# MATHEMATICAL MODELS INSPIRED BY EMPIRICAL REGULARITIES OF SPATIAL SOCIO-ECONOMIC AND BEHAVIORAL SCIENCES.

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## PRINCIPLES AND MECHANISMS OF COMPLICATION OF STRUCTURE AND EVOLUTION OF COMPLEX SYSTEMS

This part of research provides an exploration into the process of complication. The complication, in this context, means the transfer from complex towards much more complex structures in the evolution of complex systems. The simplification means the clearing place for further complication by exclusion, reconstruction and destruction of less efficient substructures. The theoretical rationale of complication studies includes the study of the spread and partial adoption of new information and partial destruction of deepness of memory that is characterized by a path-dependent process of self-organization within spatial socio-spatial complex systems. The description of the catastrophic effects of the sudden appearance of new information and gradual destruction short and long-term memory on the states of the spatial socio-economic and behavioral systems will be in a center of our considerations.

The paradigm of complication is pointing out on the deficiency of purely economic considerations of socio-economic systems and stresses the necessity to widen the concept of “Homo Oeconomicus” to the concept of “Homo Socialis.” Such a widening is radical in the study of complex socio-economic and behavioral processes because of the important difference between the economic and socio-economic rationality: the traditional identification of economic rationality of “Homo Oeconomicus” as optimization is complimentary to socio-economic rationality of “Homo Socialis” as parsimony. So the concept of complication stresses the necessity to transfer from optimization by considering the superposition of different optimization tendencies and analysis of concrete (or realizable) states of socio-economic systems.

The superposition principle serves as theoretical basis of the catastrophic jumping evolution of socio-economic and behavioral systems

One of the central parts of research is devoted to an explanation of the quintessential role of innovation diffusion as a part of the process of complication. Here we should stress the difference between invention and innovation. While invention involves the appearance of new information, innovation implies the spread of information [new or old] within the system. In socio-ecological and behavioral systems the innovation diffusion is generated by the choice of competitive innovations: the innovation is the subject of individual choice within the collective. To achieve a unifying view means applying the duality principle: a transfer of ideas from the depth of understanding of one approach to the depth of understanding of another. Methodologically this duality means that, despite the different interpretations, the mathematical models generated through the various approaches are analytically similar. Each approach is associated with a different methodological base relating to the behavior of “Homo Socialis”. In this study, the mathematical description of the complex behavior of “Homo Socialis” in choice processes within the collective is based on four different approaches, which give the same mathematical form to the innovation diffusion process in real space-time. These approaches are (i) empirical regularities of the choice process – the S-shaped change in the portion of adopters of alternative competitive innovations; (ii) the first principles of parsimonious human behavior as collective beings, (iii) the Schumpeterian gales of creative destruction and the competitive behavior of social elites in the mathematical form of variation principles and (iv) the “lock in” captivity phenomenon in the behavior of social elites. These different approaches reflect the behavior of four types of actors involved in the innovation diffusion process, spreading the information within society in space-time.

Another important part of the project is devoted to the presentation of the place and role of the bifurcation phenomena in the process of complication of the complex non-linear systems. For one-dimensional iterative processes the Feigenbaum bifurcation way to chaos is a manifestation of complication process. In many-dimensional iteration processes the set of all local bifurcations is finite: they are seating on the *critical bifurcation surfaces* in the space of bifurcation parameters. The dense accumulation of the critical bifurcation surfaces shows itself in the form of self-organized criticality.

The past and the future of complex systems are situated on a long evolutionary tail, whose observable past and future ends dissolve in the eternal creative flames of the emerging bifurcation phenomena. So the critical bifurcation surfaces present the natural boundaries of the extrapolation and forecasting of the trends developing in the dynamics of complex systems.

