Quasi-physical Model of Knowledge

In the search for a unified basis of integration of technology and society

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***Abstract* — The domain of research is the process of understanding the field of information phenomena, including its practical level, in solving problems such as fragmentation of data, which is due to their diversity and variability. The solution to such problems requires immersion in the ontology (essence) of information phenomena and a relevant cognitive model. The problem of creating such a model is interesting, in particular, in that reducing the fragmentation of data will make data, including Big Data, and then programs and organizations, more unified in form, more diverse in content, in general - more useful. To solve the problem, the following conditions had to mature: an empirical base, formed by digitizing information practices; principles of convergence of heterogeneous fundamental ideas; reconstruction of understanding how cognition occurs in various fields of phenomena. The presence of conditions made it possible to develop a Quasi-Physical Model of Cognition (QPMC), where the object of cognition is the result of the convergence of the physiosphere, biosphere and infosphere (Vernadsky's noosphere); the method of cognition is the embodiment of forms of consciousness in artifacts; the ontology of the bodies of knowledge and innovation is signs constructions (programs, databases and knowledge, organizations. The QPMC model is addressed to those who in the field of information phenomena solve practical and theoretical problems of information and communication technology, cognition, semiotics, economics, knowledge management, which, unlike, for example, "digitization" or modeling, require reflection as a better understanding of the innovator's own actions.**

Keywords- infosphere; noosphere; model of knowledge; conscious phenomena; quasi-physical effects; innovation development; sign ontology; data ontology; organization ontology; noosphere ontology; convergence of knowledge.

I. INTRODUCTION

Albert Einstein formulated the principle that a problem cannot be solved within the framework of the belief system (one might say the "model of knowledge") in which it arose. Literally: "We can't solve problems by using the same kind of thinking we used when we created them."

In the 20th century, scientific knowledge faced a series of crises in physics. Overcoming them was akin to a "drama of ideas". There was a need to form new models of cognition that correspond to the new realities brought forth by special and general theories of relativity, atomic and nuclear physics and quantum theory. This forced researchers to turn to philosophy and ask questions of knowledge. In addition to Einstein were Niels Bohr, who received physical and philosophical education, Max Born, Werner Heisenberg, Louis de Broglie, Erwin Schrödinger, Peter Kapitsa and others.

These were new areas, but they belonged to the well-known world of physical phenomena. Solutions were found, but many did not agree with them at the time and still disagree today. Kirilyuk [12] evaluated the status of sciences where mature cognition of the physiosphere has faced many of the problems specific to the sphere of informational phenomena (infosphere), which is yet at the infancy of the path of cognition. According to Kirilyuk, the desire for a commercial result at the expense of understanding the essence of the phenomena studied (fundamental science) leads to the accumulation of unresolved problems. Nobel Laureate Geim [8] also acknowledges the insufficient productivity in basic research: "Finally, in my dream, humans realize social media can make some people very rich but cannot save the planet. The latter requires new fundamental discoveries." The Manifesto of the Slow-Science movement [38] supports this: "Don't get us wrong—we do say *yes* to the accelerated science of the early 21st century… However, we maintain that this cannot be all. Science needs time to think."

Kirilyuk cites other factors that also slow down the processes of cognition. Among them is what can be interpreted as a violation of the Hegelian rule of ascent from the abstract to the concrete. In our interpretation, it consists in applying mathematical and other high-level abstractions directly to empirical material. Cognition skips requisite steps of fundamental and applied theories. Ascent is replaced with risky leaps from deep-lying mathematical abstractions to concrete empirical material on the surface.

