A Scenario Methodology as Connectability From Strategy to Operation in Complex System

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Abstract: We introduce a new scientific project, which is supposed to create a new effective semiautomatic tool. It's expected to be used for analysis and synthesis of complex social and economic systems. A new principle named «scenario methodology» was developed in order to create this tool. It was used the subject-object methodology to describe the behavior of the system object. It was constructed as formalized event, situation, scenario, principles and methods to define topological structures, create scenario characters, and indicate its properties. There was constructed a spectrum of scenario spaces to represent different management fields: technical, technological, organization, economic, lawful and etc. It was defined as scenario operations in scenario space. Thus, scenario calculus was created.

The applied areas are quite wide: a management to provide ecology security; researching sociological and economic system; scheduling and planning; working out effective technology for Production and Logistics; real steps of financial crises; effective strategies for investments and others. Advance imitation system of decision-making supporting based on the scenario methodology has been developed.

Key words: scenario, control, stability

1. Introduction

Scenarios of development of socioeconomic systems reflect changes in the states and characteristics of their elements, including potentially important objects, and serve as a link between formulation of goals and generation of particular plans of works control systems. The scenarios are used as the main tools of analysis of the variants of preventive measures for cases of emergency threat, choice of efficient decisions, and coordination of actions in different spheres of human activity. These measures are realized by computerized management systems. The paper proposes models and methods for formalization, generation, analysis and synthesis of scenarios of development of complex systems.

Decision-making assumes that information describes the analyzed system from different sides, including data about its creation, functionality and developing. There are two special problems of the decision-making process. The first problem is to represent information as a sequence of events. Note that decision-makers analyze and choose the effective control with the help of their own professional language. Therefore, the other problem is to interpret their idea and analysis of the situation in a proper way. We suggest methodology to solve the problems. It's based on the creation of a spectrum scenarios, which define main schemes and directions of possible system development under given hypothesis.

Representation of sequence of the states as spectrum of scenarios is situated and object-oriented method of data reflection to analyze the problem by natural language. This approach may be used as main tool for effective decision-making and coordination of necessary control system actions.

In control theory the notion named «scenario» is a new notion. Often it is being used in a wrong way because a formal definition has not been given. In the paper it will be given a mechanism, which if it is realized wile enable to synthesize scenario as the tool for semiautomatic analysis of alternative variants of development situation under conditions which decision-maker considers as important limitations. Two general concepts from control and mathematical point of view as «opposite» points of view were researched: chaos theory and cybernetics.

Our scientific project is supposed to create a new effective semiautomatic tool. It's expected to be used for analysis and synthesis of complex social and economic systems. It allows construct of advising expert systems, which automate a decision-making process. The new principle called «scenario methodology» was developed in order to create this tool. In order to describe behavior of the system object the subject-object methodology was used. There were distinguished six modules responsible for describing this object: identical object model, environment model, living model, measurement model, measurement envronment model, and selection model. It was constructed a formalized event, situation, scenario, principles and methods to define topological structures, create scenario characters, and indicate its properties. There constructed a spectrum of scenario spaces to represent different management fields: technical, technolcal, organization, economic, lawful and etc. It was defined scenario operations in scenario space. Thus, scenario calculus was created.

The applied areas are quite wide: a management to provide ecology security; researching sociological and economic system; scheduling and planning; working out effective technology for Production and Logtics; creating strategies to eliminate extreme situations; expending nuclear weapons over the world and other catastrophe in large-scale systems, real steps of financial crises; effective strategies for investments and others.

Advance imitation system of decision-making supporting based on the scenario methodology has been developed. We intend to discuss analytic and experimental results of our research. Some applications will represent: directive or economical limitation of production as main resource to eliminate ecology polltion, «500 days» economical conception by G. Yavlinsky, analyzing of macro economical parameters, expening of computing technology in Russia and others.