**SOME EXAMPLES OF NEW SCIENTIFIC SHEMATA INSPIRED BY EMPIRICAL REGULARITIES IN SOCIO-ECONOMIC AND BEHAVIORAL SCIENCES.**

**Convex polyhedral and inverted problem of multiobjective programming; superposition principle versus optimization in linear systems.**

In this chapter we contrast the idea of optimization which is a central idea of all modern economic analysis, with the idea of the superposition of different extreme optimal tendencies, developing within given linear socio-economic system. In such a way we opposite the idea of optimization with the idea of analysis of actual economic system. The mathematical foundation of Superposition analysis is the Theory of Convex Polyhedra (Minkovski-Caratheodory Theorem on Center of Gravity of convex polyhedron) and the ideas of Combinatorial Topology (in the form of the Atkin hierarchical Q-analysis).

The applications is supported by development of the set of computer programs for practical implementation of Superposition Principle.

This approach will be systematically used for the analysis of states of Linear balance systems in Linear and Convex Programming, Games Theory, Mathematical Multiobjective Programming and in Migration Theory, Theory of Central places, Theory of Spatial Production Cycles and Production Fragmentation.

**1. Explorations in matrix theory: perturbations of inverse matrices.**

This chapter will be concentrated on the perturbations of individual coefficients and their Fields of Influence versus classical theory of perturbations of eigenvalues.

The main results in the theory of perturbations of inverse matrix can be formulated in the following way (drawing on Sonis and Hewings, 1989, 1991): let $A=\left(a_{ij}\right)$ be an *nxn* matrix, let $E=\left(e_{ij}\right)$ be a matrix of incremental changes (perturbations) in the coefficients of the matrix *A*; let $B=\left(I-A\right)^{-1}=\left(b_{ij}\right)$, $B\left(E\right)=\left(I-A-E\right)^{-1}$ be the inverse matrices before and after changes and let *detB*, *detB (E)* be the determinants of the corresponding inverses. Then the following propositions hold:

**Proposition 1.**

The ratio of determinants of the inverse matrices before and after changes is the polynomial of the incremental changes, $e_{ij}$, expressed in the following form:

$$Q(E) = \frac{\det B}{\det B(E)} = 1 - \sum_{i_1 j_1} b_{j_1 i_1} e_{i_1 j_1} +$$
$$+ \sum_{k=2}^{n} (-1)^k \sum_{\substack{i_r < i_{r+1} \\ j_r \neq j_s}} B_{or}\left(j_1, j_2, ... j_k; i_1, i_2, ..., i_k\right) e_{i_1 j_1} e_{i_2 j_2} ... e_{i_k j_k} \tag{1.1}$$

where:

$$B_{or}\left(j_1, j_2, ... j_k; i_1, i_2, ..., i_k\right) = \begin{vmatrix} b_{j_1 i_1} & b_{j_1 i_2} & \cdots & b_{j_1 i_k} \\ b_{j_2 i_1} & b_{j_2 i_2} & \cdots & b_{j_2 i_k} \\ \vdots & \vdots & \ddots & \vdots \\ b_{j_k i_1} & b_{j_k i_2} & \cdots & b_{j_k i_k} \end{vmatrix} \tag{1.2}$$

is a determinant of order $k$ that includes the components of the inverse $B$ from the ordered set of columns $i_1, i_2, ..., i_k$ and rows $j_1, j_2, ..., j_k$. Further, in the sum $\Sigma$, the products of the changes $e_{i_1 j_1} e_{i_2 j_2} ... e_{i_k j_k}$ that differ only by the order of multiplication are counted only once.

**Proposition 2.** A fundamental formula of decomposition of the perturbed inverse with the help of the matrix fields of influence of changes:

$$B(E) = B + \frac{1}{Q(E)} \left[ \sum_{k=1}^{n} \sum_{\substack{i_r \neq i_s \\ j_r < j_{r+1}}} F\left(i_1, i_2, ..., i_k; j_1, j_2, ..., j_k\right) e_{i_1 j_1} ... e_{i_k j_k} \right] \tag{1.3}$$

where the matrix field of influence of order $k$, $F\left(i_1, i_2, ..., i_k; j_1, j_2, ..., j_k\right)$ of the incremental changes $e_{i_1 j_1} ... e_{i_k j_k}$ includes the components:

