System Approach to Modelling of Complex Systems with Special Regards to Inter-Organisational Systems

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It is impossible to prove anything here, but to persuade one of something, is possible (F. Dostojevski).

Abstract:
The similarities and differences among methodologies and models of complex systems will be discussed from a general point of view. A hierarchical formal concept will be used to explain the systems approach method in modelling of complex systems. The methodology will be applied to a tourism system, which possesses the typical property of global and local organisation. A problem will be studied through multicriteria decision making, representing a good example of an anticipatory system that enables a tourists to make a right decision.

Keywords: Complex system, anticipation, decision theory, inter-organisation, tourism

1 Introduction

The word system denoted a whole as consisting of parts and was the axiom for ancient philosophers. However, the General System Theory (GST) and cybernetics clearly pointed out the relevance of the order and structure of elements within a whole for its behaviour. Complex systems are usually understood by intuition, as a phenomenon consisting of a large number of elements organised in a multi-level hierarchical structure where elements themselves could represent systems (Mesarovic, 1989). The description of the system depends on the specific goal and point of view of the researcher. The word complex is used here only to point out the fact that the problem considered cannot be expressed only in hard (quantitative) method but the most of relevant values are qualitative. With a conception of complex systems we think about a system within which a main role plays a complexity of interaction among system elements. These elements are systems themselves and for this reason we can hardly predict the behaviour of a system as a whole: the system of systems, which exchange energy and information with their environment while transit, inflected by internal and external influences. Organisational systems are complex because between subsystems exist production, information, as well as psychological, social, material, financial, and energetic relations. The goal and interests enforced characteristics and activities that conditioned system behaviour and its development. A society is a real world, which changes by changing relations among its participants and interaction with the environment within natural law. Learning and experience through decision-making provide development and growth that we observed through evolution. Experiences as part of a past and the anticipation of a future cause these systems to grow and develop in the environment as the restriction. For this reason, these systems are further anticipatory and we refer to them as goal-oriented systems. The number of works dedicated to the different model and methodology devoted to these areas is very high. Let us recall some of them: System Dynamics (Forrester, 1961), System Thinking (Senge, 1994), Autopoietic System (Maturana and Varela, 1998), Living Systems (Miller, 1978), Viable Systems (Beer, 1959), Hierarchical Systems (Mesarovic, 1989), Anicipatory Systems (Rosen, 1985), etc.. Some relevant paradigms to system analysis were described in (Rosenhead, 1989), as for example: soft system analysis, hard analysis of a system, critical system thinking, strategic options development and analysis. Cybernetics and GST have deeply influenced the research methodology of complex non-physical problems such as medicine, biology and society. Of course, Bertalanfy's GST (Bertalanfy, 1968) and Wiener's Cybernetics (Wiener, 1948) were a reaction and generalisation of special theories, although they cannot substitute for the specialist's knowledge of a particular phenomena. The intention of cybernetics and GST is the "ontology" of action. Its goal is to find a method to predict the consequence of a decision-making action. Therefore, the anticipated system is much closer to describing the essence of complex systems behaviour. However, the influence of the observer in the process of modelling the complex system is of primary importance. In literature, this problem has not been sufficiently considered. The present article discusses the cybernetic method in modelling the complex system from the epistemological, semantic as well as decision-making point of view.

