Knowledge Basis for Integration of Finance, Economics, Management and IT Business

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Abstract: The problem of integration of finance, economics, management and IT business is the problem of activities' integration, digitalized with application of IT. Digitization leaves unsolved questions of cognitive activities objects' integration. This disintegration is partially compensated on the humanitarian level by optimization of subjects' behaviour. But integration on level of physical and informational objects of activity stays insufficient. The experience convinces that its strengthening is impossible without vertical integration of knowledge about conscious phenomena, and horizontal integration of conscious and natural sciences knowledge. Products of conscious activity are programs and databases. The understanding of their essence led to building of bilateral development models of cognition and economy. On this basis, the vertical of knowledge for spheres of sign phenomena, is built. It contains in its core the paradigm of sign constructions ontology. It is received with method of immersion from concrete to abstract. The result is used for ascending from abstract to concrete. On the way to data infrastructures as flexible "junctions" between fragments of activity, paradigms of data and computer programs are received. Their essence which is called quasi-physical is defined by analogy with computer programs, where signifier and signified have no physical connection but have correspondence.

1 INTRODUCTION

The economy includes interrelated heterogeneous objects. It is people, money, power sources, materials, documents, etc. The integrity of such complexes is ensured by people. Their activities are difficult to be technologized, despite undoubtedly high IT potential. Starting from a certain level of semantic diversity of data, IT face the difficulties even in the case of the trivial processing of diverse data. Particularly, it happens if the data have a variable structure.

Such complexes as economic and information ones, where their essence is still uncertain, are now commonly referred to as systems. In combination with the emergence, the concept of the system, associated in natural sciences with order, actually became an implicit synonym of disorder.

However, even with such a logical basis, addressing the challenges of integration of IT, business, finances and management is also possible, while being empirical and heuristic, i.e. preparadigmatic. These solutions intended not so much for the integrated objects, but rather for the personnel, who should ensure the integration.

Fundamental solution to the problems of technologization and integration of information and economic processes, that this paper focuses on, is

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possible by forming the knowledge basis including, along with technologies and practices, deep levels of cognition – philosophy, methodology, math, fundamental and applied scientific paradigms and theories. We called the innovations, covering such levels of cognition, paradigm innovations.

In order to implement the integration "in the world", it should first take place "in the minds". The approach, used therein, is related to the concept of noosphere. This concept arose in the 1920s in Paris in the social circle, including Edouard Le Roy, Pierre Teilhard de Chardin (Chardin 1987) and Vladimir Vernadsky (Vernadsky 2004). This concept was significantly ahead of time. Only a few comprehended the idea of noosphere as it was understood by Vladimir Vernadsky. The latter, primarily, meant continuity of social historical evolvement with regard to natural history.

Noosphere should comprise biosphere and physiosphere and, at the same time, it should have its own nature and consist of the bodies of the same nature. In our opinion, such bodies are signs. Actually, Vladimir Vernadsky pointed out that in cognition of conscious phenomena it is possible to be guided by approach, applied in cognition of natural phenomena. As distinct from physicalism, which tries to disseminate the results of physics beyond physiosphere, the objects of quasi-physical approach are not the conscious phenomena themselves, but the quasi-physical effects, created by these phenomena. In our case, these objects are represented by computer programs, databases and knowledge bases, economic organizations.

Until the vertical of knowledge is formed, at least, in general terms, delineation of the spheres and levels of cognition (subject specialization) here will be premature. All basic levels of cognition, from practical to philosophical, are represented in this paper. It is not an accident and it is not eclecticism. According to PIDev and VIK models (see below) such integration bears principal meaning, being, in our view, a prerequisite for fundamental solution of the problem of FEMIB integration. In order to have "normal science" and to make specialization possible, we need to develop a vertical of knowledge, which is formed as a whole. Here the specific problems like integration of FEMIB play the role of the goal as well as means.

2 BASIC CONCEPTS

Traditionally, knowledge is divided into natural and humanitarian. The specific nature of cognition consists in the fact that consciousness produces just one of two parts of sign body. It is a signifying part, that should correspond to the second – the signified part. The signifiers (for instance, text, photo, and movie) eventually point to the natural bodies, provided that the scope of the concept of sign body will also include dynamic (temporal) and multiple formations. The signifying parts of the sign represent the result of the processes, similar to programming, even if it is not about computer programs. Their application consists in performance (interpretation), which is implemented by human or special devices (computers). We can say that any sign is a program segment in the broad sense of the word.

