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## TOWARDS THE SEMIOTICS OF NOOSPHERE

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**Abstract:** *Civilization has brought us into the noosphere world. Besides physical, around (and inside of) us exist and function also mental and cultural entities. It is impossible to perform now knowledge acquisition, knowledge base creation and organizational systems management without adequate consideration of object's noosphere statuses. I tried here to clarify basic viewpoints concerning this issue, hoping that elaboration of common methodological foundations of semiotic modeling will be useful for developers and also for users of new generation automation systems.*

**Keywords:** *noosphere, antroposphere, semiotics, modeling.*

“We are faced with a harmonized collectivity of consciousnesses to a sort of superconsciousness. The earth not only becoming covered by myriads of grains of thought, but becoming enclosed in a single thinking envelope, a single unanimous reflection.”

Père Pierre Teilhard de Chardin, 1881-1955

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### Introduction

Organizational systems are extremely difficult to manage. As a rule, we have almost no adequate mathematical models to apply. In this situation step forth ergonomics, naturalness of models from the human viewpoint, easiness of support and permanent modification. It becomes self evident, that one should resort to the methods of applied semiotics, which draw together human conceptualizations and computer implementations. From the other side, we should carefully reconsider the statuses of objects participating in organizational systems, taking into consideration, that we are dealing with organizational systems management in the World, that has entered the noosphere era.

The material, presented here, reflects our initial advances in this field. That is why much attention is paid to philosophical and methodological issues, to formulation of basic definitions. We have to acquire and elaborate the new conceptual system and develop the new language for the new types of problems.

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### Noosphere Approach to Organizational Systems Management

Intrinsic limitations of rigorous mathematical models for «soft» problem domains stems from fundamental discrepancies between formal languages and real expert knowledge of application specialists in these domains. This knowledge is extremely anthropomorphic: indefiniteness, vagueness, uncertainty, ambiguity, inaccuracy, abundance of qualitative and linguistic descriptions and appraisals (large, substantial, dangerous, promising, sustainable, sound, «has a negative effect on...», «undesirable consequences», etc.). Determining role play so called «human elements»: subjectivity, emotionality, tiredness, illogicality, laziness, intricate dynamic structure of interpersonal relations – sympathies, antipathies, trust, prejudices, offence, gratitude, revenge, family relations, sense of justice, duty, humor, «sense of deep internal satisfaction», team spirit, presence of own goal creation and goal achievement mechanisms. Existing modeling methods almost completely ignore these human elements.

The valid scientific approach to the problem of management and control in such problem domains, requires, first of all, evolving the paradigm of real world knowledge representation, together with methods for its handling and manipulation: acquisition, integration, verification, information access. The world had entered the Information Society era, but we still are in acute need of languages, adequate to this problem. Serious steps in this direction were done by V.I.Vernadsky [Vernadsky, 1943] and French geologist/paleontologist Jesuit theologian and philosopher Père Pierre Teilhard de Chardin [Teilhard, 1947]. They proposed to use the term «noosphere» (Ionian Greek "noos" = mind) for integrative designation of physical world realities together with the whole mankind knowledge. Teilhard advanced the notion of «Omega point» - the ultimate stage of the evolution on the road of cultural and knowledge integration development. But, at that time, were absent computers, information technologies, applied semiotics, knowledge representation and engineering.

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## The Noosphere Doctrine from the Positions of Epistemology

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The noosphere genesis very metaphorically and romantically was described by M.Prishvin (Prishvin, 1957): «Somewhere, on the invisible sky of the whole mankind, are wandering the great thoughts, accrued during all centuries, which passed by; they cast shadows, as clouds, and looking on them, the most sensitive humans comprehend the thoughts».

