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Innovative management models of viable and stable development of technogenic region in crisis

Sultan Ramazanov

Volodymyr Dahl East-Ukrainian National University, Lugansk, Ukraine

S u m m a r y . In modern conditions of instability, systematic crises and global transformations the problem of developing methods and technologies for analysis, modeling, forecasting and decision making for stable development of viable socioeconomic systems has become the most important. In the paper there has been proposed models and control technologies of viable, stable and safe development of systems based on the type social–ecological–economical and humanitarian subsystems integrated object and subject oriented approach.
Key words: social, ecological and economic systems, object-subject-oriented approach, management.

INTRODUCTION

Currently the issues of civilization ecological and safe development have become the first point of scientific researches and public consciousness. Humanity has come to that point when modern civilization have often called technogenic–exploitative one has reached its dead-lock when it is necessary to take serious actions to review its basis, make conscious choice of another spiritual-ecological development strategy. The humanity has to refuse from some thinking stereotypes and forward innovational development vector for mind sphere's formation (noosphere, according to Vernadsky V.I.).The formation of noosphere-ecological imperative is related to the establishment of the society capable to provide co-evolutional development of socio-natural integrity, which is the most actual nowadays.Steady and safe development is impossible without cultural–spiritual development of the person itself. New model of civilization development has to have deep humanist social orientation by implementing non- traditional social, ecological and demographic imperatives. Such approach towards noosphere perception requires new development model, which should be based both on rational intellectual approach to ecosystem assessment and rely on its spiritual-cultural components. If the intelligence is the activity optimization mechanism on the way to noosphere than spiritual moral criteria are its assessment characteristics as the spirituality is opposite to the issues of material nature, not to rational or irrational aspects.

That is why taking into account current conditions of instability and crises the issue of assessment, modeling, forecasting and solutions taking methods and technologies development becomes more and more up-to-date. These human-dimensional systems are characterized by the complexity of their structure and action, synergy, nonlinearity and have a lot of "NOT" and "MANY" factor characteristics. Moreover, another important problem lies at the research of the systems having integral peculiarities – i.e. the systems having social–ecological–economical and humanitarian subsystems in their structure (SEEHS) as the systems of future (noosphere type systems). Local manufacturing systems and regional level economical activity units such as technonegic manufacturing companies and systems (TMS) are the systems of SEEHS type.

The management and solution taking methods and models on units oriented approach basis have been traditional employed for these issues research and resolution. Though, some recent scientific researches and scientific schools with the accent on the importance and necessity have proved the need of behavioral dynamics and

management subject taking into account for such tasks resolution by means of subject oriented and reflexive approaches [Lefevr 2003, Lepsky 2009, Lepsky 2010].

This research offers management models and technologies of region TMS viable and steady development as the system of SEEHStype on integral unit and subject–oriented approach basis. It offers conceptual, synergetically generalized dynamic model which takes into account various uncertainties types and the option of non-linear dynamic model of management subjectbehavioral and solutions taking model – i.e. the model of solution taking person (STP) and others.

The peculiarity of management solution taking processes during current conditions of general social-economical, ecological, social humanitarian and system crisis, the conditions of necessity and importance of society structures steady and viable development lies at the necessity of taking into account the influence of uncertain factors and review all possible consequences of alternatives choice. That is why the development of models and informational management and solutions taking technologies on the conditions of uncertainty, risks, destabilization and crises is of big practical importance. The aforementioned models and technologies provide structuring and processing of information about resolved problem and partially fill informational gap of apriori data the manager has. Though, the recommendations on management and solutions taking obtained with the help of formal models should be taken into account only in cases when the offers, lying in the basis of such models, correspond to uncertainty actual nature and source. It is necessary to understand the essence and variety of uncertainty factors and related risk and danger notions, influencing the organization.