2. Generation of the behavior scenarios: initial formalized notions

Formalized notions of the proposed concept of scenario generation were introduced in [1]. The following formal constructs are used: identified system model $M_O(Y;U;P)$, environment model $M_E(X)$, system-behavior model $M_D(Q)$, system-state measurement model M_{MO}, environment-state measurement model M_{ME}, and rules for choosing the profile of object variation $\acute{A}$ (choice model). The set ***M*** =($M_O(Y;U;P);M_E(X);M_D(Q)$, M_{MO}; M_{ME}; $\acute{A}$) of system description will be referred to as the *system metaset*, and its elements will be referred to as the *main elements of the metaset.*

From the point of view of control theory, the special feature of the first model is the presence of the parameters of description of the controlled object, including the vector of phase variables $\mathbf{y} \in Y \subseteq E^m$, vector of controls $\mathbf{u} \in U \subseteq E^r$, and vector of allocated resources $\mathbf{p} \in P \subseteq E^s$.

The main components of the environmental model involve exogenous values to be analyzed in the form of the vector $\mathbf{x} \in X \subseteq E^n$. Within the scope of available information, the decision-makers (DM) make various assumptions about the variations and interdependencies of these values which they cannot control or change arbitrarily. The model $M_E(X)$ is necessary for formal extraction and description of both the exogenous values and their relationships.

The model of system behavior $M_D(Q)$ describes in formal terms the dynamics of variations of the system phase states which is described using the procedures of transformation of the characteristic parameters, as well as the conditions of their interaction with the values describing in formal terms the environment. Here, we formulate the constraints Q that define the conditions for the behavior of the controlled object.

The models M_{MO}, M_{ME} and $\acute{A}$ describe monitoring and expert identification procedures both for system and environment states. From the point of view of the researcher these models may be consider as information transformer. Its input data contain estimated system and environment parameters. Output data fix their true values from the point of view of the decision-maker [1]. Thus, the transformers form internal and external information fields.

Therefore, the scenario of behavior of the system object is sequence of the states which a system of models is described as the process of variations of its parameters and operation conditions. The states mark the transitions to new qualitative states that are of importance from the point of view of the researcher. It is advisable to differentiate the object control scenario from the object behavior scenario. The former scenario is generated depending on the goal of control and the rule for choosing the control actions, whereas the latter scenario is oriented toward the goals of studying the object. The main difference lies in the fact that the object control scenario includes the subject of control (the operating side) which not only pursues a certain goal, but also actively participates in its realization. This distinction allows the research of both passive and active complex systems.

To make a decision, the operating side performs a certain sequence of steps. Let us consider the stages of *monitoring the chosen parameters* and *choosing the control actions* from the standpoint of the DM.

We assume that $\vartheta \in M_0 \subseteq E^d$ is the set of values of the transformation $\Lambda : E^{r+s+l} \to E^d$ which defines the set of all values of the monitored factors.

By the *controllable monitored factors* (CM-factors) are meant the components of the vector $\vartheta = \Lambda(\mathbf{u}, \mathbf{p}, \Delta)$, where $\Delta = [\tau_1, \tau_2]$ is the interval over which the vector functions $\mathbf{u}(t)$ and $\mathbf{p}(t)$ are defined. It is only natural to assume that $U \subseteq \mathrm{M}_0 \subseteq E^d$. Therefore, in the course of control the DM follows (monitors, measures) the values ϑ and, if necessary, determines the values $\mathbf{u}(t)$, $\mathbf{p}(t)$, and Δ as the solution of the inverse control problem such as the problem of designing the optimal control.

The choice of the CM-factors depends on the goals and conditions of operation [2, 3].

Some factors are generated independently of the operating side and are uncontrollable.