This article differs from previous articles developing the same topic by adapting the idea of sign bodies in combination with the idea of cognition as the embodiment of forms of consciousness. Due to this, the categories of noospheric thinking formed an integral system of categories embodied in the architecture of the QPMC, models of the

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noosphere, Paradigm Innovative Development (PIDev) and Vertical Integration of Knowledge (VIK). As a result, the architecture of QPMC and the graphic representation of each model included in the QPMC, are a combination of basic ideas through abduction and induction methods Thus, the framework of the mental structure of the article is formed by its drawings: the architecture of the QPMC model, the structure of the object of cognition, phylogenesis and ontogenesis of knowledge, ontology of the sign. It is convenient to start from these drawings. The presence of synonyms for some terms in the article is a temporary phenomenon. For example, the term “quasi-physical” is borrowed from philosophy. In QPMC it is specifically programs, databases and knowledge, projects and organizations, as sign (hyperphysical) constructions. Synonymy preserves the continuity between the carry over idea and its concretization. This is necessary for understanding and the subsequent development of QPMC. The establishment of rigid terminology would mean that the development of knowledge in the corresponding direction has been completed.

Article is dedicated to cognitive model. Section 2 describes the problem of infosphere cognition and background information of QPMC. Next Section gives a description of fundamental principles of QPMC in role of method and agenda of cognition of infosphere. Section 4 presents explanatory power and prognostic ability of QPMC. Finally, Section 5 contains salient points of QPMC and real contribution of implementing of this model.

II. Problem Statement

Vernadsky [33] classified "noosphere" as a completely different sphere of phenomena. Today it requires scientific knowledge. The concept is open to question. Most often, the noosphere is associated with information phenomena, that is, the infosphere. Vernadsky’s creative researcher Gruzman [10] specified that Vernadsky’s philosophical and meta-scientific studies should be considered in the context of his works on the theory and history of science.

Due to the lack of an empirical base, Vernadsky was unable to formulate his views on the noosphere into a constructive model of cognition. He used the concepts of matter and energy. He did not have a sufficient base of empirical knowledge of information, more precisely, of signs. At the same time, however, Vernadsky managed to put the whole world into one word (noosphere) as an object of knowledge. LaRouche [6] is one who managed to appreciate the significance of this step.

The work of philosopher physicists at the level of reflection in terms of the cognitive process was continued by Kuhn [14]. He focused on the phylogenesis of knowledge and the social aspects of cognition. His “Structure of Scientific Revolutions,” in particular the concept of paradigm, precipitated a lively discussion. Popper [25] was particularly interested in drawing a demarcation line between scientific and non-scientific knowledge. But the primary source of scientific knowledge is not scientific, but rather empirical knowledge. Losev [15] wrote: “What is science? A systematic representation of knowledge gained from experience (through the medium of external feelings), i.e. exposition and explanation of empirical phenomena.” Popper should have taken Kuhn's [14] position in order to think more broadly in terms of logical transitions from pre-scientific knowledge to paradigmatic (meta-scientific) and then to scientific. Perhaps it was psychologically difficult for an ambitious person such as Popper. As a result, attention has been concentrated on important, but limited questions of the truth and social role of paradigms (scientific achievements), rather than the structures of scientific revolutions (model of the genesis of knowledge).

Most likely Mamardashvili was under the influence of these discussions when he wrote the book “The Arrow of Knowledge”. Mamardashvili [18] formulated the principle of “destruction-reconstruction of understanding”, which in a more categorical form corresponds to a paradigm shift, that is, to a change in the cognitive model during the scientific revolution.

A detailed picture of cognition was given by Losev [16], using the concept of a name (which is actually a sign and information as a message). It can be considered as the most complete picture of the world as a noospheric object of cognition, in which there is substance, energy, and signs (information) in their relationship and development. It is difficult to work within this picture - it should be illustrated in relation to the current moment and the actual tasks of cognition.

The use of computers in economics and society has exposed and exacerbated the problems of the development of the infosphere, whose main features determine the structure of the noosphere. Under these conditions, Einstein's cognitive principle gains particular relevance. Today, the infosphere uses inherited and not always conscious models of cognition. It can be said that today’s knowledge of the infosphere is conveyed through inherited and poorly formulated models of knowledge. These interpretations then establish the nomenclature of scientific specialties, the standards for teaching scientific disciplines, as well as the methods of conducting scientific work and writing articles and books, etc.