$$f_{ij}\left(i_1, i_2, ..., i_k; j_1, j_2, ..., j_k\right) = (-1)^k \begin{vmatrix} b_{j_1 i_1} & b_{j_2 i_1} & \cdots & b_{j_k i_1} & b_{i i_1} \\ b_{j_1 i_2} & b_{j_2 i_2} & \cdots & b_{j_k i_2} & b_{i i_2} \\ \vdots & \vdots & \cdots & \vdots & \vdots \\ b_{j_1 i_k} & b_{j_2 i_k} & \cdots & b_{j_k i_k} & b_{i i_k} \\ b_{j_1 j} & b_{j_2 j} & \cdots & b_{j_k j} & 0 \end{vmatrix} \qquad i, j = 1, ..., n \tag{1.4}$$

Further mathematical exploration of these fundamental results will lead to construction of computer software for analysis of the structure of inverse matrices.

The extensive applications of this analytical technique has been started already in the dynamic Input-Output economic analysis, developed by the principle investigators of the project M. Sonis and G.D.J. Hewings and their students and followers. The notion of the matrix fields of influences appeared to very effective for the analysis of structure of many national economies in USA, Europe, Japan, China, Brazil, Indonesia and other countries (see attached bibliography). The significance of this research is in construction of the complete set of mathematical tools and computer programs for analysis of economic structure of economic regions.

**Theory of discrete nonlinear probabilistic and barycentric chains in moebius spaces: applications to forecasting.**

The main purpose of this chapter is to develop the theory of non-linear discrete probabilistic and barycentric chains that are the sequences of probability (barycentric) vectors**.** The linear probabilistic chains are well-known Markov chains. The non-linear probabilistic chains in the generalizations of linear Markov chains in the case that set of transitional probabilities does not exists, but possible consider the dynamics of finite discrete probability distributions. Moreover, each n-dimensional iteration process can be continuously transformed into non-linear probabilistic chain within the simplex of all probability vectors. The general probabilistic chain can be generated by the iteration of transformations of this simplex into itself. The recent paper (Sonis, 2003) presents the analytical description of all such transformations. The asymptotical behavior of non-linear probabilistic chains includes the bifurcation behavior much richer then the ergodic properties of Markov chains – quasi-periodic motion and different ways to chaos. In the case of existence of attractors or repellers the shifted Shannon entropy changes regularly (increasing or decreasing) along of the orbit of discrete dynamics. The different forms of probabilistic chain are useful for the statistical evaluation of relative dynamics of many socio-economic stocks, such as migration, population, capital, labor, etc. Important socio-economic interpretation of the probabilistic chains as discrete relative Socio-Spatial multiple population/many location dynamics is presented in the book by D. Dendrinos and M. Sonis, 1990, *Chaos and Socio-Spatial Dynamics*, Applied Mathematical Sciences, vol. 86, Springer Verlag.

The properties of Shannon entropy allow deriving the many classical inequalities (such as inequalities between weighted arithmetical and geometrical means, the Hoelder and Minkovski-Brunn inequalities and equalities for minimal information matrices) as implications of the Kullback-Leibler discrete information inequality.

The consideration of the non-linear probabilistic chains can be expanded to the consideration of the non-linear discrete quasi-probabilistic chains in the Moebius space of all quasi-probabilistic vectors. It is important to note that in the vicinity of fixed points the linear Jacobi approximation of non-linear probabilistic chain is linear quasi-Markov chain. Moreover, there exists the discrete time analogue of the variational principle: for each autonomous *n*-dimensional iteration processes as well as for probabilistic chains these is an **information** functional of universal Shannon entropy form defined on the set of all autonomous n-dimensional iteration processes such that its maximization in this set will give the preset iteration process.

The significance of the theory of probabilistic (barycentric) chains is in that this theory gives the methodological computerized basis for the forecasting of wide spectrum of socio-economic processes. These broad specifications of probabilistic chains draw from references to both classical and general location theory and from the economic theory of production and comparative advantages. The temporal and locational advantages generating functions of probabilistic chains depict composite socio-economic-geographical factors depending on socio-economic forces associated with relative availability of natural resources in different locations, the scale effects in each location and other social, cultural, political factors; as well as geographical features of locations, like topography, climate, distance involved in generating temporal locational advantages for attracting social stocks.