2 The Epistemological Problem of Modelling

In the cybernetics method there is no ontological problem. We describe systems on the manifestation level as they are. System appearances are quite explicit. By definition, we anticipate that the system consists of elements and is greater than its parts. An element is the smallest part of the whole necessary for system description, which cannot or will not be divided further. The essence of the elements is very important from the epistemological point of view. By modelling, we understand an activity enabling us to describe our experiences within a definite procedure (mental model) with one of the existing languages in the framework of a definite theory. From a pragmatic point of view, a system is defined by the double $S=(E,R)$, where $e_i \in E \subset U, =1,2,..n$ represents the set of elements, $R \subseteq E \times E$ the relation between the elements, and U the universal set. The construction of concrete systems requires certain knowledge $K(e_i) \in E$ (property of elements) in order to identify the elements of the systems (including those from environments) and a theory $T(e_i, e_j) \subset R$ to find relationships among the elements. Each element e_i can be set as well as $R_j \in R, j = 1,2,...m$ defining different relations between the elements. In fact, such a procedure is inductive and represents the model of a real system. In other words, modelling represents the activity of describing our experiences by using one of the existing languages within the framework of a certain theory such as formal concepts analysis described in (Wolff, 1999). In this way, our experiences also become accessible to others in that they may be proven, confirmed, rejected, broadened or generalised. This paradigm can be expressed with a triplet (O, S, M), where O represents the real system, S represents the subject (observer), and M the model of the object. The modelling relation $h(m): O \rightarrow M$ exists between O and M. If $h(m)$ represents the mapping of O to M, then $M \subset O$ and we have a simplified model. The description of the system depends on the specific goal and the researcher's point of view. From the methodological point of view, which is more important, one can only understand complex systems as a whole, which means in their total appearance in the environment. The relations between Objects and Subjects in the process of Modelling are shown in Fig. 1. The scheme is a paraphrase of Planck's standpoints that are generally acceptable:

1. An external world exists independently of the observer
2. This world is not directly observable
3. For its representation, we set up simplified models

The rigorous elaboration of the existence of a physical universe was carried out by Bounias (Bounias, 1999). The relation between the observer S and the object O - is of essential significance in the description and representation of the object. The observer is a man, with all his cognitive qualities, while the object of research is something else that we are analysing.

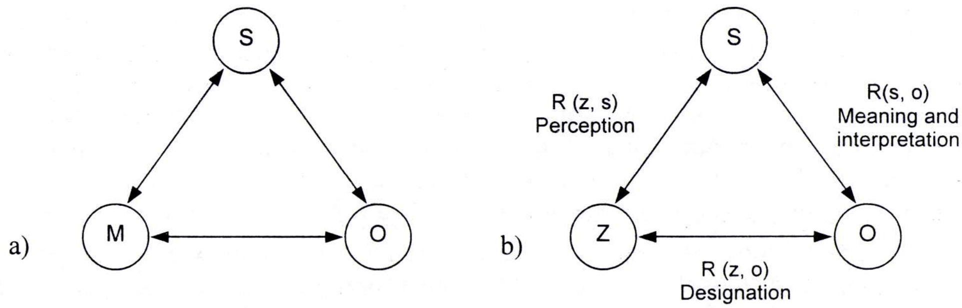

Fig. 1: a) Schematic view of the subject in the modelling process and b) Semantic view of modelling

The object of our research is the manifested world, regardless of how we can describe it. In this case, the object and the system have the same meaning. Both are related to a phenomenon, which exists by itself. The third article of the triplet, M, is the consecutive one and represents a model or a picture of the analysed system O. The $O \leftrightarrow S$ relation, in Fig. 1 a), indicates the reflection of human experiences to concrete reality. This cognitive consciousness represents our mental model or "inner show", the phrase used by Schrödinger (Schrödinger, 1967). The relationship $S \leftrightarrow M$ represents the problem of knowledge presentation, respectively the translation of the mental model into the actual model. The $O \leftrightarrow M$ relation represents the phase of model validation or proof of correspondence between theory and practice, which render possible the generalisation of experiences into rules and laws. The $S \rightarrow O \rightarrow M$ relationship is nothing else but an active relation of the subject in the phase of the object's cognition. The $M \rightarrow O \rightarrow S$ relation is nothing more than the process of learning and generalisation. As for the complexity of object O, the state of knowledge, goals and judgements of S, we can speak about the homomorphic and isomorphic relations between the model and the original. Evident is the relativity of knowledge, theory and models in science, which develop constantly through the course of time in respective interaction and compliance with the progress of civilisation. We can find many examples in astronomy, physics, biology, organisation and society. In the cognitive process the value standpoints of subject S_v is far more important to us in relation to the object of research in the modelling process. This can be stated in the following condition:

$$S_v \cap (O \cap M) = 0 \tag{1}$$
$$S_v \cap (O \cap M) \neq 0 \tag{2}$$

In the second part of equations (1) and (2) $O \cap M \leq 1$ are always fulfilled. In the case of $O \cap M = 1$, the model and original are identical. The expression (1) is valid for formal and natural sciences, where $S_v = \varnothing$ (empty set). This means that it is impossible to find any link between the axiom and the hypothesis linked to model M and value standpoints of the subject. That is of course not valid for the scientific hypothesis in the process of modelling, which is always the product of the intellect and historically conditioned by the progress of science (Fihte, 1967): but these hypotheses are always rejectable (Popper, 1973). In the case of organisational sciences and humanities, equation (2), the value standpoints of the researcher and the object of the research are always $S_v \neq \varnothing$. A kind of inner shadow (Stevanić, 1996) exists, which does not allow us to see what we are looking at, such as it is. Some qualities are always added to the description of the observer in question that are not provable. Indeed, in this case certain phenomena are factographic and measurable, but their interpretation depends on goals and criteria which are part of the value judgement of the observer. Eq. (2) expresses statements of bonded rationality (Simon, 1957, p.199) "...it is only because the organised group of beings are limited in their ability to agree on goals, to communicate, and to cooperate that organising becomes for them a "problem"". This does not mean that systems, which are exceptionally important and complex should not be modelled. The conditions expressed by Eqs. (1) and (2) have a key meaning in the choice of research methodology and for the scientific value of the statement. The first expression renders possible the setting up of the principle testable hypothesis by means of active experiments of the subject, while the second cannot and is not allowed to prove the hypothesis through experiment, but rather by observation and generalisation dependant on the qualities of the observer.

The model, as a simplified picture of reality, is nothing else but a way of communicating about the world. It depends on the context of the communication and the way of communicating, to determine whether we are dealing with a scientific or an ordinary language. To communicate means to exchange and understand messages between two or more participants. This process can be illustrated in Fig. 1 b) by means of a semantic triangle (Carnap, 1952). In this way, among the set of the designated objects, $o \in O$ and signs $z \in Z$ can form a system of designation $R(z,o)$. The content and idea of the information $R(z,s)$ is formed in relation to the set of signs $z \in Z$, and the receptor of the information $s \in S$. $z \in Z$ designates the object of thinking and comprehension from the point of view of the receptor $s \in S$. At the end, the $R(s,o)$ relation wakes up certain associations, signification, ideas and comprehension of the information from the part of the subject $s \in S$ in connection to the object $o \in O$. As we see, the main problem in understanding information lies in the relation of designations formed by the words in the framework of a language and in judgements and understanding formed by a group of people. When comparing the schemes a) and b) in Fig. 1, we acknowledge that these schemes are identical (Kljajić, 1998), if we suppose that equivalence $Z = M$ is true. From above explanation it is clear that Z and M are nothing else but a model of the reality O from point of view of S (observer or receptor). The cases of formal and natural systems scientific language of communication and the subject of communication maximally suit each other. The conclusions are provable. In that case, science is talking about entities and relations, which are strongly ordered. In the case of a system whose relations are weakly ordered (meaning that variables can not be expressed in an international system of measuring units), our language is inevitably inaccurate and therefore we are off to the field of social sciences, aesthetics, philosophy, religion and politics.

In light of quations (1) and (2), three groups of the system, which are basically different in nature, can be identified: formal, natural and human. The formal system (or abstract) consists of abstract objects, where relations among them are based on a set of axioms. Strictly speaking, relation $O \cap M = 1$ in expression (1) is fulfilled. In such systems, all knowledge is a known priority within accepted rules. For this kind of system differences between true and false are limited by the famous Gödel consistency and completeness theorem. Natural systems consist of real objects where relations among them are founded by evolution. Knowledge about it, in principle, is accessible by experiment up to the Heisenberg's principle of uncertainty. In these systems, the $O \cap M < 1$ relation between the model and objects is usually fulfilled. Systems described by equation (1) belong to the Winner's cybernetics class or first order cybernetics. Human systems or organisation consist of different interactions between people and nature in order to realise certain purposes. Prior knowledge about system behaviour is limited and experiments are not allowed. Intuition is the main component of creation. The model of these objects represents a description of real objects in terms of an abstract system. How good and useful these descriptions are is the problem of model validation. From equation (2), two cases can be found: the observed system is complex and in its model contents some assumptions of the observer are contended. Conditionally such systems could be classified as second order cybernetics.