Uncontrollable factors, which include, in particular, the uncertain natural factors, are grouped in the degree of information available to the operating side:

uncertain factors — the vector $\boldsymbol{\alpha} \in N_0 \subseteq E^k$: the operating side knows only the set N_0 of their values, and

random factors — the vector $\boldsymbol{\beta} \in B_0 \subseteq E^l$: the operating side knows the set B_0 of values of the random variable $\boldsymbol{\beta}$: in additional, some information about the law of distribution (that is, the distribution function or probabilistic measure) $\nu(\boldsymbol{\beta})$ of this random variable is known either precisely or to the extent of $\nu(\boldsymbol{\beta}) \in \Omega$, where Ω is the set of distribution laws.

By the *conditional solution* is meant the point $\varsigma = (\vartheta, \boldsymbol{\alpha}, \boldsymbol{\beta})$ of the set $\Gamma_0 = M_0 \times N_0 \times B_0$, and the set Γ_0 itself is called the *set of conditional solutions.*

If there exists a set of alternative variants for achieving the goal, then the DM formulates the priority rule for choosing the CM-factors: the criterion $W_{ef}(\varsigma)$ for operation efficiency. The operating side tries to choose the CM-factors so as to maximize the value of the function $W_{ef}(\varsigma)$.

To construct the scenario of object behavior with the aim of making a control decision, it is advisable that the DM is able to structure the information about uncontrollable factors. The information available to the operating side by the time of making and executing the decision is formulated as an informational hypothesis. This notion is widely used in operations research theory as a means of substantiating the applicability of the *principle of guaranteed result,* which is the basic procedural principle for constructing efficient DM strategies. From the point of view of the goals pursued by the authors of this approach, this was sufficient when the problems of DM information were at the foreground. However, when similar structures are used in control theory, some important factors remain unaccounted for which makes their detailed description a must. In particular, the problems of structural organization of the object, effect and distribution of the actions, volume of allocated resources, and so on are not considered in precise terms.

These factors are the CM-factors or information characterizing the degree of "completion" of the ele-ments of the main metaset; that is, they reflect, in essence, the degree of model completion upon using the concept of incomplete modeling [4].

By the *quasinformational hypothesis (QIH) of the DM* will be meant the totality of images of the arbitrary map $\Theta:\Gamma_0 \to \Gamma_0$; by the time when a decision is made, the operating side knows the construct $\Theta\ (\varsigma)$, which defines the particular situation in terms of the CM-factors (completely constructed model). To make efficient decisions, it is advisable to describe in detail the possible variants of information, methods of organization, assignment of control functions, and so on, that is, to formulate this information in precise terms of informational hypotheses by which the DM abides when analyzing the object behavior and controlling it.

The proposed scheme of elements, which is formalized in the main metaset, is used as the procedural principle of structuring the QIH:

(1) by the *external uncertainty* is meant uncertain factors that are weakly, if at all, controlled by the DM, such as the parameters of internal and external, for the object, conditions, various ecological, demo-graphic, foreign-policy, and external-economic factors that do not yield to control by the DM, the possi-bility of supplying additional resources from outside the system, and so on. They, therefore, include the exogenous values $\mathbf{x} \in X \subseteq E^n$ that characterize the environmental model, the class $\check{\mathbf{D}}$ of incomplete models of object behavior, the set Q of constraints that are imposed on the conditions of operation of the object in its behavioral model, which are defined as the conditions $\mathbf{x} \in Q$, and the possibilities of choos-ing the means for measuring the environmental state and object trajectory, that is, the class of models $\hat{\mathbf{I}}$ where the methods and means of measurement can be chosen. We note that the methods and means them-selves as elements of the aforementioned models are the CM-factors. Part of the QIH information field that was localized in the external uncertainty we named external informational hypothesis of the DM;