Vladimir Vernadsky focused on the issues of cognition. His concept of noosphere gives a new insight into the processes of cognition and structure of knowledge. He did not live to see the emergence of computer technologies. Having no experience, brought by these technologies, it was not always that he formulated his views explicitly. It creates grounds for trivial interpretation of these views, when the issues of noosphere are equated with ecological issues of biosphere or issues of digitization of information practices. The utter nonsense that Vladimir Vernadsky has given no reason for, is a mystification of the concept of noosphere.

The thoughts of Vladimir Vernadsky about the nature of knowledge and cognition become more coherent, if we view them, like Thomas Kuhn, in terms of scientific revolutions (Kuhn 2012). The key distinction of Vladimir Vernadsky is that he uses larger spatial (geosphere, biosphere, noosphere) and, accordingly, temporary categories. Moreover, he builds a bridge between the spheres of natural and conscious phenomena. It enabled him, using the concept of noosphere, to foresee inevitability of the new scientific revolution. This is the second revolution of that magnitude after the revolution in natural science of XVII century. Its prelude is the current technological revolution, taking place in the sphere of physical processes of data handling and called the information revolution. We believe that the events of such revolution are still ahead. It will affect not only circulation of information, but also the entire sphere of conscious phenomena. Therefore, the title "noospheric" would be the most appropriate for such revolution.

Its main content, able to accelerate dramatically and, at the same time, to stabilize scientific and technological development, will be not so much the technological advances, but rather "destruction and reconstruction of understanding" what is happening

in reality (Mamardashvili 1997). Destruction-reconstruction of understanding assumes revision and extension of the system of concepts, acting in the studied sphere. Therefore, developing the ideas of Pierre Teilhard de Chardin and Vladimir Vernadsky, related to noosphere and continuity between the natural and social history (Chardin 1987, Vernadsky 2004), ideas of Thomas Kuhn, related to scientific revolutions and paradigms (Kuhn 2012), and ideas of Merab Mamardashvili, related to quasi-physical effects of non-physical phenomena (Mamardashvili 2011), we believe that, for today, the most relevant challenge is to form the language, applicable for raising and addressing the issues of developing the cognition and economic management as the spheres of non-physical (conscious) phenomena, producing quasi-physical effects.

2.1 Ontology

For some time, the term "ontology", which came from the philosophy, has been widely disseminated in IT sphere. Ontology in philosophy is a teaching on being, essence and existence. We consider the ontology in science as a synonym of fundamental science, i.e. knowledge of the essence and existence of the objects of study. The ontology is also an object of a certain scientific discipline, an abstraction, determining its internal structure and external relations. Thus, philosopher Gustav Shpet, calls physics to be a science of the ontology of physical bodies, biology – a science of the ontology of living organisms. According to Gustav Shpet, semiotics should become a science of the ontology of signs (Shpet 1996). So, the fundamental science is a science of the ontology of objects, which cannot be reduced to other objects.

A little bit different understanding of the ontology was developed in the sphere of information technologies. We can say that it is thesaurus, describing the subject area of computer program. At the same time, the subject area can be the area of interests of program user, although, more often it is the existing source domain of data processing, being a subject to digitization and modernization. Under this arrangement, the major ontological issue of the information development of economy and society, consisting in ensuring the maximum correspondence between syntax and semantics of the sign, becomes optional.

2.2 Spheres of Phenomena

Sphere of phenomena is a set of phenomena, deriving from a certain entity, which is not reduced to any other entity. The examples of such objective scientifically grounded entities can be represented by physical bodies and living organisms. The signs are hypothetic entities, and their objectivity needs theoretical and empirical justification. The use of the concept "sphere of phenomena" in science about science and knowledge economy leads to understanding of the relativity of dividing the sciences into the natural ones and the humanities as well as an opportunity to discover new spheres of phenomena and extend nomenclature of fundamental sciences.