It is worth mentioning that the development and research of integrated economical mathematical models (EMM) and the usage of informational and innovational technologies at ecological and economical management of such socially and ecologically oriented units as TMS is up-to-date issue as well [Ramazanov 2004, Voronkova, Ramazanov, Rodionov 2004, Evtuh, Shevchenko, Ramazanov 2005, Ramazanov, Pripoten 2006, Ramazanov 2008, Evtuh, Shevchenko, Ramazanov 2009, Ramazanov, Nadion, Kryshtal, Stepanenko, Timashova 2009, Ramazanov, Aptekar 2010]. Such approach is fully confirmed by the opinion of a lot of well-known scientists about steady development concept. The steady development concept has appeared due to uniting of three main models and points of view (triune model): economical, social and ecological one. Mostly this model is the continuation of noosphere concept about "obligatory coordination of economical, ecological and human development to keep human life quality and safety, environment condition and social progress on steady level, taking into account the needs of each individual", formed by VernadskyV.I. Theory and practice confirms that VernadskyV.I. theory has turned out to be necessary platform for the development of triune concept of steady ecological social economical development and the construction of integral model of "socially oriented ecological economics" and "knowledge economics" – i.e. the model of "intelligent society" – the highest form of society development based on knowledge and innovational technologies [Ramazanov 2004, Evtuh, Shevchenko, Ramazanov 2005, Ramazanov, Pripoten 2006, Evtuh, Shevchenko, Ramazanov 2009, Ramazanov, Nadion, Kryshtal, Stepanenko, Timashova, 2009, Ramazanov, Aptekar 2010]. It is worth mentioning as well that according to the opinion of internationally approved specialist in the sphere of economical competition research - M. Porter "the counties with the most strict environment protection legislation have the highest economical indices". This means that M. Porter disproves common opinion about strict ecological policy negative influence over the country competitiveness. That is why the share of social ecological safety is very important at GDP. In the conditions of society's further transfer to the sixth and especially the seventh technological economical development stages it is significantly important to take into account social-humanitarian aspect, reflexive and subject oriented approaches and other during integral models and technologies creation. The present article is devoted to the study of the aforementioned methodological issues.

OBJECTS AND PROBLEMS

Find below some signs and definitions: environment (environment - surrounding nature, ecosphere) - En; economics (economic – economical system) - Ec; social sphere (social – social system) - So, appropriate synergetic peculiarities of their integration model are the following: viable – i.e. ecological–economical surrounding - En+Ec; social oriented (equitable) economical system - So+Ec; social-ecological (bearable– acceptable, reasonable) system -

So+En; system (concept) (sustainable) development – makes: So+ En + Ec (fig. 1).

The notion of sustainability (steadiness, viability) supposes the capacity of the system to function on the conditions close to equilibrium on the conditions of steady external and internal disturbing actions. The system functioning and development complications factors are the following: external and internal threats, dangers, crises, uncertainties, instabilities and other "NON" and "MANY" factors together with new informational and innovational technologies and others [Evtuh, Shevchenko, Ramazanov 2005]. The development of social ecological economical monitoring, management and efficient solution taking integrated system for the solution ofTMS economy socio–ecologization, particularly for the decrease technogenic companies manufacturing activity negative influence over environment and maintain social infrastructure on the conditions of economic reforms.

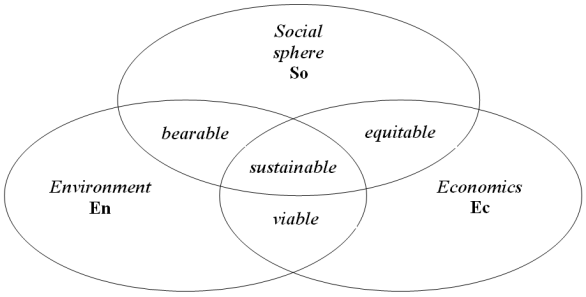

Fig. 1. Integral system diagram

This research is devoted to the issue of TMS social-ecological economical management, functioning at current conditions of instability and uncertain surrounding. Innovative integrated intellectual informational system of TMS ecological economical monitoring, modeling and management. The system basis lies at the developed concepts; complex of non-linear models, solutions taking methods and EEM; integral criteria (economical, ecological, social, technological transport and others); the idea of "five plus"with integral management model of social economical, ecological and social humanitarian system, taking into account the range of factors: *<Ec, En, So, CM; S, IT; I>*; both endogenous and exogenous and two conclusions - "useful" and "harmful" ones; based on mixed informational base: determined, scholastic, multiple and unclear information forSEEHS TMS and other.