The history of the Earth and, generally speaking of the whole Universe comprises several stages. Classifications, given by different researchers, closely resemble one another. As for example, one can mention [Turchin, 1977] and [Korsuns'kyy, 2000]. For our needs, it seems reasonable to fix the following five stages:

*cosmogensis* – processes of Universe transformations, which have lead to our Galaxy, solar system, and Earth creation;

*geogenesis* – inorganic processes in solid, liquid and gaseous media;

*biogenesis* – uprising of metabolic processes and life on Earth, humankind in its initial stages;

*sociogenesis (civilization)* – further development of humankind activity: natural resources development, intentional or unintentional interference with geological and biological processes, environmental state and processes; in the course of time civilization was increasing its influence on the state and transformation of the World;

*noogenesis* – the epoch, where the total mass of humankind World knowledge explosively increases, anthropomorphic influence on environment becomes heavy on planetary scale, and human mental power could be used to fundamentally change behavior patterns, taking into consideration all planetary factors, aiming at thorough harmonization of civilization development on the whole Earth and beyond.

This list gives the ordering of the starting points for the corresponding stages. They all are still active now and keep influencing one another.

Let us give more detailed definition of the concept: «*noogenesis*». It is the evolutionary stage of World development, when certain conditions– «*nooconditions*» - determining the transition from *homo sapiens* to «*intelligent society*» hold.

Scientific, technological, social, ethical, moral and cultural potential of the society achieve such crucial level, at which the following conditions become feasible.

As a most general goal for humankind is adopted freedom of pursuit for happiness for each live being as far, and to such extent, which does not interfere with the interests of other live beings.

As the basic ethical principle is adopted the reciprocity principle: treat others as you would like to be treated by them.

*The Global distributed knowledge and data Base (GB) is formed, which explicate knowledge of humankind in all spheres of activity: theories, applications, factual information, skills, arts, beliefs, know-hows, etc. – in any modality: mass media, printed matter, computer data, words of mouth... Computer modality is strongly preferred (ease of creation, support and dissemination).*

Advanced information telecommunication infrastructure is created, which supports efficient and convenient communication between society members and access to the GB for its creation, support and use for decisions support in all spheres and levels of societal activities.

Juridical, social, administrative, educative and political societal functions are oriented towards the most efficient fulfillment of all previously formulated nooconditions.

Fulfillment of condition 5, due the explosive progress of Internet technologies, may be considered as being solved, in principle. At the same time, preparedness of society to implementation of condition 4 is restrained by difficulties of public thinking paradigm change, cultural orientation, abundance of white spots in knowledge integration methods, methods of modeling for «soft» problem domains – to which systems of humanitarian knowledge and management in organizational systems belong.

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## Applied Semiotics as a Paradigm for Information-Noosphere Models

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Semiotic approach to the problem of modeling preserves high correlation level between the problem domain and its model. It helps considerably on the stages of model creation and support during its whole life cycle.

*Semiotics* – is the science, studying the structure, properties and dynamics of formal symbolic systems in their relation to physical and cultural world – from the position of world cognizing system, development and use of symbolic models of reality, behavior of such models, rules of interpretation and manipulation.

Semiotics stems from works of ancient philosophers. More detailed presentation of its basic concepts was done by G.Frege [Frege, 1892]. The notion of signification was introduced by A.Church [Church, 1956]. Fundamental investigation of the basic semiotic triad – things, properties and relations – was done by A.I.Uyomov [Uyomov, 1963]. E.F.Skorohod'ko [Skorohod'ko, 1962] was among the first, who proposed to build computer models using relations – «rx-codes». This approach was further elaborated in works on situation management and control [Pospelov, 1975, 1986]. Further development of applied semiotics approach for semantic nets and relational knowledge representation systems were presented in [Lozovskiy, 1979 – 1999].

*Applied semiotics* differs from its philosophical sibling in its object and approach: here are studied not just pure formal, but quite real symbolic models, which are implemented by means of computers for modeling and control of real applied objects and systems.

Computer semiotic models are marked with intrinsic semantic wealth and depth, it gives the possibility to create on this basis procedures for assimilation of new knowledge, checking it for consistency and completeness, create plans of goal-directed behavior, support behavior monitoring and control, diagnostics, decision support. Applied specialist can interact with such model in terms of customary notions: actions, states, goals, scripts, procedures, functions. Compiled down to low computer level program solutions are devoid of these abilities. Semantics on these levels is already lost, one can have only preprogrammed scenarios and receipts– without dynamics and the ability to analyze and explain unforeseen situations. Let us formulate the basic definitions.