Inherited models reflect the specificity of cognition in the post-paradigmatic phase of the development of natural sciences or the pre-paradigmatic phase in which humanitarian or practical knowledge is found. The question arises: is it possible to bring together the spheres of phenomena which are studied by the natural and humanitarian sciences? These are generally considered irreducible to a common basis. To solve this problem, one can apply Marx’s theories on transformed forms of consciousness. These thoughts were further developed by Mamardashvili. He introduced the concept of “quasi-physical effect of non-physical (conscious) phenomena” into philosophical discourse [18].

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Today, knowledge of the infosphere is approaching the paradigm phase and it needs a model that covers all phases of the development of cognition, including pre-paradigmatic (empirical-heuristic), paradigmatic (scientific revolution) and post-paradigmatic (scientific). Such a model is necessary, especially in order to solve the problem of the ontology of information (more precisely, the sign). This problem has a thousand-year history. Examples of attempts to address this in the context of modern cognition may be found in the efforts of the scientific axiom of Stamper [31] and the monograph Tanaka-Ishii [32].

Knowledge of the ontology (essence) of data is necessary for the development of the applied paradigms of computer programs, data, business organizations, and economics. Knowledge of these ontologies aims to optimize and unify the structure of programs, data and business organizations. These results will serve as a tool for optimizing the information (more precisely, sign) infrastructure of the economy, from the enterprise level and higher, by reducing its rigidity (resistance to changes) and fragmentation, both of which are caused by the presence of a complexity barrier due to semantic diversity and data variability [24].

Moreover, according to Martens [20], the essence (ontology) of the economy can be defined as an information (or rather, a sign) machine for the production of materialized knowledge. Saussure, Hayek, and Coase [27] also noted the similarities of economics and sign systems, including language. Therefore, from both a practical and theoretical perspective, optimization of the sign structure is the primary task of the economy.

For a long time, continuous attempts have been made to create models of practical work in the infosphere, including elements of cognition. Some of these are called methodologies. Examples include Object Oriented Analysis and Design (OOAD) [3]. The subject of this methodology is software systems. Furthermore, these are: Theory and Practice of Business Processes (TPBP) [28]; Enterprise and System Architecture (ESA) [35]; and Semantic Technologies (ST) [1], as well as other tools .

Each is typically based on some significant and more or less adequate and principled position. For OOAD, this is "a program as an object, not an algorithm", TPBP is "a program is a tracing-paper from business processes", ESA is "overcoming the disintegration between technologies (information) and business," ST - "technologies must take into account the semantics of data." These tools have not become cognitive models that ensure the transition of the infosphere from pre-scientific to scientific knowledge. Obviously, such a model needs a comprehensive and well-integrated basis of the empirical, philosophical and scientific.

It would not be an exaggeration to mention cognitology or cognitive sciences (of knowledge). However, the attention of these disciplines is mainly the manipulation of knowledge-bearing data, or the processes of formalizing knowledge expressed in natural languages [9].

In fact, there are many models designed specifically for the knowledge of humanitarian phenomena or in claiming universality. These include the tektology of Bogdanov [2], the cybernetic approach of Wiener [34], the praxeology of Slutsky [30] and Kotarbinsky [13], among others. These and similar works can be considered as experiments in the search for a real model of cognition of non-physical phenomena. They have fulfilled their tasks and today they are potential subjects of an instructive history of knowledge and sources of positive and negative experience.

The "philosophy of information" by Floridi [7] focusses directly on the application of philosophy to explain the phenomena of information. Its default object, practically without restrictions, is any phenomenon to which the word "information" can be attributed. Such phenomena form the empirical basis of Floridi's philosophy of information. However, according to Losev's definition ("What is philosophy? — A worldview compiled by synthesizing scientific information"), philosophy is not directly connected to empirical foundations, but rather to the achievements of science. Moreover, science is "A systematic exposition of knowledge gained from experience (through the medium of external feelings) [15]."