Infosphere is a sphere of information (produced by messages and data) phenomena. Information is a multiple-meaning term, where the scientific meaning is still controversial. Synonym of the words: a)message, data; b)one of the measures of message impact on the recipient. Econosphere is the sphere of economic phenomena. Scientific cognition is one of the parts of the process of cognition as a whole. Economy is not only a consumer, but also a source of new knowledge. Natural sciences function within the framework of the developed verticals of knowledge, relating to famous spheres of well-known phenomena. Development of the vertical of knowledge requires paradigm innovations, which start from empirical material and end with practical results.

Innovative Development of Economy (IDE) is a systematic introduction of progressive changes, resulting from new knowledge, into products, means and ways of their production and distribution, organization and management of economic processes. It is in need of continuous inflow of new knowledge, produced not only by science, but also by practical activity. Consequently, IDE – is a mutual development of cognition and economic management. Noosphere is a sphere of phenomena (anthropological, economic, social, cultural), where the signs play the key role. Noosphere contains biosphere almost similarly as biosphere contains physiosphere. At the same time, the larger sphere is not reduced to the smaller one.

2.3 Paradigms

Paradigm is a scientific achievement, a foundation, a core of methodology, model or theory, playing a fundamental role within the framework of scientific discipline or its subdiscipline. Until the paradigm is

recognized, the respective methodology, model or theory is of trial nature. Paradigm innovation is such innovative changes, which cover major part of the vertical of knowledge, starting from the depth of fundamental science and philosophy, and ending with practices.

Model of Paradigm Innovative Development (PIDev) is a three-tier model of mutual development of economy and cognition, where development of a certain sphere of phenomena starts from prescientific (in respect of a specific sphere) phase of empirical and heuristic innovations. Based on the experience, accumulated herewith, in the course of paradigm innovations there is a transition to the third phase – scientifically grounded innovations. According to the model of PIDev, the sphere of conscious, primarily, information phenomena, is in the empirical and heuristic (pre-paradigm) phase of development. The invention of computer became one of the technological revolutions in physiosphere. It had aggravated and exposed the problems of infosphere development, bringing it closer to the beginning of paradigm phase.

2.4 Vertical and Parabola of Knowledge

Figure 1 shows the Model of Vertical Integration of Knowledge (VIK) and parabola of knowledge in graphical form.

The model includes five levels of cognition, from practical to philosophical. It divides cognition into the area of practices, including economy (zero level), and cognition area, consisting of five levels, as well as analysis area, where the problems and their causes are identified, and the area of synthesis, where the search of solutions to the problems takes place. Natural sciences are developed in compliance with the existing parabolas of knowledge. Similar verticals (parabolas) of knowledge should be developed for sciences of infosphere, econosphere and sociosphere.

In the figure 1 the Vertical of Knowledge Integration reflects the view on the structure of knowledge, which, in our opinion, is relevant for the current stage of cognitive development. The vertical integrates practical knowledge (upper semisphere) with the applied fundamental and philosophic knowledge (lower semisphere), and it also integrates subjective knowledge, gained by heuristic and empiric way (left semisphere) with logically verified and tested in practice knowledge (right semisphere).

The parabola of knowledge symbolizes the process of solving the problems ("ontogeny") in the

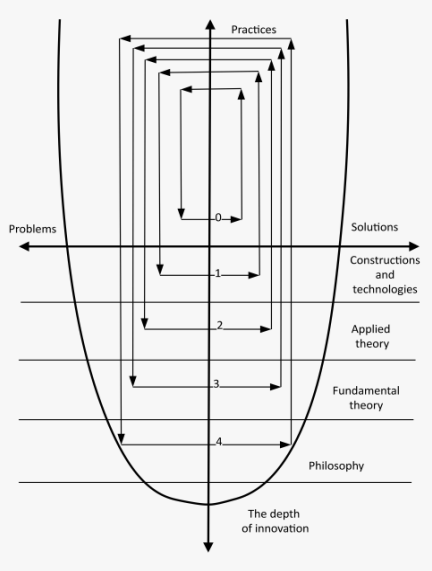

Figure 1: Model VIK and Parabola of Knowledge. Integration of knowledge for integration of objects and means of conscious activity (Polyakov 2017).

infosphere. The left branch corresponds to immersion from the concrete (practice) to the abstract (paradigms), and the right one – to Hegel's ascending from the abstract to the concrete. Considering the sphere of conscious, in particular, information and economic phenomena through the prism of the vertical and parabola of knowledge, it can be noted that in this spheres there is an accumulation of experience, required for paradigm development. It takes place, among other things, using the modeling methods. In terms of the model of VIK, the modelling is also a transition from abstraction of the high level (philosophic, mathematical, semiotic, etc.) to practical concrete. The specific feature of such transition consists in absence intermediate steps in the form of the fundamental and applied theories with ontological focus. As a result, instead of gradual "ascending", there are risky "jumps".