Empirical applications of probabilistic chains forecasting are of relatively recent vintage. A few examples may be mentioned here. The first, by Dendrinos and Sonis (1988), produced a four-region dynamic relative population distribution for the United States for the period 1850-1985-2050 while the others examined the redistribution dynamics of United States Gross National Product (GNP) among nine regions for the period 1963-1989-2050 (Hewings *et al.*, 1996), and compared GNP redistribution in the North of Brazil and the Midwest States of the U.S. (Magalhaes *et al.*, 2000). The further improvements of forecasting technique and the development of suitable software are the main aims of the part of the project.

## 2. Theory of log-linear systems of differential equations in moebius space: application to innovation diffusion theory

The system of log-linear differential equations has a form:

$$\begin{cases} \dfrac{d\ln y_i(t)}{dt} = \sum_{j=1}^{n} a_{ij} y_j(t), \quad i=1,2,\dots,n, \\ \sum_{i=1}^{n} y_i(t) = 1 \end{cases} \tag{2.1}$$

where vector $Y(t) = \begin{pmatrix} y_1(t) \\ y_2(t) \\ \vdots \\ y_n(t) \end{pmatrix}$ is the barycentric vector and coefficients $a_{ij}$ of the nxn matrix $A = (a_{ij})$ are time independent.

This system of differential equations (5) presents the socio-ecological contagious type mechanism of innovation spread in time and society: the products $y_i y_j$ are proportional to the maximal number of admissible direct and indirect contacts between adopters of innovation i and j and the parameters $a_{ij}$ are measures of the effectiveness of these contacts.

This system of log-linear equations represents the Volterra relative ecological multi-species competition dynamics with the zero “self-growth” rate and unit “average weight” of the species. The possibility to continue the innovation diffusion process from arbitrary distribution of adopters between innovations and the conservation condition $\sum_{i=1}^{n} y_i = 1$ imply (see, Sonis, Dendrinos, 1990) that the competition matrix $A = a_i a_j$ is antisymmetric, i.e.,

$$a_{ij} + a_{ji} = 0, \quad a_{ii} = 0 \qquad (2.2)$$

Drawing on principles of Theory of Games (von Neumann and Morgenstern, 1953) this antisymmetry can be interpreted as that each pair $i$ and $j$ of competitive innovations are participating in a zero-sum antagonistic game with the payoff (expectation of gain) which is value of game $a_{ij}$. From the viewpoint of collective behavior of adopters and adoption units (firms) the specific substantial character of the individual strategies, used by adoption units is nor essential; only the global effects of competition, represented by payoffs, are important .The essence of strategies of competitive behavior was articulated by Nelson and Winter, 1982, and was composed of three main components of behavioral competition in firms: “organization routine”, “search” and “selection environment”. “Organization routine” presents the description of organizational and technological procedures of the production process; “search” presents the evaluation of the effectiveness of routines and the recognition of routines, which should be modified or replaced; “selection environment” includes the multitude of methods of decision-making within the firm strategy. These strategic behavioral attitudes define the collective payoffs of the competition between innovations.

The further steps of the development of innovation diffusion theory and its modeling has been greatly supported and stimulated by rediscovery of the seminal contributions on the subject by Joseph Alois Schumpeter. Schumpeter considered the spread of technological and administrative innovations as a main engine of capitalistic economy. He argued that it was not price competition, but the competitive behavior of entrepreneurs, developing new technical and organizational possibilities, that was a most powerful source of competitive advantages of firms or industries resulting in “creative gales of destruction”.  Schumpeter assumed that the entrepreneur’s original innovative behavior and the behavior of their imitators, based on changing profit expectations during the growth of an industry, were the major determinants of a temporal S-shaped pattern of growth. The introduction of clusters of new interconnected innovations and their diffusion within an industry were considered to be the driving forces behind the short and medium size economic cycles and long term economic cycles

The Schumpeter's great follower and ingenious critic Francois Perroux did a further step in explanation of the evolutionary dynamics from micro-economic general equilibrium viewpoint. The most essential from the innovation diffusion theory notion was the notion of "Homo Socialis" coined by Perroux in 1964. Homo Socialis is the collective being, whose individual choice behavior in many human collectives, to whom he belongs, is based on the social co-interaction with adopters and adoption units of different innovation alternatives. Homo Socialis participates in the imitation and learning process within an active uncertain socio-ecological environment directed by subjective mental evaluation of marginal spatio-temporal utilities (expectation of the future gains) (see Sonis, 1986, 1991, 1992a, 1997, 2001).