Specific attention is paid to the issues of informational, innovational technologies and EEM TMS economical mathematical modeling processes usage. This research mentions the following important innovational instruments and technologies for set tasks' solution: modern methods, models and informational technologies for assessment and synthesis of management and solution taking systems, forecasting, management methods, anti-crisis management innovational technologies and TMS safe management innovational instruments. The issue of integration at modeling, management and solutions taking is the most important fundamental issue of economics and science in general [Ramazanov 2004, Ramazanov, Pripoten 2006, Ramazanov 2008, Ramazanov, Nadion, Kryshtal, Stepanenko, Timashova 2009, Ramazanov, Aptekar, 2010].

THE DECISION OF THE TASK

The conceptual model of integral ecological-economic, social humanitarian management of complex system on the conditions of uncertainty, instability, "NON" and "MANY" factors and other can be presented in the form of the following theoretical- multiple range:

$$IS := \langle \langle E_c, E_n, S_o, \mathrm{H}_u \rangle; \\ \langle X_I, Y_I, F_I, G_I, K_I, \Omega_I \rangle, R_I, U_I, E_I, T \rangle, \quad (1)$$

where: $\langle E_c, E_n, S_o, \mathrm{H}_u \rangle$ - makes an integral range of systems' main set, where Eclies for economics (economical system); En lies for surrounding (ecosphere); So lies for social sphere (social system); H_u - lies for humanitarian components of the model. The range $\langle X_I, Y_I, F_I, G_I, K_I, \Omega_I \rangle$ consists of the commonly known components for each aforementioned system. $R_I = \langle R_c, R_n, I_n, \tau_{II}, R_S ... \rangle$ - lies for the range of resources, where R_c and R_n lie for economic and ecological resources; I_n lies for investments; τ_{II} lies for informational and innovational potential; R_S lies for the source of provision of the security from the complex of threats, risks and other.

General scheme of system sustainable and socio-humanitarian development integration model can be presented in form of symbol called "Integrator", which is commonly used at cybernetics (fig. 2). Fig. 2 uses the following definitions: E_c – economical system, E_n –

ecological system, S_o – social system, H_u – humanitarian system; $S = E_n \oplus E_c \oplus S_o \oplus H_u$ - integral "4 united" system; $X(t,r)$ – the condition of integral system S; in the space of variables $(t,r) \in [T \times R^3]$; X_o – the condition of S system at initial period of time t_o; W – various disturbing variables (factors) of external surrounding.