*Universum (Universe)* – the set of all entities (objects) in the Universe (noosphere).

*Entity, or object* – something, cut out from Universe by observer, guided by certain pragmatic considerations; at which their attention is directed, about which they speak or think, which is referenced somehow or other. For example, «Black Sea», «is to the West of...», «Christianity», «gravitation», «socialist emulation», «sustained development of the regional economy» ...

Any research, analysis, modeling presumes cutting out of the Universe certain restricted domain. Of course, this action is very informal, specific and depends upon the problem to be solved, viewpoint of the researcher and on many other circumstances. We will call it *problem domain* (PD). Usually, PD includes the object of investigation, modeling and/or control per se, and also, its environment. Their interaction and interference should be considered in complex.

One more delicate issue concerns the interrelation between the model and the object being modeled. Should the model be included in PD? And, at last, what to do with researcher, who studies the given PD, builds the model, produces certain conclusions on this base, and then uses the knowledge obtained in actual work with the prototype object? The model, in its turn, can have direct links with the object of modeling, receiving from it raw measurement data. Results of modeling, in their turn, can directly or indirectly influence the object of modeling, researcher or end users, their administration.

*Problem domain* (PD) thus is the set of all entities (objects), which have material effect on the problem of analysis, modeling or control being solved.

Giving so broad definition to the PD notion, I am aware, that it goes against the classic philosophical canons. Within the sphere of our consideration become included, together with «material», also «ideal» entities. From the viewpoint of «pure» science, it is the deadly sin, conceptual farrago... I have only two answers.

Firstly, life encourages us to adopt the noosphere approach to management and control of organizational systems (OS) in contemporary world. As in this world practically on equal terms act material and «ideal» objects, our picture of world should adequately reflect it.

Secondly, what was beyond the power of the classical philosophy becomes feasible today, on the basis of semiotics and knowledge representation researches. One needs to change the paradigm, and we have the means to do it.

PD encompasses the set of entities – *d-entities* – domain entities. The same meaning I assign to the term «object» - something at which our attention is focused, which is under consideration. It should be emphasized, that «entity» - could be really *everything*, even something ephemeral, which participates in our picture of the world – not only material things, physical objects.

From the viewpoint of noosphere approach, in our interpretation, d-entities can have one of the three possible noosphere statuses.

**Physical entities** (P-entities) – objects, which exist or undoubtedly existed in physical world, in «reality». The issue of «physical existence» - is the ancient philosophical stumbling block, one of the main battlefields between materialism and idealism. In spite of many fallacious, disputable and boundary situations (phlogiston, UFO, telekinesis, God Almighty), we are forced to use this loose definition, because it nevertheless brings us closer to reality and can play the role of common ground in PD languages development and usage for academicians and application specialists. It is quite uncomfortably, really, but we should eat this crow, accepting the fact, that this issue cannot be completely formalized. Simply, we should only provide for the facilities to modify the knowledge base correspondingly, if cognitive positions of knowledge engineers or application specialists somehow change. It is the routine general requirement for lifetime support for all bases, and this case is nothing more restrictive or outstanding than others.

**Mental entities** (M-entities) – objects (thoughts, ideas, representations), which are formed within the thinking systems of Intellectual Subjects (IS), and used by them in the processes of cognition, analysis, modeling, forecasting, planning, control.

We can think about IS as of biological subjects (humans, animals), or as of artifacts – robots, expert, decision support, artificial intelligence systems. The physical nature of IS and of their internal processes are of no relevance. Important are their cognitive – semiotic and functional properties, joint interactive dynamics of m-entities of the given subject, interaction with the outer world, information transformation processes.