The seeds of the mathematical models of innovation diffusion process are the Verhulst, 1838, and Pearl-Read (Pearl, 1925) logistic differential equations and their solutions – the logistic S-shaped curves, presenting the fundamental temporal empirical regularity of the innovation diffusion process-the socio-ecological contagious-type mechanism of innovation diffusion: potential users of an innovation become adopters as a result of direct personal contacts with adopters. These simple equations describe the competition between innovation and non-innovation, the competitive exclusion of non-adopters through Schumpeterian "gales of creative destruction", the process of individual choice of innovation within an indifferent or active environment, and the intervention of an active environment into innovation diffusion process, resulting in the generation of socio-economic niches (see Part III below). The Verhulst logistic equation was widely used for explaining the growth and substitution of new technologies for old ones. The long line of the logistic type models and their modifications appears.

The generalizations of Verhulst and Pearl-Reed logistic differential equations to the case of many competitive innovations gave the system of log-linear differential equations. The methodological way for these generalizations and their analytical metamorphoses is presented in detail in Sonis, 1992b.

In this study the mathematical description of the complex behavior of the "social men" in choice process within the collective is based on four different approaches, giving the same mathematical form of the innovation diffusion process in real space-time. These approaches are:

Empirical regularities of choice process – the S-shaped change in the portion of adopters of different innovation alternatives. These empirical regularities reflect the sociological mechanism of transfer of adopters from one innovation alternative to another in the form of the temporal Volterra type system of log-linear differential equations.

The first principle of parsimonious human behavior as collective beings (of individual choice behavior of Homo Socialis in collective), which mathematical realization gives the generalization of the temporal Volterra type system of log-linear differential equations to the case of innovation diffusion within the space-time-society continuum.

The competitive behavior of social elites in the form of variation integral, whose entropy–type integrand presenting the interconnections between social contacts of adopters of different innovations and the level of equalization of different innovation alternatives. The Euler conditions of the minimization of this variational integral give the same Volterra-type system of differential equation of innovation diffusion process.

The “lock in” captivity phenomena in the behavior of adopters under the influence of social elites and active socio-economic environment.

**Discrete non-linear dynamics and calculus of bifurcations; applications to the complexity and complication theory.**

In this chapter the procedure of linear bifurcation analysis for discrete non-linear finite-dimensional dynamics will be developed, based on the movement of equilibria of non-linear dynamics in the space of orbits. This procedure will be laid out formally as a sequence of calculation steps describing the content of the analysis. The cases of two-, three- and four dimensions will be considered in detail.

The choice of this research topic is justified by the central place of the bifurcation phenomena in the modern theory of Complexity and Complication. The main feature of the evolution of a complex system is the emergence of new properties which did not exist in previous trends and which add new information to the system. The complication means not only transfer from simple to complex structures, but mainly transfer from complex to much more complex structures. Even the simplification of the system is the part of process of complication, since simplification is clearing the room for the further adoption of new information. This clearing presents the essential force acting against the modern information explosion and playing the important role in the process of self-organization.

Spread of information within the complex system presents the essence of the process of complication. This spread shows itself through the partial adoption of new information and through the path dependent process of self-organization within socio-spatial complex system.

The important feature of the complication process is the phenomenon of bifurcation. For one-dimensional iterative processes the Feigenbaum bifurcation way to chaos (Feigenbaum, 1978) is a manifestation of complication process. In many-dimensional iteration processes the set of all local bifurcations is finite: they are seating on the *critical bifurcation surfaces* in the space of bifurcation parameters (see Sonis, 1993, 1997).