(2) by the internal uncertainty is meant the totality of the factors that the DM's monitor incompletely but on which they can exert some influence, such as the internal political and socioeconomic situation in the controlled system, the availability and suitability of the resources at the DM's disposal that are required to attain the goals, the efficiency of the control system, the skill and morale of personnel and experts, secon-dary risk factors and their cause-effect relationships, and so on. We mention among such factors the nomenclature$\mathbf{y} \in Y \subseteq E^m$ of the phase variables, nomenclature$\mathbf{p} \in P \subseteq E^s$ of the resources used, the set Q of conditionally admissible states (therefore, it is assumed that $\mathbf{y} \in Q$ }, the set $\check{R}$ of goal states defining the desirable goal for the end of the planning period, and the transformation Λ. Part of the QIH information field that was localized in the internal uncertainty we named *internal informational hypothe-sis of the* DM;

(3) by the *structural uncertainty* is meant the degree of "completion" of the object model, in particular, the degree of destruction or development of the system elements. The main factor of structural uncertainty is represented by the data of the model $M_D(Q) \in \check{D}$, which is then regarded as complete for the given planning horizon. The subsystems of the hierarchical organizational control system are generated in compliance with their functions. The organizational structure is generated depending on the goals that are attainable at each hierarchical level; here, the totality of goals of the subsystems of one level must be aimed at attaining the goal of the upper master level. For a wide variety of objects, it is only natural to rely not only on the formal methods, but also on the user's experience and intuition, which often are preferable. The scheme of incomplete modeling orients the user toward the processes of model construction and decision analysis and the procedure of problem solution, whereas the DM makes the final decision. The *compact image of the incomplete model* of system behavior [4] offers a way of defining the structural-organizational component of the QIH. Part of the QIH information field that was localized in the structural uncertainty we named *structural-organizational informational hypothesis of the DM (SOI-hypothesis).*

Part of the QIH is made up of the submodel of the choice model that determines the rule for choosing from the which indicates the instants of measuring the trajectory of the object behavior.

3. Formalization of the scenario elements and stages of its construction

By the *expected event* of object behavior is meant the triple $\Im=(\mathbf{x}(\mathbf{t}),\mathbf{y}(\mathbf{t})\mathbf{t})$, where t is the time instant chosen by the rules $A^{(t)}$ and $\mathbf{x}(\mathbf{t})$ and $\mathbf{y}(\mathbf{t})$ are the expected realizations of the parameters of envi-ronmental description and phase trajectory, respectively, that were obtained at time t using the models *of* M.

By the *situation* S(t) at time t is meant the chronologized set of events that occurred before t :

$$S(t=\{\Im^{(i)}(x^{(i)}(t_i),y^{(i)}(t_i),t_i)\ 0\leq t_i\leq t,\ i=0,1,\ldots,s;\ t_0=0\}.$$

By the *conditions* I(t) at time t is meant the pair (S(t),Θ(t)), where S(t) is the situation at time t and Θ(t) is the DM QIH.

By the *scenario* $\Re$ *of object behavior* from the DM point of view is meant the sequence of pairs $(I(t_i),t_i)$that was generated using the choice rules :

$$\Re=\Re\{(I(t_i),t_i)|\}\ i=0,1,\ldots,N;\ t_0=0.$$

Here, N ,$T=t_N$, and $\tau_i=t_{i+1}-t_i$, are called, respectively, the *scenario depth*, *scenario horizon*, and *scenario time* step. Depending on $A^{(t)}$ the time step can be either fixed or variable, which is defined by the strategies that are used by the operating side to construct the scenario.

The generated scenario enables one to reflect adequately the behavior of the object, develop strategies for organization and realization of the preventive and operative measures aimed at changing the situation, plan actions for long and short terms, carry out qualitative analysis of the aftereffects, and also to forecast the anticipated losses, damage, and risk.

The formalized scheme enables one to represent the generation of a scenario at time as a sequence of several stages:

(1) The models **M** are used to estimate the initial state of the object, that is, refined $\Im^{(k)}(t_k)$.

(2) Some basic state of the metaset is fixed in the form of a possible set of CM-factors, thus, providing the set $M_o(t_k)$.