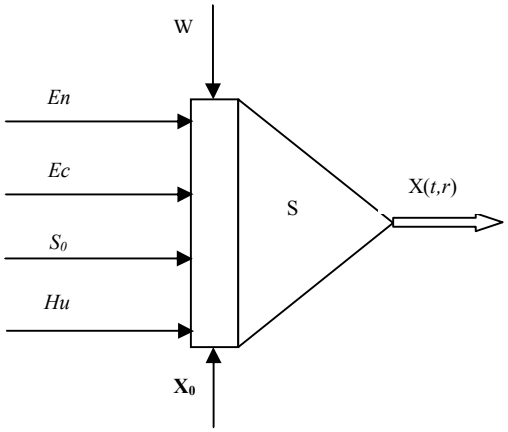

Fig. 2. System development integration model scheme

It is worth mentioning that for ecological economical modeling and management the following symbols have been used: $Y = \langle Y^{Ec}, Y^{En} \rangle$ lies for TMS overall output, where Y^{Ec} lies for efficient set(i.e. "efficient output"), and Y^{En} lies for pollution set (i.e. "harmfuloutput"); X lies for the TMS set of possible conditions; $F = \langle F^{Ec}, F^{En} \rangle$ lies for TMS model reflection; $H = \langle H^{Ec}, H^{En} \rangle$ lies for observations (measurements) general operator; G lies for targeted set; K lies for generalized criterion of management and solutions taking; Ω lies for limitations set; R lies for resources set (i.e. TMS controlled input); $U = \langle U^{Ec}, U^{En} \rangle$ lies for EEM set (the set of managing influences); E lies for the set of uncertain disturbances (both external and internal ones – i.e. additive and multiplied ones). Particularly it goes about the set of scholastic, uncertain, multiple or mixed uncertainty; T lies for time interval of TMS functioning and development. The symbol of "Ec" and "En" appropriately mean economic and ecological variables [Ramazanov 2008].

So the task of TMS EEM lies at the definition of efficient generalized U на management vector based on TMS dynamic ecological–economic model, providing the task fulfillment on the set generalized ecological economical criterion and limitations taking into account the conditions of uncertainty and risks.

Particularly, the synergetic model of non-linear complex ecological-economical system (EES) dynamics management taking into account scholastic and chaotic behavior has been presented in form of differential equation system:

$$\partial x_i / \partial t = \left[\lambda_i \xi_i(t) x_i(t) \left[X^0 \pm \sum_{j=1}^{n} a_{ij}(t) \prod_{k=1}^{j} x_k(t) \right] + \sum_{l=1}^{3} d_{il} \frac{\partial^2 x_i}{\partial r_l^2} + w_i \right] + \quad (2)$$

$$+ b_i u_i(t), \; i = \overline{1,n}, \qquad \bar{x}_i(0) = x_{i0},$$

where: $X(t,r) = (x_1(t,r), x_2(t,r), ..., x_n(t,r))$ – lies for social ecological economical system condition vector (particularly TMS), where $\{x_{i0}\}$ lie for initial conditions vector coordinates; $\langle \xi_i, w_i \rangle$ lies for scholastic, multiplicative, additive disturbing components of the model; $\{a_{ij}(t)\}$ lies for matrix elements defining non stationary model components; $\{u_i(t)\}$ lies for managing influences vector coordinates; $\{b_i(t)\}$ lies for management vector coefficients; $\{d_{il}\}$ lies for diffusion coefficients – i.e. the coefficients taking into account the effect of such spread (distribution); X^0 lies for maximum value of n-dimensional vector $X(t,r)$, where r lies for 3- dimensional vector; λ_i lies for measurement responsible for system chaotic behavior, and $t \in [0, T]$ lies for time interval of system functioning and development. Moreover, such model allows taking into account both risk and security level have their own dynamics and are scholastic processes.

The generalization of integral system diagram at fig. 1 is 4 unite integrated noosphere model ("civilization model") of system development which is social–humanitarian and ecological economical system, presented at figure 3. Figure 3 shows the following system components (sub systems): 1–Economics, 2–Ecology, 3– Social sphere, 4– Humanitarian sphere together with appropriate integrated (synergetic) peculiarities:1.2– "Viability" (ecological-economical),1.3– «Justice» (socially oriented),1.4– «Culturology orientation» (humanitarian-economical), 2.3 –«Acceptability» (social-ecological), 2.4– Humanitarian-ecological, 3.4– social–humanitarian. More refined peculiarities of integrated system such as 1.2-1.4, 1.2-2.3, 2.3-3.4, 1.4-3.4 and others require further review, assessment and definition.