3 Overview of Theories

Even though methodologies do not belong directly to system theory, they are its products in searching for the means for complex problem solving. The diversity of systems phenomena created a variety of concepts and theories to describe them. We agree that a description of a system depends on a describer and his/her point of view, interests, culture and time (Fihte, 1967, Koizumi, 1993). All these descriptions are only partly correct. We can say that a society is a worldview reality (Yolles, 2001) or even more: it is realised reality. Experience, learning, knowledge, motives, prayer or meditation influence an individual's consciousness and consequently society's awareness, which results in a certain choice of action. Changes of individual awareness definitely change society and its environment because of the action. You can change a society if you change yourself, since a society consists of you and me (Krishnamurti, 1987). Sure we will, but the old ethical values, which caused the problem, remain. A reality, which is a consequence of a compromise, is an organisation and is measurable by its goals and means for achieving these goals. This is an objective matter, although it is a problem of measurability, scale ordering and subjective understanding of an individual and his will. The objective exists in time and place and not separated from them, even though it is only partly described in eq. 2. It reminds us of the story about blind people seeing an elephant. Everyone "sees" according to his or her life experiences yet the elephant is only one, regardless of partial descriptions. *Awareness that partial description is not wholeness and the fact that we can more or less get close to this* wholeness requires careful approach. It seems that system approach is a synthesis of all other approaches or considerations (Kljajić, 1994).

Miller's Living systems (Miller, 1978) represent some kind of a comparative analogy between the structure, functioning and processing of energy and information among different living phenomena. A comparative scheme is just the analogy without the power for deeper understanding of the phenomena. Even though we can find some similarities among an organism, an organ and an organisation, we can say that these are actual different systems considering their behaviour. Notably, an organism represents much more that just a sum of organs and an organisation differs from an organism. Viable systems represent a general cybernetic model of systems – living systems and describe the property of a system to be viable. Maturna-Varela's concepts of Autopoiesis come out of a concept of maintaining biological systems. Comparable analyses represent an ontogenetic thesis of maintaining the structural identity of systems. This approach can be partly useful as an analogy with organizational science.

A similar view can be found in Levi Strauss' anthropological research (Piaget, 1974). Though that ancient origin are the same to all living being, although the organisation structures have similarities we strongly believe that human organisation has principal difference in environment and so responsibility. Anticipatory systems in (Rosen, 1985) belong to a more general control theory, which is similar to system approach. Forrester's systems dynamic and Fith's discipline are equivalent and can be unified within the systems concept (Kljajić, 1994). It is not surprising that a number of works have been dedicated to these topics. Discussions focus more on the naming of a single methodology rather than on the differences among methodologies. For example: systems thinking, system dynamics, soft system analysis, hard system analysis, critical system thinking, strategic options development and analysis, etc... There are almost no differences among the single methodologies; it is only a semantic one caused by the complex context and the author's point of view. As Forrester states (Forrester, 1994), all these titles have one and only one aim: to tone that this is the wish following an integral research of a complex phenomena through its feedback connections. It is the eternal wish of a human being for the complete never ending description of its surroundings. The cybernetics and general system theory expose these wishes even more. We can accept a named system approach or system point of view as being proper. Even more: thinking and rethinking is the mental process of a human being. It can be true or false in relation to a matter of thinking. If we take it terminologically it is a metaphor with which we would like to expose a working method for mathematics (mathematical thinking) or philosophical method (philosophical thinking). It is not possible to describe complex systems as organisational in a punctual and concrete way. This is the reason that the basic concept of STS was the interdisciplinary work for complex problem solving. It is obvious that we cannot find an actual solution with formal methods. Abstract matters need concrete ones and the opposite. The philosophy of system approach is typical for complex problem solving and can be united with two words: methodology + context = system approach. Its openness and transparency satisfy Popper's requirements (Popper, 1973: 131): "Within a methodology we do not define only a problem and search for a solution, but also set conditions for right solution verification and validation of alternatives. If someone denies one hypothesis, we will not be satisfied with his feeling of doubt or his persuasion of false viewing. It is necessary to create at least the opposite view and directions on how to understand this doubt. The hypothesis, which cannot be proved, can in the best case be a stimulant –it can lead to a problem". All social phenomena are systems in their facts, which are why the ideas from cybernetics and general theory spread to the social area as well. It is not surprising that ideas of all contemporary sociologists derive out of a system theory. Systems are everywhere and their elements have interconnections, even though we cannot comprehend these interactions as a whole.