3 PROBLEMS OF TECHNOLOGY AND INTEGRATION OF FEMIB

In fact, finances, economy, management and IT business cannot function, being not closely related between each other. It is an objective reality. Their mutual functioning is ensured, amongst other things, manually, owing to human factor. An increase of the level of their integration is impeded by the subjective factor. IT is not able to overcome the

barrier of semantic diversity of data, although it is not high. The cause of the barrier is of psychological nature, and it consists in the fact that a human, in particular, a programmer, is able simultaneously to control a limited number of elements and their relationship. At the same time, he needs to reflect in the program a correspondence between data, operation of computer, actions of user (for instance, manager) and an area of user's interests (subject area).

As a result, processing of data, related even to one natural gender of objects, can be a serious problem. Data have to be fragmented, thereby losing their integrity and informativeness. Complexity depends on objective and subjective reasons. We have already indicated the objective reason (semantic diversity). The subjective reason is an inability to simplify data structures by the way of its decomposition, unification and application of flexible connections, damping the mutual impact of the contiguously-allocated structures of signs. This situation also has its cause. It is called digitalization and is also of subjective nature. Digitalization is embedded in IT paradigm. Thus, if we look closely, IT are indeed the technologies, but rather physical than information technologies of data processing. From the information side, IT include information practices but not technologies.

Using this approach, there is no need to think about the nature of data and programs. Evolutionary developed data forms and structures are adapted to machine-readable media. As a result, a considerable part of the capability of computer technology remains unused. Thus, the root of all problems is the problem of understanding the essence (ontology) of data, programs and economic entities. Even at first sight, it is evident that the sciences, having a direct relation to the phenomenon of sign – semiotics and linguistics, should be closer to addressing such challenges.

4 FROM SPECIFICS OF PHENOMENA IN FEMIB SPHERE TO ABSTRACT OF SIGN

4.1 The Theory of Sign Constructions Instead of Semiotics

More than a half of century, on the signs basis, the school of organizational semiotics is working towards the problems, close to the ones raised in our paper (Gazendam 2005). Just as we do, they suggest their view on the nature of signs. The monography of Kumiko Tanaka-Ishii "Semiotics of programming" is also worth attention (Tanaka 2010). The author uses a slightly eclectic mix of the paradigms of sign of Ch.Peirce (2009) and F. de Saussure (2017). The different paradigms of sign are used for different types of programs. Each one claims to be the universal paradigm.

According to our quasi-physical approach, scientific cognition is going in the way of ascending from abstract to concrete. Although to do this, we should have an appropriate abstract of sign. The usage of a universal paradigm of sign does not allow the exit beyond the limits of philosophy.

Our paradigm of sign is the product of the immersion from concrete to abstract. As a concrete we use not any sign bodies but just the outcomes, obtained in the process of the development of strongly formalized signs bodies of a specific kind. These are databases, programs, organizations. As for our version of knowledge about signs, we called it the theory and practice of sign constructions. We would like to emphasize the high degree of our objects formalization and the application to them of the methods of development which are close to the methods of physics development. We were delighted to discover some convergence of our views on signs, programs and organizations with results of the observations of Peter Brödner, who saw the similarity in such objects as organizations and programs (Brödner 2005).

4.2 The Paradigm of Ontology of Economic Sign

The problem of the integration of FEMIB elements can be solved by gradual changes in the existing structures (programs and data) of every element and interfaces between them. But as a consequence of high data and programs fragmentation, and their alterability, there is a low level of the unification and standardization. This forces to search for an alternative. Appealing to IT, in this case, looks absolutely natural. This improves productivity but not the flexibility of the data processing. The latter becomes worse due to the increasing costs of changes.

There are persistent attempts to solve the problem fundamentally by the development of the flexible IT, which have to prevent the fragmentation of data and programs, support their unification, and also quick and simple changes. Although, these attempts end with the integration on the level of

personnel instead of the integration on the level of the objects of activity. The fails of these attempts are natural. They are unavoidable and necessary for the accumulation of experience of empirical and heuristic innovations. As a result, the vertical of knowledge from philosophy to practices is forming.