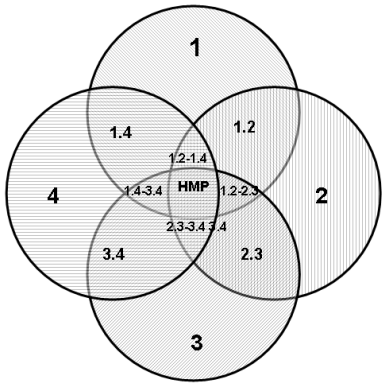

Fig. 3. 4 unite integrated system development diagram

This means that the system (model, concept) of sustainable development is an integration, and NDM can be defined as noosphere development model ("civilization model") and the set of (1.4-1.2), (1.2-2.3), (2.3-3.4), (1.4-3.4), defining the system having integrated peculiarities.

Integrated social-ecological-economic model can be presented at general (block) form:

$$\begin{cases} \dot{X}_1 = f_1(X_1, X_2, X_3, P_1, \xi_1), \\ \dot{X}_2 = f_2(X_1, X_2, X_3, P_2, \xi_2), \\ \dot{X}_3 = f_1(X_1, X_2, X_3, P_3, \xi_3). \end{cases} \quad (3)$$

where: $X = (X_1, X_2, X_3)$ lies for united vector of social-ecological–economical system conditions (SEESC) such as TMS, where $X_1 = X_1(t)$ lies for economic variables vector; $X_2 = X_2(t)$ lies for ecological variables vector (pollution vector); $X_3 = X_3(t)$ lies for social variables vector; $P = (P_1, P_2, P_3)$ lies for aggregate vector of SEESC measurements (internal system and external ones); $\Xi = (\xi_1, \xi_2, \xi_3)$ – lies for the vector of external uncertain random variables. And $X_1 = \langle K_1, L_1, I, \tau, C \rangle$, $C = (C_1, C_2, C_3, C_4)$ lies for the vector of some variables for consumption (expenses), C_1 lies for social consumption changes (i.e. salary and other related expenses), $C_3 = C_E$ lies for ecology expenses, $C_3 = C_s$ lies for security expenses, $C_4 = C_i$ lies for the amount of investments for innovational and informational technologies.

The generalized scheme of integrated hierarchic unit and subject oriented management system and ST is presented at figure 4.

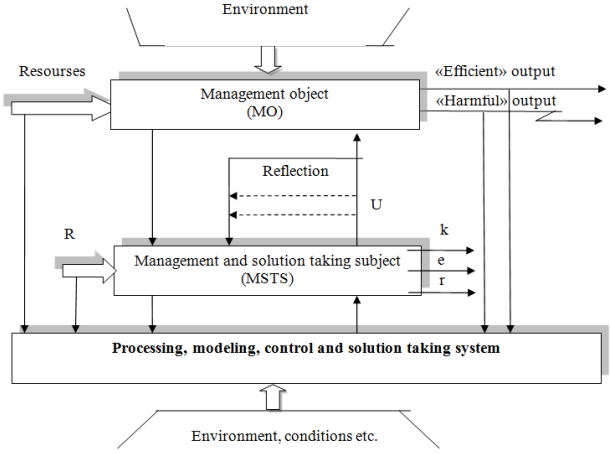

Fig. 4. Unit and subject oriented management and ST scheme

Subject oriented management and solution taking (SOM and ST) at figure 4 is presented in block "management subject and ST", where k, e, r lie for appropriate modes where k lies for cognitive variables, e lies for emotional psychological variables, in the aggregate defining behavioral dynamics of the person taking the solution.

Generalized model of STP cognitive emotional dynamics as a complex integrated system. The subject or the person taking the solution as organism and person is an open system which self organizes and develops and has the set of non-linear and unpredictable behavioral process. That is why formal mathematical methods of non-linear science allow adequate description, assessment and modeling of solution taking processes.