Besides images of specific p-entites (Ukraine, A.S.Pushkin, Duke's Monument in Odessa), in the brain of IS can exist pure abstract entities (mathematical theories, concept of dwelling, «what is good», etc.) and also fictional, folklore, mythological, religious conceptions, which, in principle, have no p-prototypes.

We arrive at the conclusion, that m-objects are quite specific entities, which dwell in unique media – thinking brain of IS. From one viewpoint, they are undoubtedly real, objective, because they are formed within the material media and with the help of material absolutely real biological, chemical, electric processes, have material carriers, but, from the other viewpoint, they are subjective, belong to specific individual, depend upon their ability to interpret them, obtain their *meaning*. They are extremely hard to be explicated by individuals themselves, in the form of introspection, and even more harder – by collocutor, psychoanalyst.

**Intellectual subject** (IS) – is the subject, which:

- possesses the unique ability: to build the model of him/her/its-self and of corresponding environment; this model should adequately, *objectively reflect* essential properties of pertinent p-objects;
- possesses the ability to act purposefully;
- can build and modify its own knowledge representation system, including abstract m-entities, use axiomatic method, definitions, methods of deduction, induction, abduction, algorithms;
- possesses learning capability, ability to plan own activity, implement plans, can actively interact with environment in order to obtain information needed and implement own goal directed activity.

**Objectivity of reflection** is settled a posteriori – depending on the results of goal directed activity of the given IS: if it is successful, one may assert that their model was objectively reflecting reality.

Civilization, integration of knowledge and skills, communication between IS, upbringing and education of young people would be impossible, if results of individual intellectual achievements would remain on the level of separate individuals' m-objects. With necessity, we arrive at the conclusion about existence of the third type of entities – cultural objects (c-entities).

**Cultural entities** (C-entities) – are the objects of «*cultural world*», created by evolution and civilization within the frame of world human community – on the most general scale: sciences, arts, customs, religions, rituals, laws, regulations, plans, purely «human» relations and feelings (fear, hatred, love, trust, admiration, amazement, irony, etc.).

C-entities are far not simple objects - they are centaurs, integrating objective and subjective features. They are sort of objectified analogs of m-entities – as far as they are alienated from individual subjects. C-entities do not exist «in nature». They «materialize» only during the process of interpretation by some IS.

Distinction between m- and c-entities can be elucidated as follows. Conception of the «War and Peace» conceived by Leo Tolstoy, - is the system of m-entities. When it was written, printed, distributed read and understood by different people, we can say, that the corresponding c-entity sprang into existence. It can be an object of discussions; there appear more or less canonical interpretations of its characters, one can use them metaphorically, and such metaphors will be perceived by educated people in similar way.

Sometimes arise the temptation to abandon cultural gnoseological category at all, and handle c-objects as ordinary p-objects, with which they really have much in common. Frequently information on certain c-object is much more complete and systematized, than on some p-object. Thus, Cinderella or Red Hat are much more familiar and similarly understood by many people, than, say, hydrogeologic characteristics of North-West Black Sea shelf.