Thus, the development of science relies on achievements of empirical knowledge and the development of the philosophy of scientific achievements. More precisely, the dependence is stepwise and mutual.

The activities of the research community of The International Federation for Systems Research (IFSR) [37] are directed at forming the foundations of the information sciences, as in the case of the cognitive model. Its members working on the Fuschl Conversations project state: "We want to build a general theory that conceptualizes reality as a field containing meaningful human social interactions, as well as technology and nature [4]."

The goal is ambitious, but is it achievable? Indeed, the history and current state of cognition show that cognition of the whole is effected in parts, due to the limited capabilities of a person. In this case, the knowledge of each part is divided into stages. Periods of continuous evolutionary development of cognition are replaced by discrete transitions between areas and stages of cognition. This means that a single object (synchrony) and the process (diachrony) of cognition require a rational decomposition that corresponds to the current values of development. It is doubtful that a "theory of everything" could be created, but it is possible and necessary to build a model of cognition, according to which a large whole is divided into parts in a certain way, and the processes of their cognition are divided into phases. At the same time, the procedures for knowing each part in each phase should be regulated with universal terms.

The article may seem abstract, and therefore complex. Indeed, one can engage in the digitization of simple information practices without realizing how this is done. But in order to learn how information processes, characterized by a higher diversity, work, it's necessary to understand how cognition of these processes works. In this case, their mutual abstraction is a tool to simplify the problem.

The subject of the article (model of knowledge) is self-sufficient. However, it is part of a broader plan and aims to achieve practical goals. Based on the QPMC, a solution to the problem of the ontology (essence) of the sign is proposed [23]. Based on the ontology of the sign, applied ontologies of programs and data are developed [24]. They are used as a basis for the development of data infrastructure, architecture of programs and organizations. The QPMC model relates to the theory and practice of cognition. As a practice, it is needed when it becomes impossible to cognize and create without reflecting. So far, there are enough analogies, conjectures and associations for creativity, its practicality is not obvious. QPMC is necessary for solving problems such as a barrier of semantic diversity (fragmentation) of data and the tasks of developing a data infrastructure, architecture of programs and organizations resulting from them.

It should be understood that this article is devoted to the self-sufficient topic of knowledge of the sphere of information phenomena. At the same time, it describes the problems of this sphere, for the solution of which the QPMC is intended, and provides links to articles where this is discussed in more detail. Section 4 of the article provides schematic examples of explanatory, prognostic, and productive strengths of the QPMC model. In subsequent works, each area of application of the QPMC is supposed to be considered from the perspective of the final economic result.

III. The Architecture of the Quasi-Physical Model of Cognition

In order to apply Einstein's above-mentioned cognitive principle to the infosphere, the Quasi-Physical (Noospheric) Model of Cognition (QPMC) is proposed, as shown in Figure 1. Vernadsky's noospheric thinking is embodied and transformed in this model, taking into account the characteristics of current times.

The main sections of the model depicted in Figure 1 are as follows: Consciousness, Cognitive-Creative Activity (CCA) of consciousness, the sphere of phenomena, the totality of CCA effects of consciousness, the model of knowledge ontogenesis (Vertical Integration and the Parabola of Knowledge), the model of knowledge phylogenesis (Paradigm Innovative Development), the ontology of phenomena, and transformation of the sphere of phenomena. The definitive structure of noospheric thinking consists of these and other QPMC concepts.

The scientific activity of consciousness occurs within the framework of actual being, which grows out of potential being (meon, meonal environment) as a result of the cognitive and creative practical activity of consciousness. CCA of consciousness triggers phenomena and forms pre-scientific knowledge about them. They are fixed in consciousness, specifically in natural language. These descriptions can be varied, integrated, differentiated, formalized by digitization, etc. Problem-oriented lexicons can be derived from natural language, and can be called ontologies. These operations, as a connection by association and fact rather than by essence and meaning, can be attributed to modeling. However, the scientific knowledge modeled after natural sciences is different.