(3) The situation $S(t_k)$ is estimated, that is, the estimates of the preceding events are updated with regard for the current state of the models M.

(4) The current situation is formalized by fixing the current DM QIH $\Theta(t_k)$.

(5) The possibility of continuing the generation of a scenario in the given direction depending on the current state of its main forming elements and environmental conditions of the socioeconomic system (SES) or

the need for scenario subdivision (detailing, consideration of fragments, and so on) are established.

(6) The set M_0 (t_k) of strategies of scenario generation depending on the formulated QIH is chosen.

(7) The rule of estimation of the scenario generation strategies is refined.

(8) The strategies of generation of the operating-side scenarios depending on the DM information are estimated.

(9) The scenario horizon as the choice of the component Δ (t_k) of some point $\varsigma=(\vartheta,\alpha,\beta)$ of the set of conditional solutions $\Gamma_0=M_0 x N_0 x B_0$ is updated.

(10) The degree of scenario detailing is refined.

(11) The current event and time step are chosen upon realizing the chosen strategy of scenario generation.

The proposed scheme is a constituent part of the process of logical modeling, which is carried in stages. Here, a complete logical model - triad scheme consisting of the executive structure (object), scenario, and "stage director" (control system) - is generated and studied at each step. The scheme features in-variance to particular methods of scenario generation, which can be classified as nonformalized (expert), partially formalized (interactive), and formalized methods.

The *nonformalized* methods include the methods of scenario generation where priority is given to the opinions of experts. The *formalized* methods include the methods of scenario generation based on automatic or computer-aided procedures, as is exemplified by scenario generation using cognitive cards and formal grammars. The *partially formalized* methods include schemes of formalized construction that are corrected on the basis of expert estimates. The actual behavior of the object, which usually differs from that generated in the scenario, is generated in the course of operation depending on the interaction of the object components among themselves and with the environment. The arising mismatches initiate the DM decisions that are made interactively.

4. Scenario spaces and scenario calculus

The proposed approach to formalized scenario generation virtually introduces a special *scenario space* $Z^{(SC)}$ whose characteristics and properties were first investigated in [1]. The set-theoretical approach - decomposition of the extended phase space Z into subsets characterizing the qualitative properties of the object (phenomenon or process) under study that are of importance to the expert - provides a natural way of introducing $Z^{(SC)}$ for the formalized expert's description of operation of the object. Here, ex-perts define the "workspace" $Z^0 \in Z$ where the modeled process is considered.

The expert's description is based on the notions of expert-important decomposition (EID) of the extended phase space Z and *expert-important event* (EIE) occurring sequentially in compliance with the ordering system $\Re(\Xi)$ defined by the objective natural laws (basic model). Analysis of the basic model establishes the basic scenarios of object behavior. In this approach, a diversity of scenarios is ensured by generating different EIDs and systems for EIE ordering, which is the subject matter of the proposed DM QIH. The reader is referred to [1] for the definitions.

The next step in scenario generation consists in establishing the interrelations between the elementary EIDs. The choice of the EIE-effect strategy can be based on various considerations. There exist two basic extreme possibilities: the effect defined by the exogenous expert method (synergistic approach) and the endogenous effect based on describing in detail and taking into account the transients - in particular, the transients with a desirable goal - (attractive approach). A spectrum of scenario variants lies between these two opposite point. The model of object behavior where the EIDΞ $=\{\{Z^{(\alpha)}\},A^{(e)}\}$ and the effecta $\Re(\Xi)$ EIE are defined is called the EID-model. The immediate effect of the ElEs, the path of a given length, the probabilistic characteristics of the EIE effect, and so on, are defined in a natural way. As soon as some QIH is fixed, one can determine the order of the ElEs.

The expert description is based on the notion of ***expert-important decomposition*** (EID) Ξ of the space Z and *expert-important events* $\mathfrak{I}_{ev}{}^{(\alpha)}(t)$ (EIE) which occur in the sequence indicated in the ordering system $\Re(\Xi)$ which is defined by the objective natural laws (basic model).