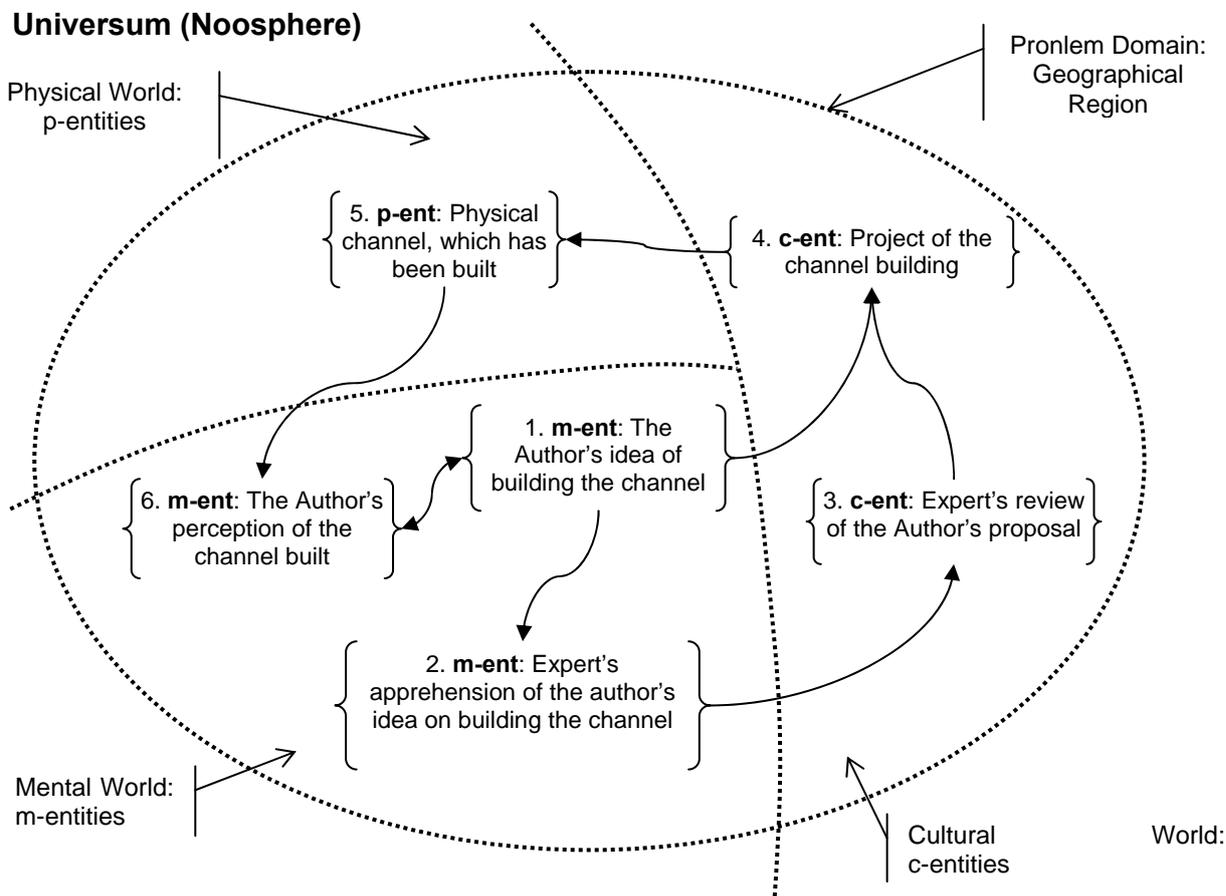


Fig. 1 An example of noosphere semiotic structure of a problem domain

Some c-objects have p-objects as their material correlates. Other c-objects go without material correlates at all – verbal folklore, «common laws». To exemplify «reality» of c-objects let us consider juristic term: «common-law marriage» - typical c-entity - a marriage without a civil or ecclesiastical ceremony, generally resulting from an agreement to marry followed by the couple's living together as husband and wife, performing joint housekeeping. If the court acknowledges two people being in the state of common-law marriage, certain cultural attitudes, rights and obligations arise between them and towards their community property, children, etc., leading to corresponding physical attitudes and actions with certain p-objects.

IS interact with physical environment in two ways: directly (your car bumped – God forbid! – into the road post; in this case neither you, nor arrived police officer have any doubts about reality of the car, road post, damages) and cognitively – through the reflection, modelling in the IS's brain. In this case, m-objects formed in participants' and witnesses' knowledge representation systems, of course, are different. Creation of the accident report – c-entity - is thus aimed at working out single official viewpoint on this accident. But even after it is completed and even signed by participants, one cannot be sure that the synthesis of unique, adequate to reality, c-object has taken place. Here you are! We have arrived at idealistic, in fact solipsistic, interpretation: for each human participant of the current incident «objectively» exist only their own (subjective!) feelings and mental constructs, m-objects... Of course, it is only until the guilty person will have to pay for the property damage and car repair with quite real, «material» money (p-object with its corresponding c-object, as a correlate, by the way!).