This is the scheme under which natural sciences, particularly, physics have been developing. However, it is widely thought that programs and data are an absolutely different matter, relative to which can be used notions such as "intangible assets". Nevertheless, artefacts are also the result of conscious activity. This fact does not bother the application of the apparatus of physics to them. Programs and data are signs, and the specific feature of signs is that they are programs in a broad sense.

A sign is a signifier and a signified together, but they are not connected to each other directly. The signifier should correspond to the signified. The latter can be a static, dynamic (temporal) or multiple body. In the case of the temporal body, the maximum overlapping with metaphor, where sign is compared with computer program, is achieved. Cognitive activity creates physical artefacts, which are signifiers of signs. Although they cannot be considered without signified parts. The latter are also physical bodies, but not connected directly to the signifiers. Quasi-physical effects of cognitive activity appear and require special treatment, when signs become the products of cognitive activity.

As long as signs exist in the form of, at least, two physically disconnected parts, which connect to each other in the social consciousness in the form of the relation of the correspondence, they cannot be presented as static objects. Space and time (causal) relations between the signifier and signified parts of sign are realized in the process of its functioning by means of human or technical devices. Thus, the ontology of sign can be presented as substantivisation of the actions of sign and with sign, i.e. in the form of the temporal (dynamic) body. The appropriate principal scheme of the structure (the paradigm of ontology) of the economic sign is shown in figure 2.

According to figure 2, the sign is a quasi-physical object, consisting of the signifier (sign syntax), and signified (sign semantics) parts. The connection between parts of sign has been supported by people (design or programming, the execution of a project) or automatic devices (the execution of a program). This definition is the ontological one. The example of functional (pragmatic) definition: "Sign is everything that is a potential producer of response on something different from itself" (Ackoff and

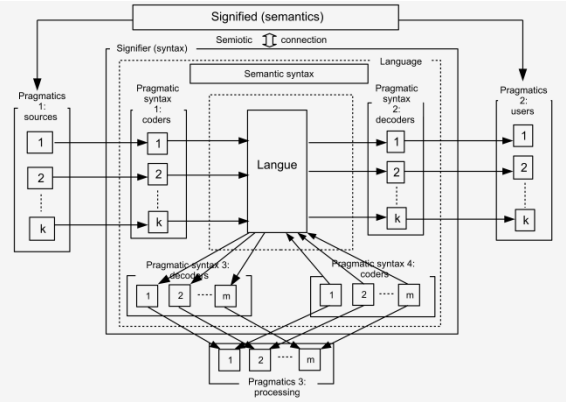

Figure 2: The paradigm of economic sign (Polyakov 2018).

Emery 1974). We are going to call weakly formalized, and therefore, allowing multiple treatments sign formations, the texts. The sign construction is, oppositely, strongly formalized (appropriate for mechanical processing both as an object and as a mean) sign formation. For example, signs with tables, texts of programs etc. as signifiers. Data is the signifier part of sign construction. Usually data is understood as just objects of processing. This does not allow seeing the text of program as the same object of processing, and program, in general, as a sign construction similar to the one signified by data. Therefore, computer program is a sign construction with "text of program" (data) in the role of signifier part, and signified part represented with the dynamic object, which realizes the process of handling the other data. The latter has the area of users' interests as the signified part.

Obviously, the processing of signs as integral units is impossible. Just signified part can be processed (data). For that purpose, it is separated from signifier (disassembling), and after the processing, it again connects to signifier (assembling). The pragmatics of sign is a set of properties of signs as the objects of manipulations or tools, which allow the impact on the area of interests of signs' users. The pragmatics of sign reveals itself in the process of its disassembling- assembling, processing and application in the management or cognition.

Semantic syntax – the part of syntax, reflecting the architecture of semantics (signifier part) of sign. "Syntactic" syntax – the part of syntax reflecting a state of the signified part (semantics) of a sign. Pragmatic syntax is a part of syntax, reflecting its forms and structures, which are used in the process of disassembling- assembling and processing.

Observations show that the processing of signs depends on the forms and structures of data and does not depend on their semantics.