The object behavior model where the EIDs Ξ $=\{\{Z^{(\alpha)}\},A^{(e)}\}$ and sequence of ElEs$\Re(\Xi)$ are defined is called the EID-model $\mathbf{M}(\Xi,\Re(\Xi))=\{\Xi,\Re(\Xi)\}$. The immediate sequence EIE $\Sigma(Z^{(\alpha)},\Re(\Xi))$, path $W\gamma$ $(Z^{(\alpha)},Z^{(\beta)},N)$ of the given length N, characteristics of EIE sequence, and so on are defined in a natural way [5].
To construct a scenario, one assumes that the following two time scales are used:

- the (usually continuous) scale ZT for describing the dynamic trajectories of an object of the extended phase space Z and
- the discrete-time scale $\Re T$ for the events of the generated scenario.

From the DM's point of view, by the scenario $\Re$ of object behavior is meant the sequence of pairs $(I(t_i),t_i)$ generated according to the choice rules $A^{(t)}$. As soon as some QIH in the form $M^{(QIH)}(t)$ is registered at time $t\in ZT$, one can determine the current EIE by choosing the CM-factor $\vartheta=\Delta$ (u, p, Δ) according to the chosen strategy $\check{C}$ of generation of the scenario $\Re$. The rules $A^{(s)}$ are used to generate $\check{C}$. Each point $z=(x,y)\in Z$ together with the elements of the metaset and the QIHs $M^{(QIH)}(t)$ fixed at each time instant $t_{(i)}\in ZT, i=0,1\ldots$, or on some horizon of the scenario T define, therefore, the object behavior scenario $\Re\in(z,I(t_i),t_i)$ proceeding from the point z as a se-quence of QIHs, strategies of scenario generation, rules for their choice, and their corresponding expected events. Determination of the scenario as a sequence of ElEs and QIHs, that is,

$$(1)\Re= \Re\{(I(t_i),t_i)\}$$

is oriented to the user which is "external" relative to the process of problem analysis and DM. In contrast to 0, the detailed technology of obtaining this sequence as a set of strategies and choice rules

$$\mathfrak{I}_{ev}{}^{(\alpha_{i+1})}(t_{i+1}) = \mathfrak{I}_{ev}{}^{(\alpha_i)}(t_i), M^{(QIH)}(t_i), \check{C}(t_i)).$$

is intended for the expert responsible for formulation and solution of the problem.

To construct a special -step scenario space we recommend making next steps in 0 form:

- construct the EID-model;
- generation of the packets of k -step uncertainties;
- generation of the packets of k -step strategies;
- generation of the packets of k -step rules of efficiency estimation.

Each scenario space describes one unique control field component, that is, to represent different management fields: technical, technological, organization, economic, lawful and etc. Thus, generated scenario

Let K be an arbitrary set of elementary EIDs. There exists the closed set K that is characterized by the fact that, as soon as the trajectory reaches it, only its events can occur in the scenario. Extraction of the corresponding system structures and the preventive actions or controls retaining closedness relative to the set of EIDs are of great interest for analysis of the SES and various emergencies.

Therefore, when the EID-model is used to study the SES for stability, some set K of EIDs is regarded as the aim of study.

Let us consider some questions which must be answered when studying the EID-model for K-stability:

1. Are there closed sets for the EID under consideration?
2. Is there a scenario of attainability from the given EID $Z^{(\alpha)}$ for the given closed set K ?
3. What are the estimates of the attainability time for the given sets of EIDs?

A negative answer to the first question means that the EID-model and object described by it are not sta-ble. In terms of the above definitions, the lack of scenario stability of the EID-model means that it is sce-nario-irreducible.