The border between physical and cultural world appears, first of all, as a result of natural distinction between p-entities and their cultural correlates, interpretations, which create World cognizing systems.

Let us take the c-object: «Project of the channel building» (4, Fig. 1). The corresponding p-object – the set of printed lists – is omitted, for simplicity, from the figure. With c-object (4) is associated the certain semantic and pragmatic interpretation. Information, acquired by specific person on making acquaintance with this object, differs with professional orientation, theoretical baggage and personal experience, their goals, accompanying circumstances, relations with authorities, adjoining organizations, etc. Complexity and ambiguity in cultural objects' evaluation – is among the main difficulties in creation of management and control systems for OS.

Sometimes, m-objects can play the role of p-objects – entities beyond the comprehension of specific World cognizing system. Thus, lecturer's efforts are aimed at creation within the student's minds some specific system of m-objects – knowledge and skills in the PD of interest. The following examinations are aimed at explication of «objective» c-situation in students' understanding. This tendency towards m-objects' explication – is the task permanently being solved by humanity. Science, its cutting edge, is done predominantly in the sphere of subjective, m-objects. In the course of time, the definite paradigm is created, then – specific scientific school. Along with this, primary subjective conceptions (m-concepts), are becoming the common property of given scientific community, supported by published works, information exchange on conferences, implemented applications, start to acquire more and more objectivity... At this stage, we can say, corresponding c-objects flourish, becoming explicated from individual m-objects in the process of human thinking and communication. And at last, the new theories, well developed branch of science find their way into textbooks and are presented to the broad students' communities, obtaining a kind of objectivity. This «a kind of» is becoming evident when different scientific schools, evolving different paradigms, create different empirical theories. Some c-objects can, at last, obtain their physical, «real» p-incarnations.

Let us illustrate these considerations. Look at the schematic example – fragment of noosphere – semiotic object structure for chosen PD (Fig. 1). PD is a part of the Universe. Before IS appearance and noosphere emergence the Universe comprised exclusively p-objects of natural origin (the Earth, gravitation, electromagnetic waves, chemical elements, minerals, vegetable and animal kingdoms, etc.). IS perceive all these with their organs of sense, measuring instruments, supplementing the picture being constructed with their own conceptualizations, considerations, hypotheses, logical inferences.

This argumentation supports materialistic hypothesis on primariness of substance. M-entities' existence is possible only in the conscience of thinking subjects, their material bearers, which should be extant *before*, the first thought could arise. Thought, «word» without material substratum – is senseless concept. It is impossible to create a painting without brush, paint, canvas. C-entities formation in certain orders takes place on the basis of corresponding subjective m-entities. Reverse process also takes place: transformation of c-entities into m-entities of concrete individuals during their upbringing and education. These processes are inseparable from appearance of natural languages, which play the dual role – of thought and communication.

Let in the brain of some subject – the author – appeared the idea of building some channel: (1), Fig. 1. It is subjective m-entity, available only to its author. Then some other individual – expert – makes acquaintance with it thus creating in their brain the corresponding m-entity (2). Just like the source author's plot, it is completely subjective notion: we have no guarantees of its adequacy to the subject of investigation. Its formation is liable to be influenced by abundance of uncontrolled and implicit factors (educational qualification, practical experience, acquaintedness with the field, their pertaining to some or other professional group, paradigm adhered to, etc.).

The expert's work results in creation of c-entity (3) – review of the author's proposal on channel building. From this moment on – expert's opinion becomes available to other humans – the transition of given entity from subjective mental category into cultural – objectivization, or explication – has taken place.

Assume that the idea of channel creation was supported by authorities, and, as a result, the new c-object appears: «Project of the channel building» (4). It comes as a result of many people efforts, analysis of many documents, reference manuals, etc.

Let then the designed channel is physically built. It is designated in our scheme with the p-entity (5). The author of the initial idea, making acquaintance with its implementation in reality, can form in their conscience the corresponding notion (6).

What have we arrived at as a result of this consideration?