This research reviews one of the options of STP behavioral dynamics partial description during the process of efficient solutions taking. Moreover, it is necessary to take into account both ST cognitive and emotional element. That is why in this research it is worth mentioning the following. Human and rather highly developed animals' psychic forms the models of environment. This fact is common at modern behavioral science. Various authors have called these models cognitive schemes (Levin K.) or cognitive schemes (Tolman E.) at various periods of time. We will employ general scientific term – "model", which is currently employed at cybernetic and synergetic (non-linear dynamics). Though, even with adequate model the process of optimum solution taking and unit management might turn to be quite complex. That is why human psychic has simplified mechanism of situation assessment and solution taking, called "emotions". Emotions assess the situation not on all existing criteria, but only on some which are the most for psychic

bearer (i.e. in accordance with modes). Accordingly, the emotions can launch behavior which is not optimum for the aforementioned situations but some other which is probably "commonly used" during evolutional process at the same situations. Taking into account the above considerations the emotions are treated like psychic (cybernetic) mechanism of STP behavioral management, assessing the situation on some set of measurements (own set for some specific emotion) and launches appropriate behavioral program (for some type of emotions).

The dynamics of interaction and inter-influence processes (i.e. the dynamics of synergetic processes) of cognitive and emotional modes (group of significant measurements or variables) between themselves and emotional and cognitive modes with each other can be described as the equation system of Lotki-Walter type.

The generalized form of this model is presented in the following way (2):

$$\dot{x}_i(t)=\lambda_i^s x_i\left[\mu_i(R)-\sum_{j=1}^{n}\beta_{ij}(R)x_j(t)\right]+\eta_i(t)x_i(t),\ i=1,...,n, \quad (4)$$

where: $x_i \geq 0$ – lies for activity i -st mode (the quantity of i -st population in ecology); n lies for the amount of interacting modes (population); $\mu_i(R)$ lies for the increment of i -mode; R - lies for the set of resource variables such as available information and other available types of resources; $\beta_{ij}(R)$ lies for the elements of matrix interaction; $\mu_i(t)$ lies for multiplicative noise, which is present at the system for i -mode; λ_i lies for specific time defining the process (setting speed); s =-1,0,1,2. Depending on the measurements correlation this model demonstrates great behavioral variety. In case of more-less symmetrical correlations i.e. $\beta_{ij}=\beta_{ji}$ shows multi stability phenomena i.e. the system can display two or more steady conditions. The implementation of one of them is defined by initial conditions. In case of non–symmetric connectives heterocyclic and related cycles, steady heterocyclic channels and dynamic chaos [Rabinovich, Muezinolu 2010].

It is interesting to remember the researches where peculiar dynamic chaos, when scholastic (random) occurs only during the shifts between metastable conditions, the shift order is steady. This transitional dynamics restored from the point of view of sequence cognitive modes maintenance in the circle can be interesting solely for the display and understanding of various thinking processes. Such dynamics opens new perspectives for studying complex processes of subject behavioral dynamics.

Cognitive and emotional modes are closely connected to each other. Nevertheless it is natural to consider that the modes of one family are connected to each other stronger than with the modes of other family. We can consider that one family models the dynamics of other without destroying it. Particularly the cognitive modes support emotional balance and emotions induct or suppress (in case of being negative) intellectual activity. By bearing this in mind it is natural to describe the interaction of emotions and cognitive activity with the help of related subsystems of equations of 4th type. Taking into account the s dynamics of the resources for which the emotional and cognitive modes fight there should be three subsystems: emotions modes, cognitive modes and resources (attention, memory, energy). The role of attention should be specifically highlighted. The attention selects those objects among presented by sensor informational system, which are currently considered to be the most crucial for information assessment and making the correct behavioral strategy. The experiments prompt the efficiency of various mental processes support by means of attention are defined by the competition between various objects of attention. In order to simplify further description let's consider that the description of the competition for attention does not require the specific modes specification, that is why we are able to limit with the review of competition fight for the attention "in general" for emotions: $\overline{B}=\sum_{i=1}^{M}B_i$ and "in general" of cognitive modes: $\overline{A}=\sum_{i=1}^{N}A_i$ [12].