4 Decision theory

It has been shown that organizational systems are complex artificial goal-oriented systems (Ackoff, 1994, Kljajić, 1994) designed by man to achieve certain purposes. Past states determine their memory: biological, social, cultural and historical, and together with human vision they strongly influence the future state. It was shown that a system's anticipatory essence and its development as well as growth are consequences of decision-making. Therefore, the basic principle of its control is feedback and feed forward information. To estimate the consequence of decision-making, the decision maker needs a model of the system and the environment. This statement is in good accordance with Rosen's (Rosen, 1985) concept of an anticipatory system. From a decision point of view, an organisational system is defined as $O=(P,D)$, if mapping exists (Mesarovic, 1989) $P: X \times U \to Y$ and $D: X \times Y \to U$ such that it is satisfied; $G: X \times Y \times U \to V \in R$ and $E: X \times Y \times V \to U$, where X and Y represent the input and output of the system, U control, P process, D decision process, G objective function and E evaluation strategy.

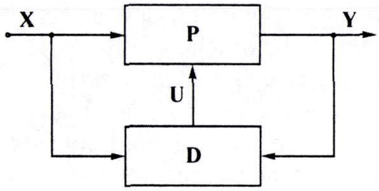

Fig. 2: General model of the goal-oriented system

Note that *G* represents the objectification of the alternative and usually is defined as a multi-objective function with which we express our wholeness to the problem. *E* represents the subjective evaluation of the decision. It exceeds the rational decision level and reflects Simon's idea of bonded rationality (Simon, 1967). In Fig. 2, loop $P \to Y \to D \to U \to P$ represents feedback information, which functions on the *cause consequent principle*; therefore we can call it *reactive control*. For small perturbations such control is satisfying. For decision-making in an organizational system, information from the environment is necessary. Chain $X \to D \to U \to P$ provides feed forward information, which represents the *anticipation* of the future state of the environment. Such kind of anticipatory system according (Dubois,2000) belongs to a class of weak anticipation, because its anticipation of future state are based of system model and model of the environment. It is an important part of the strategy of goal-oriented systems. The relation between feedback and feed forward information in the course of time in decision-making can be described (Kljajić, 2000) as:

$$O(t+1) = F(O(t), M(t+1)) \quad (3)$$

$$M(t+1) = F'(O(t), M(t), M_E(t+1)) \quad (4)$$

where $O(t+1)$ and $M(t+1)$ represent the state of the system and state of the model of the system respectively at time t+1. F And F' represent the mapping of the system $F: O(t) \times M(t+1) \rightarrow O(t+1)$ and the model $F': O(t) \times M(t) \times M_E(t+1) \rightarrow M(t+1)$. State of the environment is modelled as $M_E(t+1) = F''(M_E(t))$ and are usually estimated as the state of the nature. Note that: Eq. 4 expresses our managerial knowledge about the possible impact of the environment, obtained on the model *M*. According to Fig. 1a), our knowledge about the system object and its model is never finite. Due to the complexity of the organisational system *O(t)* and its openness to the environment, the anticipatory information can be obtained through simulation model *M(t)* (Kljajić, 2000). We will consider the decision problem from a managerial point of view. The main problems of each managerial system are the completion of information about the state and environment and finding a satisfactory solution in the appropriate time. From the control point of view a dynamic system can be described as:

$$y(k+1) = f(y(k), u(k), x(k))$$
$$u(k) = \varphi(y(k)), \mathrm{k} = 0,1,...,\mathrm{n} \qquad (5)$$

where $y \in Y$ represents the vector of a state, $u \in \mathrm{U}$ the control vector and $x \in X$ the input corrupted with disturbances and $u = \varphi(y)$ represents feedback information. With proper $u \in U$ we wish to maintain the system state in $y \in Y_t$ at the presence of disturbances $\mathrm{x} \in X$. The general control low can be stated as (Ashby, 1958):

$$VAR(X) - VAR(U) \leq VAR(Y_t) \qquad (6)$$

where, $VAR(X)$ means variety of input, $VAR(U)$ variety of a management vector and $VAR(Y_t)$ represents permitted states (system tolerance). This is Ashby's low of requisite variety. It means that only a variety can compensate for variety and it represents the necessary condition for the control of systems (social, viable or any one living systems). In this case only a diversity of the managerial vector can compensate the variance of disturbances. In general $VAR(X)$ is random and independent and thus $VAR(U)$ is smaller than $VAR(X)$. This is the reason that Y_t is never a point in the space of a controlled system, but a multi-dimensional volume. The better the control of a system, the better the functioning. We call the state deviation from the target managerial entropy. This term is entitled to be used, since the more the systems are complex the more statistical properties they have. Let us define the terms in equation (6), as a logarithm of a variety. In this way we can show a connection among information, management quality and entropy. We presume that we know feedback information as a function of state variables as shown in Fig.3.

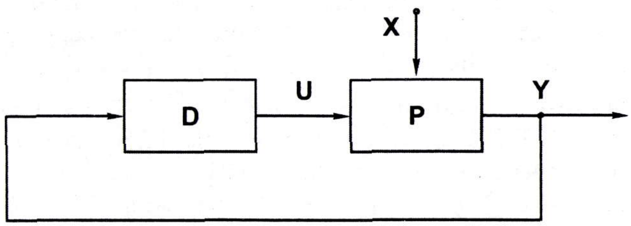

Fig. 3: General model of the feedback control.

The logarithm of a state deviation Y, $H(Y)$ from the target represents a measure of a management quality. In an ideal case, $X = 0 \Rightarrow Y = Y_t$ and the $H(Y = Y_t) = 0$. The presence of disturbances X influence state Y deviate from the target value and thus the entropy is: $H(Y) = H(Y/X) \neq 0$. To keep $H(Y) \leq \mathrm{H(Y_t)}$ we must introduce control $u = \varphi(y)$ (based on feedback information) with a small variety $H(Y/U)$, which means, acceptable control. In other words:

$$H(Y) - H(Y/U) = I(U,Y) \tag{7}$$

where $I(U,Y)$ represents managerial information, as a function of a state Y. To reduce entropy $H(Y)$ a managerial system U must have a requisite variety $H(U)$ (compare with $VAR(U)$) so that:

$$H(U) \geq I(U,Y) \tag{8}$$

is fulfilled. If we put equation (7) into equation (8), we get the unequation:

$$H(Y/U) \geq H(Y) - H(U) \tag{9}$$

which gives us interdependence among the variety of state Y caused by a disturbance, diversity of control U and entropy of state Y as the function of control U. Equation (9) represents information equivalents (Lerner, 1975) of Aschby' low of requisite variety equation (6). Only in the case where $H(Y/U) = 0$ (perfect information about state) and diversity of control $H(U) = \mathrm{H(Y)}$ do we have perfect control and $H(Y = Y_t) = 0$. For $H(Y/X) \neq 0$ not only $H(U) = \mathrm{H(Y)}$ are needed but also the time succession of $H(Y/X)$ to the $H(U/Y)$ must be satisfied, which is impossible in the cause consequence system. Therefore, good control is always within the prescribed tolerance. For larger disturbances, feedback information is not satisfied. Feed forward information is needed to control equation (5), which is uncertain in principle so that equation (9) holds as $H(Y/U > H(Y) - H(U)$. In real systems we look for a compromise among the managerial level, entropy of a system and quality of functioning. The same concept can be extended to complex systems.