Firstly. We should decidedly agree, that the three worlds allocated by us: physical, mental and cultural are closely adjoined and are interrelated.

Secondly. We should become convinced, that goal directed activity within the frame of contemporary human society should be considered from the positions supporting natural trinity of designated noosphere semiotic

categories. This conclusion falls into certain contradiction with «pure» scientific approach, warning us against mixing «material» and «ideal», building unpenetrable watershed between these worlds.

Thirdly. Creating modern computer expert and control systems, pretending to be highly adequate to reality and be competent on decision support level, one should be certain to deal correctly with objects of all three worlds. Particularly, if traditionally management and control sciences consider one stage reflection of physical world realities by computer knowledge representation system, the more adequate noosphere approach to the process of IS interaction with environment and especially with other IS leads to importance of taking into consideration the phenomenon of m-entities reflection. Roughly speaking – while interacting with intellectual beings, we should take into account, how do they perceive our ideas and representations. Faults, committed already at this – first – reflection level may lead to unwanted results. For successful performance of communicatory acts in the vein of goal directed activity, due interference of human elements, one should take into account not less than two, and sometimes even more levels of reflection [Lefebvre, 1973].

In the process of evolution, the role of human elements was increasing, and nowadays, especially when we deal with organizational systems management, cannot be ignored. That is why one should adequately take into account peculiarities of «ideal» - mental and cultural objects, efficiently coordinating these processes and activities dealing with p-entities. And all this – under the pressure of complicating factors: incomplete, invalid, unreliable, imprecise information, errors of all possible kinds, dealing with incompletely observable and incompletely controllable systems.

M- and c-objects both can possess different level of objectivity, reflection precision, modeling the properties of prototype d-object and are situated at different points on abstraction axis, originating in PD. Its other extremity corresponds to pure abstract objects. Role of the prototype can be played by any (p-, m- or c-) object of the PD.

We arrive at the conclusion that in any organizational control and management system, and also in any knowledge representation system, one should accurately discern noosphere status of entities, with which we deal.

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## Conclusion

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Automation of management and control in organizational systems required revision and more precise consideration of semiotic definitions and approaches to problem domain model building in the frame of noosphere representations. The current research was aimed at elicitation of noosphere statuses for the entities which participate in the domain. It was proposed to consider three problem subdomains: physical, mental and cultural spheres followed by explicit consideration of these statuses in semiotic models. The subsequent research will be concentrated on developing the methods of goal directed activity in organizational systems management representations basing on explicit accounting of noosphere statuses of participating entities.

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## PLANNING TECHNOLOGIES FOR THE WEB ENVIRONMENT: PERSPECTIVES AND RESEARCH ISSUES

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**Abstract:** *This work will explore and motivate perspectives and research issues related with the applications of automated planning technologies in order to support innovative web applications. The target for the technology transfer, i.e. the web, and, in a broader sense, the new Information Technologies (IT) is one of the most changing, evolving and hottest areas of current computer science. Nevertheless many sub-area in this field could have potential benefits from Planning and Scheduling (P&S) technologies, and, in some cases, technology transfer has already started. This paper will consider and explore a set of topics, guidelines and objectives in order to implement the technology transfer a new challenges, requirements and research issues for planning which emerge from the web and IT industry.*

*Sample scenarios will be depicted to clarify the potential applications and limits of current planning technology. Finally we will point out some new P&S research challenge issues which are required to meet more advanced applicative goals.*

**Keywords:** *Planning, Web, IT, technology transfer*

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### Introduction

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The Information Society (IS) is announced by a set of interrelated emerging technologies where the web it is certainly one of the most apparent and popular elements. These technologies envision new relationships of the individuals between his/her own tasks and the new tools.

Individuals are forced to develop new methods of work in order to exploit the ITs at their best, new tools and application should reflect and model these new methods in order to be effective.

Despite of the successful buzzword “web” (and popular e-*something* terms such as: “e-commerce”, “e-business” etc.), it is important to focus on a wider vision of the potential role of planning and scheduling