Attribute of the Absolute Scenario Instability. The EID-model is absolutely scenario-unstable if and only if there exists an attainability scenario for each pair of the elementary decompositions $(Z^{(\alpha)}, Z^{(\beta)})$ and $(Z^{(\alpha)}, Z^{(\beta)})$ [1, 5].

Using the above approach we have got stability conditions for Markov systems. Scenario spaces building on EID-model on the operator oriented graph allowed produce the imitations and research the Pulse Stability of SES. The production system describing on von Neumann model was been tested on turnpike stability.

Conclusions

The above results have demonstrated the feasibility of formal methods for generation and analysis of the characteristics of SES development scenarios with the aim of making substantiated control decisions. It is suggested to employ the methods of analysis of SES stability characteristics for making strategic control decisions.

The results obtained demonstrate the feasibility of the apparatus of scenario analysis of complex systems. Its main stages are as follows:

- choice of the goal of system study;
- choice of the scenario classification attribute;
- construction of the EID-model of the system;
- choice of the packets of k -step uncertainties;
- choice of the k -step strategies of scenario generation;
- indication of the scenario space where the analysis is carried out; and
- application of formal operations to the resulting scenarios. It is hoped that a more detailed development of the methods of generation and analysis of the behavior of a complex system on the basis of the scenario calculus could not only allow one to obtain rational solutions to the control of socio-economic processes, including emergencies, but to investigate a number of new promising applications as well.

reflects object behavior into the component. To construct the integrated scenario we create integrated scenario space adding the next steps:

- generation of the integrated packets of k -step uncertainties;
- generation of the integrated packets of k -step strategies; and
- generation of the spectrum or unique integrated scenario.

Packets of k -step uncertainties and strategies can be generated according to the recommendations of [6]. The EID-models and integrated EID-model are constructed using the following procedures based on the principles presented in [7]:

- construction, structuring, and determination of the characteristics of the EID-models describing the behavior scenar-ios of the object into researched control field component;
- construction of a unique integrated EID-model incorporating the general and specific parts of individual scenarios;
- determination of the degree of generality of the elements and parts of the integrated EID-model; and
- identification of the subsets of the EID-models of the unique integrated EID-model which have different levels of generality.

We define topological structures, create scenario characters, and indicate its properties. It was defined scenario operations in scenario space. Thus, scenario calculus was created.

The important part of our research consists of the optimal scenario problem. Formalization and some of the possible approaches to solve the problem the reader is referred to [8].

These constructions are based for scenario methodology analysis.

5. Applications

The applied areas are quite wide: a management to provide ecology security; researching sociological and economic system; scheduling and planning; working out effective technology for Production and Logis-tics; real steps of financial crises; effective strategies for investments and others. Advance imitation sys-tem of decision-making supporting based on the scenario methodology has been developed.
We research stability of the behavior scenario of complex systems as application in more time than an-other one.

The most important feature of SESs is their stability (lack of emergencies) in the course of their operation and development. From the most general standpoint, it can be formally characterized as the presence of the following conditions of system operation:

1. the possibility of defining and retaining some system parameters within the given domain of the phase space $\mathbf{v} \in Q$, that is, observability and controllability of the system,
2. prevention of critical phenomena that wreck the SES elements and/or their relationships (resonance, runaway, and so on), and
3. the possibility of ensuring that in the phase space the object moves in the given direction - for example, in the direction of stable balanced growth $\bar{\bar{e}}$ - that is, formulation and efficient solution of the problem of deriving, executing, or continuing the system-behavior scenario along the given turnpike. Notion of stability must be considered not only in connection with the system structure, but also with the possible control actions and behavior of the environment. In terms of the operative use, these controls can be divided verbally into two main groups of static and dynamic controls.

To analyze the problem we introduce some new definitions: $\Re$ *-scenario-connectable points,* $\Re$ *-scenario-connectable events,* $\Re$ *-scenario-connectable elementary decompositions, connect-ability and attainability scenario, and expert-absorbing decomposition.*

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