5 FROM ABSTRACTION OF SIGN TO SPECIFICS OF FEMIB INTEGRATION

Figure 3 shows the schematic diagram of integration of the objects and subjects of different types of conscious activity, including FEMIB, targeted at common object.

It is based on the obtained abstraction of sign in the form of paradigm of its ontology (Figure 3).

The result is sign construction. The common for different types of activity (for instance, FEMIB) is its signifying part (semantics). It is the area of interests, common for all users from FEMIB. Before we move to the signifier, i.e. data or syntax, which create highly formalized language for describing the Area of Users' Interests (AUI), it should be considered using unformalized language of the actor of integration. The result is a presentation of AUI as a network of objects, belonging to substantive classes. This result can serve as an example of how a change in signifying capacities can have impact on the signified.

The existing systems of classification, like a fragmentation of the areas of user's interests and objects of activity, is a tool for reduction of semantic variety and, as a result, a complexity of development and processing of data structures. Computer processing enables to be satisfied with a limited number of basic substantive classes (for instance, people, materials, machines, power sources, etc.), using a system of filters in all other cases. They can be prepared in advance or specified in the course of processing. Every substantive class corresponds to a basic form of semantic syntax (BFSS). Basic forms are interrelated (i), creating the extending network. Pragmatic syntax enables to describe information capacities of users by filling of database, and their information needs - in terms of semantic syntax. Before processing the data is transformed in compliance with requirements of one or another processing tool. The paradigm of the ontology of sign construction, in combination with quasi-physical logical-conceptual framework, allow presenting formulas of sign construction as an invention. Such work is carries out in respect of the existing versions of BFSS.

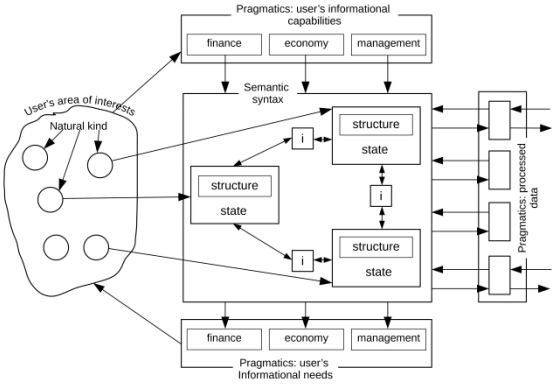

Figure 3: Principle of FEMIB integration based on integration of the objects of activity.

6 CONCLUSIONS

6.1. The problem of FEMIB integration based on IT is a result of our confidence that the potential of these technologies is capable of ensuring the higher level of integration of the parts of FEMIB complex.

6.2. For today, there are trials to compensate the disintegration by improving the integration of personnel's efforts. However, such integration should correspond to the integration of objects of activities. There is a growing confidence that the integration of these objects is impossible without the integration of the levels of their cognition. A central place in the vertical of knowledge should be occupied by knowledge about ontology of signs. The attempts to use the existing humanitarian semiotics in this place led to its discrediting as a basis for technologies. There is a necessity to develop the science of signs of other type. However, its place is still vacant.

6.3.Our solution to this problem is based on the appropriate interpretation of noospheric philosophic views of Vladimir Vernadsky and Pierre Teilhard de Chardin, papers of Thomas Kuhn, the teaching of Merab Mamardashvili on quasi-physical effects of conscious phenomena.

6.4. Formation of the vertical of knowledge, which is necessary to derive the paradigm of the ontology of sign, required an understanding of the specifics of cognition in a paradigm phase of development that the sphere of conscious is in. As a result, the Model of Paradigm Innovative Development, Vertical and Parabola of Knowledge have emerged at the confluence of philosophy, science about cognition and knowledge economy. The model of PIDev establishes basic patterns of innovative development of the sphere of phenomena

as a whole. VIK model defines the structure of the Vertically Integrated Unit of Knowledge (VIUK). Vertical links between them are established using the parabola of knowledge.

6.5. Through substantivization of the basic functional diagram of communication process, the developed basis of knowledge enabled us to obtain quasi-physical paradigm of sign. In these sign constructions, the signifier and the signified are integral, but, at the same time, are not linked directly. The integrity consists in maintaining the correspondence between them.

6.6. Development of such structures is carried out. The quasi-physical approach and logical-conceptual framework, created on its basis, build the background for development of patent claims and patenting of the obtained sign constructions.

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