5 The hierarchical concept of a complex system

The basic property of hierarchical systems is complexity and vice versa. Hierarchical systems are usually organised in a multilevel structure, where processing of information is distributed in several places with different importance in a system. Subsystem interactions carry on through so-called co-ordination entrances, which are sent by a higher level. A multilevel system can have goals on each level. A managerial problem is a complex one since we have to deal with complex information and "… the capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problem."(H. Simone, 1957). The decision making principle of a hierarchical system (Mesarović, 1989) consists of several levels: Regulation, Co-ordination, Learning and Adaptation and a level of Self-organisation. Each level has a structure as those in Fig. 3. A Regulation level takes care of the direct solving of managerial tasks with a basic knowledge of the local state of a system and its competence. The multitude of possible solutions, which would satisfy the managerial task, represent managerial uncertainty. A consequence of a chosen solution for a system as a whole is not clearly determined. The second level represents co-ordination or harmonisation of managerial tasks. This means a reduction of the uncertainty of lower levels regarding chosen solutions. The higher level, which represents learning and adaptation, has a wider view of a system as a whole. It has a goal for reducing managerial uncertainty of the lower level and enables it alternative solutions. The last level, self-organisation defines the direction of a system's working. It defines a system development strategy where it can change goals, structure and priorities of a system as a whole. This conceptual structure is rich enough to describe a variety of complex systems. An example of this is Parsons' AGIL model of structural-functional sociology for researching a society. A, G, I and L represent Adaptation, Goals, Integration and Latency. According to Parsons, every social system must, in order to exist in its environment, have its own mechanisms of economy, politics, legislation and education, which answer to the A, G, I and L properties, which following (Mesarovic, 1989) correspond to regulation, harmonisation, adaptation and self-organisation. We can understand this hierarchy by looking at how the education process extends over a long period and how from this point of view, social changes begin. Consequently, a new state flows into a legislation (adapt to new conditions smoothly). Politics harmonise different goals and interests and economy regulates optimisation of single procedures. (Each opposite procedure drives into a dictatorship). Even a model of viable systems according to S. Beer with its five subsystems can be explained following this model.

6 Inter-organisational System and Tourism

In order to demonstrate the methodology described above, we have presented a part of the model for decision assessment of strategic development in tourism as a good example of complex systems. It is known that development of information technology, especially the internet and global communication also caused change in organisational systems. Their structure became more smooth, open and flexible with new inter-connections in the environment. The way of work has been changed as well as the borders and organisation of systems. The main property and driving force of organisation today are information processing, decision-making and learning. Market environments are becoming global. A typical organisation such as this is tourism. Tourism subsystems are strongly connected to each other and this enables them on one hand to smoothly obtain the world market while on the other hand create turbulence in the world market with the demand for flexibility and fast reactions of the entire service industry. Tourism organisations belong to inter-organisational systems with global and local properties. Problems are softly defined and phenomena uncertain. As service users and tourism organisations as service providers, they are requested to make fast and integral decisions and are responsible for the satisfaction of guests. Thus we urgently need an excellent methodology approach to these problems. There are many different methodologies and methods, which try to master soft-structured problems. Here we meet methods and tools of system dynamics and system thinking, which became common tools of management in the 90s. These tools were brought into force first in the learning and training area in the form of different computer games and later as tools for decision-making and organisational re-engineering. Tourism is a relatively young socio-economic activity, which encompasses a large variety of economic sectors, players and academic disciplines. The complexity of its composition makes it inherently difficult to draw up universally acceptable definitions, which help to describe the concept. (Fayos, 1997). There is no single definition of tourism, but rather a multiplicity of them, each catering for the particular area being studied and emphasising different aspects of the same activity. The economist will therefore focus on consumption, the psychologist on the consumers' motivation (Cooper et al., 1993). A system researcher will focus on tourism as a system with its inputs and outputs and interactions among single subsystems. A strong bond exists between development and the welfare of civil society. Decisions, which include wide financial, technical, logistic and environmental resources, demand the decisions' simulation before they go into action in a production or service process (Kljajić, et al., 1998). With all organisational systems, human skills and creativity play an important role in efficient problem solving. Therefore, teamwork has to be included in the decision process for achieving the satisfied solution. Implementation of a group decision support system enables participant testing of different business scenarios and the sharing of common views regarding a problem. Following this, the indirect effect of testing scenarios in tourism is understood in an environment, which is less risky prior to the actual implementation into the production process (Verna, 2000, Asproth at all., 2000). Fig. 4 represents a tourism macro-model and an influence diagram of a simulation model. Gross Domestic Product (GDP), Population, Global tourism market etc. represent a set of entities and the directed branch represents the flow between entities. In other words, Fig. 4 represents the directed graph of the system. On the outline one can find the polarity of the causal loop and estimate the qualitative trend of the system behaviour. For example, the Local tourism market, Quality of service, and Local tourism market loop represents negative feedback and the regulation of quality. Meaning that desired Quality of service is a function of strategic planing. Tourism market's growth is proportional, among other, to quality of service, but quality of service is dependent on the investment, which is function of difference between the target state and current state of the system. This loop is the basis for all other loops in the system, most of which are positive loops. In the example, similarities among different methods of operating complex systems can easily be seen; cognitive graph or semantic graph or influence diagrams. If the above entities are considered as a Level in the System Dynamic (Forrester, 1961) and directed branch as a flow between Levels, one can derive a difference equation for the computer simulation.