Then our basic equations can be presented in the following form

$$\frac{d}{dt}A_i(t)=\lambda_A^{-1}A_i(t)\left[\sigma_i(I,B,D)R_A-\sum_{j=1}^{N}p_{ij}(D)A_j(t)\right]+ \quad (5)$$
$$+A_i(t)\eta(t),\quad i=1,....,N,$$

$$\frac{d}{dt}B_i(t)=\lambda_B^{-1}B_i(t)\left[\zeta_i(S,A,D)R_B-\sum_{j=1}^{M}\xi_{ij}(D)B_j(t)\right]+ \quad (6)$$
$$+B_i(t)\eta(t),\quad i=1,....,M,$$

$$\frac{d}{dt}R_A(t)=\lambda_{R_A}^{-1}R_A(t)[\overline{A}- \quad (7)$$
$$-(R_A(t)+\phi_A(I,D)R_B(t))],$$

$$\frac{d}{dt}R_B(t)=\lambda_{R_B}^{-1}R_B(t)[\overline{B}- \quad (8)$$
$$-(R_B(t)+\phi_B(S,D)R_A(t))].$$

Here A_i and B_i lie for indispensable variables, corresponding to cognitive and emotional modes, the general intensity of which is defined as $\widetilde{A}$ and $\widetilde{B}$ appropriately, and A and B lie for vector presentation of variable. Both types of activity receive signals from external surrounding: the information I and characteristics of emotional influence S (in case of negative emotions it goes about stress), D goes for the level of taken energetic means (e.g. some preparations). The measurements λ_A^{-1} and λ_B^{-1} are peculiar times of conscious and emotional activity. Like at (4), $\eta(t)$ goes for multiplicative noise. The variables R_A and R_B characterize the dynamics of resources, the attention first of all; the coefficients ϕ_A and ϕ_B define the intensiveness of fight for attention from the point of emotions and thinking.

The emotional and cognitive processes of STP brain can differ significantly based on dynamic peculiarities. It goes both about the divergence about time parameter τ (the emotional reaction is much faster) and behavioral character. In most cases the cognitive activity can be regarded as transitional process depending on the set goal. Steady heterocyclic channel can be regarded as mathematics form of such process.

The dynamics of the emotions can be much more variable. These can be irregular pulsations (strange attractor), transitional regimes reminding the cognitive ones, recurrent dynamics which corresponds with cyclic mood fluctuations and finally long term equations-clinical case of deep depression or constant over agitation.

The dependence of increments σ_i and ζ_i from AandB accordingly describes direct influence of cognitive process activity over emotions and the influence of the emotions over thinking. This might be for example the things, agitating or slowing the emotions actions for cognitive processes or the emotions' suppression due to the development of correct behavioral strategy in case of stress or over agitation.

CONCLUSIONS

B this research reviews the issue of innovational modeling in case of integral object and subject oriented approach at TMS management as the system of SEEHS type. This research offers conceptual integrated model, generalized synergetic model of dynamics taking into account the uncertainty (scholastic and chaotic factors) together with the option of non-linear behavioral model of management and solution taking object. Further researches require the development of the range of specific models of the solution of object and SOM and ST in the systems of SEEHS type.

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ИННОВАЦИОННЫЕ МОДЕЛИ УПРАВЛЕНИЯ ЖИЗНЕСПОСОБНЫМ И УСТОЙЧИВЫМ РАЗВИТИЕМ ТЕХНОГЕННОГО РЕГИОНА В УСЛОВИЯХ КРИЗИСОВ

Султан Рамазанов

Аннотация. В современных условиях нестабильности, систематических кризисов и глобальных преобразований проблема разработки методов и технологий для анализа, моделирования, прогнозирования и принятия решений для устойчивого развития жизнеспособной социально-экономической системы становится весьма актуальной. В работе предложены методы, модели и технологии управления жизнеспособным, стабильным и безопасным развитием системы в зависимости от типа социо-эколого-экономической и гуманитарной подсистем с использованием интегрированного объектно- субъектно-ориентированного подхода.

Ключевые слова: социо-эколого-экономические системы, объектно-субъектноориентированный подход, управление