably, by analogy with the results of the study performed with a large number of repeated events (up to 40% of the total number of events), government spending on ministries, with the correct accounting of repeated events, can be reduced to 30%.

Figure 6 Structural model of student learning failure in five disciplines



15 The role of public opinion in management 'from below'

Grains of real personal experience in real projects of many people, presented in publications and on the Internet, can be generalised by public opinion for unsolved problems, which will force the government to solve them in the interests of improving the quality of life of the population. The proposed approach applies to all countries whose population is interested in improving living standards and the quality of economic management. The population can rely on smart and decent officials, but everyone can present their real experience in solving problems and provide feedback in the management of the economics and the state, that is, management 'from below'.

Nobel Prize laureate J. Buchanan has shown that the government, when managed 'from above', is inclined to cooperate with corruption and crime, since it does not have the resources and personnel to solve all problems. Public opinion efforts (in the form of opposition, democracy, newspapers and television) are needed to make government work in the public interest. Public opinion can also be expressed in the form of sociological research, parliamentary inquiries, demonstrations, etc.

Management of the quality of economics and the state 'from below' is carried out by public opinion on the basis of generalising the results of many studies of individual people on the quality of their lives: treatment, education and decision-making. These studies reveal the deficiencies of governance in the state and economics. Public opinion, represented by the opposition, democracy, television, etc., can generalise the research results. It controls the authorities and business to make them work in the public interest. The state cannot deal with this. Each study on the management of the quality of life of even one person (treatment of a person, education of a student, decisions of a minister, scientist and entrepreneur) allows drawing conclusions about the shortcomings of the system of managing the economy and the state. Only public opinion can summarise the findings of many studies.

The above identified shortcomings of quality management of various processes of human life can be used by public opinion to put pressure on the government and relevant bodies in order to correct them. This is the management of the quality of economics and the state 'from below' (Solozhentsev, 2021).

16 Conclusion

1 This work presents the new direction in economics and state management 'from below', based on event-driven management of the quality of human life, using artificial intelligence, logic algebra and logical probabilistic calculus. Life quality is represented as a logical addition of the quality of various life processes. The management of the quality of life processes (medical treatment, education, decision taking) is performed with the involvement of an actual person.

2 The management 'from below' has a feedback from the management 'from above'.

3 Economic and state management relies on real personal experience of real projects of many people, whose stories can be found in literature and on the Internet. Management 'from below' is realised by public opinion, which sums up past experience for solving problems and makes the government solve them and, ultimately, improve life quality.

4 Our approach to management 'from below' eliminates dozens of unnecessary actions and billions of roubles invested by the President and the Government. It creates a vast field of application of public opinion.

5 For quantitative estimates we developed the structural, logical and probabilistic models of event-driven management of the following life quality processes have been developed: medical treatment, a student's education, decision-making by a minister, a scientist and a businessperson.

6 Human life quality management allows us to: mobilise personal efforts to improve the quality of life processes; establish self-management and common sense in spending one's resources; make conclusions about the drawbacks of the systems of economics and state management based on the results of managing life quality of various people; involve public opinion in summarising the results of different studies describing the drawbacks of systems.

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