The past and the future of complex systems are situated on a long evolutionary tail, whose observable past and future ends dissolve in the eternal creative flames of the emerging bifurcation phenomena. So the critical bifurcation surfaces present the natural boundaries of the extrapolation and forecasting of the trends developing in the dynamics of complex systems.

In this part of the project we will present the methods of the analytical description of the critical bifurcation surfaces for discrete non-linear dynamics in finite-dimensional systems.

**Spatial analysis of socio-economic systems**

In this chapter we will concentrate ourselves on the forms of complication and self-organization in linear spatial socio-economic systems. The description of the catastrophic effects of appearance of new information and new emerging properties in the states of the linear spatial socio-economic systems will be in a center of our considerations.

This paper can be considered as a recognition and reflection of a new phenomenon in the field of emergence and organization of scientific paradigms: the theorists of the mainstream economics once more found the existence of economic and urban geography and spatial analysis. Forty-five years after the seminal book by Walter Isard, 1956, "*Location and Space-Economy"* a book by M Fujita, P Krugman and A Venables, 1999, "*The Spatial Economy*" appeared. In the later new book the reasons of neglecting of spatial theories by mainstream economics were determined: the absence of unifying framework of theoretical models – the absence of standard mathematical modeling tricks. It should be noted that the negligence was two-sided: other spatial analysts formulated and resolved separate theoretical and practical problems, connected not with control and optimization, but with the analysis of actual states.

This lecture is pointing out the deficiency of purely economic considerations of socio-economic systems and stresses the necessity to widen the concept of "Homo Oeconomicus" to the concept of "Homo Socialis." Such a widening is radical in the study of complex socio-economic processes because of the important difference between the economic and socio-economic rationality: the traditional identification of economic rationality of "Homo Oeconomicus" as optimization (Arrow, 1963, p.3) is complimentary to socio-economic rationality of "Homo Socialis" as parsimony and risk aversion (Sonis, 2001, pp. 330). So this paper stresses the necessity to transfer from economic optimization by considering the superposition of different optimization tendencies and analysis of concrete (or realizable) states of socio-economic systems.

In this lecture we are considering the unifying frame for the partially ignored and neglected, partially misunderstood and misinterpreted theories of linear spatial analysis of complex socio-economic systems: the Sensitivity Analysis of the optimal solutions of the Linear Programming and the Transportation Problem, the Push-Pull theory of Migration Streams, the theory of Central Place Hierarchies, the extensions of optimal transportation flows in developing urban systems, the Spatial Production Cycles and Trade Feedback Loops.

The important part of linear economic theory is treated in the chapter devoted to the static and dynamic versions of the classical Leontief Input-Output Analysis.

**New developments in input-output analysis: fields of influence of changes, temporal leontief inverse and the renovation of the classical key sector analysis.**

In this chapter the new dynamic approach to the classical Leontief Input-Output Analysis is elaborated, based on rejection of the assumption of the constancy of the direct inputs. The presentation builds on earlier work (Sonis and Hewings, 1989, 1991, 1992) that examined a variety of issues surrounding error and sensitivity analysis, decomposition and inverse important parameter estimation. These ideas are now brought into a general form as a basis for more complete, general fields of influence approach which is the main vehicle for describing the overall changes in economic relationships between industries created by combinations of changes in technological coefficients. The most important new concept based of the notion of the direct fields of influence is the multiplier product matrix and the corresponding artificial economic landscape which represent the classical Key Sector analysis and hierarchies of sectoral backward and forward linkages. The multiplier product matrix is the main part of the fundamental minimal information decomposition of Leontief inverse in the form of the difference between the global presentation of direct effects of the changes in inputs coefficients and the synergetic effects of the overall interaction of the changes. The new Temporal Leontief inverse is constructed which can serve as the basis for temporal analysis of an evolving input-output system: the inverse depends on its *evolutionary tail* of changes in a highly non-linear manner. The detailed analytical structure of the Temporal Leontief inverse addresses the possibilities of tracing the impact of each change in the individual direct inputs in each time period through to the final state of the economy. The presented analytical technique gives the basics of the new perturbation theory for matrix inversion.