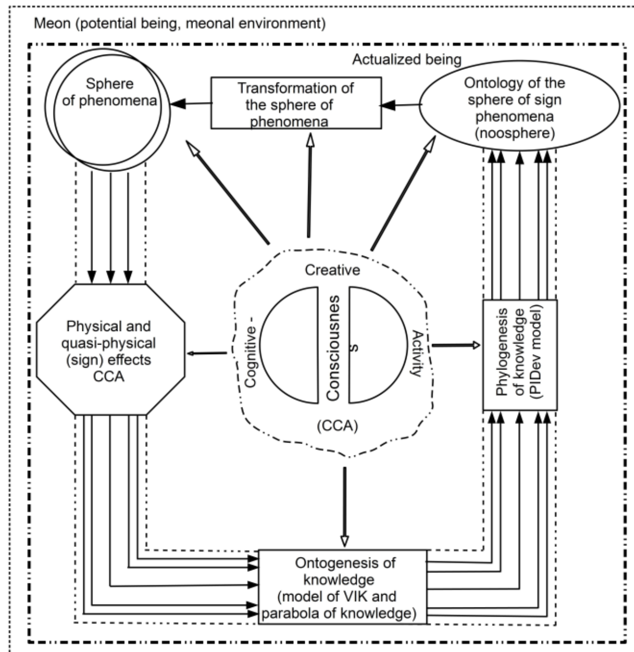

Figure 1. Architecture of quasi-physical Model of Cognition.

Pre-scientific knowledge corresponds to their embodiment in the effects caused by CCA. These can be natural or artificial objects (artifacts). First of all, they should be distinguished by their nature (ontology), which is established by way of acts of scientific knowledge (Figure 1). The cycles of knowledge can be repeated many times. In this case, each block can be connected to any previous block through feedback loops.

Thus, the consciousness arising from life continues the practical (not yet theoretical) cognitive-creative development of a potential being. The result of this activity is the formation of an empirical knowledge base in the form of a targeted combination of physical and quasi-physical effects.

On this basis, it is impossible to deny the existence of the empirical roots of mathematical knowledge, even though some researchers may at times have difficulty trying to establish them. There can be no science for science. The deepest abstractions should be the quintessence of infinitely diverse empirical phenomena.

Scientific knowledge begins with immersion from the concrete (many effects, that is, the results of activity) into the abstract, and continues through the ascent from the abstract to the concrete. This provides the opportunity to optimize existing and create fundamentally new and more effective (optimal) artifacts. This is the principle of ontogenesis, that

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is, the Vertical Integration of Knowledge (VIK). The ontogenesis of knowledge involves individual phenomena and their structures, forming a hierarchy up to the sphere of phenomena. The phylogenesis of the sphere of phenomena and its structures depends on the breadth of coverage and completeness of the ontogenesis of knowledge of the phenomena. One might say that phylogenesis is a change in the degree of paradigmization of these structures.

With the accumulation and ordering of practical knowledge, the studied and transformed sphere of phenomena passes from the empirical-heuristic (pre-paradigmatic) to the paradigmatic, and then to the scientific (post-paradigmatic) phase of development. The ontology of sign phenomena is the result of these processes in the infosphere. It enables subjects of innovative activity to think and act based on an understanding of the essence of phenomena, that is, essentially. Today, natural sciences are close to this. QPMC implies the convergence of the natural sciences and the humanities. Therefore, the construction of the ontology of the subject area is a fundamental requirement of this model.

The fundamental principles of QPMC are the well-known laws of philosophical logic. Mamardashvili [24] formulated them in a generalized form as fundamental philosophical abstractions. There are Plato's embodiment of cognition, Descartes's cogito and Marx's criterion of truth (practice). Similar principles, upon which the world is built, are contained in the principle of sufficient reason as amended by Losev [17]. These are also Peirce's [21] categories of "Firstness," "Secondness," and "Thirdness," and particularly the relationship between them.