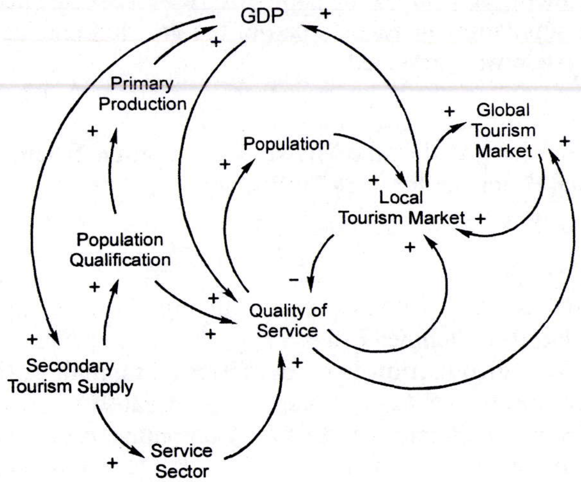

Fig. 3: Simplified influence diagram of a Local tourism model

The business system simulator is going to be the bases for the assessment of strategy development in tourism. The simulator will be connected with Group Support System (GSS) as well as the database so that each scenario will be analysed by an expert group. Thus the dynamics of future behaviour of the system as a function of decision is more transparent to decision maker. Simulation results are evaluated with the help of group decision support systems and with expert systems. We must mention that opportunities and the future need this kind of decision-making system. A tourist can at once become a creative worker, which is possible by using telework. The tourism facility (hotel, agency, restaurant) enables him a qualitative information system for telework (decision-making) such as the internet, intranet, teleconferences, GSS, global system mobile etc. The Tourism decision support system must fulfil the needs of tourism suppliers and users of tourism services: i) Decision making of tourism suppliers for their rational and qualitative service in co-operation with a tourist and ii) Enable a tourist the use of the communication system for global decision making and work indifferent problem areas.

7 Conclusion

This article discusses the system approach method in modelling the complex system from the epistemological, semantic as well as decision-making point of view. It is indicated as the equivalency of epistemological and semantic limitation in modelling of complex systems. It is suggested that the modelling methodology of complex systems should be considered also as a hierarchical decision-making paradigm. However, the problem of measurability and ordering scale relations with moral values in utility interpretation is objectively restrictive to unified interpretation. An overview of the most important organisational systems concepts was discussed. It seems that there are no major differences among them, only different points of view. Last but not least, the system approach paradigm simulation model as a part of the decision-making system in tourism as an anticipatory system was presented.

Acknowledgment
This research has been supported by the Ministry of Education, Science and Sport of the Republic of Slovenia, Grant No. PP-0586/2001.

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