**Socio-ecology of individual choice of "social men": ethnogenesis, gumilev's passionary elites and "ten commandments of aggressive intolerance".**

The objective of this lecture is the consideration of the Gumilev Passionarity Ethnogenetic processes from the view-point of individual choice behavior of “Social man”. ”Social man” ("Homo Socialis") (the notion coined by Francoi Perroux) is an individual whose choice behavior in collective is based on co-interaction among of different innovation alternatives and on the imitation and learning within an active, uncertain territorial environment directed by the subjective mental evaluation of marginal spatio-temporal utilities (expectations of riscks and gains in the future or in other location). This mental evaluation is heavily influenced by the information flows through the contacts with the "near-peers" and through mass media presenting "ready" opinions and solutions and making difficult the rational evaluation of innovations and their utilities.

In this lecture we will consider the behavior different groups of choice makers - **innovators and innovating elites**, i.e., different systems supporting, producing and spreading the innovations. In economics of capitalistic development of Schumpeter innovators appears as entrepreneurs (Schumpeter, 1943), in Political Sciences innovators are charismatic political leaders, in show business they are “stars” and “superstars”, in the Gumilev theory of Ethnogenesis innovators are called “passionarii” (Gumilev, 1994).

The power of elite influence on decision making of individuals depends on the ability of passionary elite to attract and to capture (lock in) the largest portion of adopters. Elites will do everything possible to attract and capture the adopters; they are using social manipulation, information distortion of the reality in the form of poetic history and poetic geography. They use their ability to influence mass media, because they have a good understanding of a meaning of insufficient understanding of Homo Socialis and its propensity to replace the rationality by emotionality. In modern times of spread of cultural, religious and nationalistic fundamentalism, when the “Cold War” era of ideological collisions is replaced by the era of cultural and ethnic clashes (see, Huntington, 1996) there is an urging necessity to understand properly the essence of elite's behavior.

Passionary elites understand perfectly that their power proportional to the amount of adopters obtaining their innovations and ideas. Therefore they are trying to organize and explore the adopter behavior dominant. The tool of the organization of behavior dominant preferring the innovation or idea supported by definite elite is the manipulation of individual adopter choice behavior. Using the basic principle of the collectivity of human being, each collective, driving by its own elite, trying to impose its rules and values on the individual belonging to this collective: economic elites using a sophisticated system of advertisement, political elites using a powerful system of political propaganda and demagogy, cultural, religious and ethnic elites using spiritual, cultural and ethnic indoctrination, power elites trying to convert each individual in to a small part of social machine, military elites actually converting each individual into the small controllable part of military machine.

The arising of captive behavior dominant by the activity of manipulative elites is an integral part of the consolidation of ethnical collectives. In the present age of cultural collisions and rise of international terrorism the manipulation of human behavior became the effective mechanism of innovation spread of different social/political/geopolitical/territorial societal changes.

The tool of manipulation acting against tolerance and responsibility concepts developed by humanity during its social and cultural evolution. The main tool of terrorism is aggressive intolerance.

As an example of possible implication of socio-ecological approach in innovation diffusion theory, let us formulize a model of aggressive elite behavior in a polemic form of "ten commandments" of aggressive intolerance. This ladder of increasing intolerance (Sonis, 1997) built up from the public polemic utterances of different cultural, religious, political and ethnic leaders and in parts well known to wide public:

I am Us

We know the Truth, all the truth, we are speaking truth - therefore we are always right.

All others are wrong.

Whoever is not with us is against us, against the Truth.

Whoever is against us is an enemy, the enemy of truth.

The enemy should be restrained: if you do not know the truth we will teach you; if you do not want to we will make you.

Once enemy - always enemy.

The enemy should surrender.

If the enemy does not surrender, he must be destroyed.

Our Thrust will eventually prevail, if not now then in near future.

In the era of widespread international terrorism the humanitarian approach should actively support the obligatory education to tolerance and responsibility. This education should continue the great humanitarian traditions of Ten Commandments from Bible, the main slogan of Great French revolution “Liberte, Eligate, Fraternite” (Liberty, Equality, Brotherhood), the Confucius learning of social responsibility among other well-known examples.

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