The classical principles in QPMC are supplemented by ideas about transformed forms of consciousness and the quasi-physical effects of non-physical phenomena [19]. These give QPMC its quasi-physical nature. The connection between the fundamental traditions of cognition and its development and the convergence of natural science and humanitarian knowledge is a fundamental feature of QPMC against the background of such teachings as Shchedrovitsky's [29] "methodology". This methodology at its core breaks with the traditions of scientific knowledge. The foundation for it is thinking and activity [29]. But it is not Peirce's "Firstness", that is, this is not the ontology as "quality" [21].

A. Quasi-physical model of the object of knowledge

The objects of knowledge for QPMC are phenomena (manifestations of unknown entities yet to be determined) as well as the structures in which they consist, up to the world level which contains all of the phenomena. World structure is divided into spheres, each of which consists of phenomena of one nature (one quality, one ontology). Their incarnations (effects) are physical bodies and living organisms. Since ancient times, signs have been called the fundamental essence. Peirce [21] gave this thought a definitive form. His "firstness" (simply "quality") can be compared with *ratio fiendi*, that is, the need to become, or the "physical" necessity. "Secondness" (relations) is the need for mathematics, that is, relations in space and time (*ratio essendi*), especially the need for action, or activity of consciousness (*ratio agendi*). Peirce's "thirdness" means a universal connection, including consciousness. One can compare the *ratio cognoscendi* of the law of foundation with thirdness. According to Peirce [21], thirdness is accomplished by signs, which are studied by semiotics. Peirce provides a concise and accurate answer to the question "What function does signs perform?" Firstness and secondness can be interpreted as the signified, with thirdness as the signifier part of signs. We can then say that the objective world, that is, the world as a result of scientific knowledge, is constructed of signs.

Vernadsky paid little attention to the words "sign" or "information". The idea of the world phenomena interconnection is expressed by the word "noosphere", i.e., sphere of mind and thought. It would be naive to assume that his point of view maintained confidence in human intelligence. Most likely, he implied that thoughts, and subsequently the signs they produced, were, are, and always will be elements of the world order.

At the same time, Vernadsky was a researcher of the geosphere and biosphere, and has achieved a great deal in his field. Exploring and acting, he represented the world as a whole. His thinking was global and historical. "Social history," he argued, "is a continuation of natural history [33]." From Vernadsky's point of view, it follows that the biosphere contains the geosphere, but is not reduced to it. This is not accidental, considering they each consist of different entities. Similarly, the noosphere must also contain the biosphere and not be reducible to it. It should be a sphere of sign, or informational phenomena (if we understand information as messages).

The idea of the noosphere is encoded in Peirce's frame of reference, and the idea of the Peirce's sign likewise in Vernadsky's system. Their belief systems can serve as answers to each other. The biosphere is the whole world as it was yesterday in the scope of its scientific knowledge, but the noosphere is the further development of the world today. The main features of the described model are presented in graphical form in Figure 2.

In Figure 2, the vertical structure of the noosphere is superimposed on the vertical of integrations and a parabola of knowledge, which are discussed below. The full circle corresponds to the noosphere. It covers a segment that corresponds to the biosphere. In turn, it contains a segment symbolizing the physiosphere (an extension of the concept of the geosphere). Concentric rings and parabolas of knowledge show that a unified model of cognition is applied to the knowledge of various spheres. It is characterized by levels of abstraction and the asynchronous nature of the development of scientific knowledge of various fields. The most developed is the physiosphere, followed by the biosphere. The scientific knowledge of the noosphere is just beginning.

It should be noted that phenomena differ from effects (objects) in their uncertainty, as do objects from phenomena in their more complex structure. We can say that objects are phenomena that have found their embodiment and application.

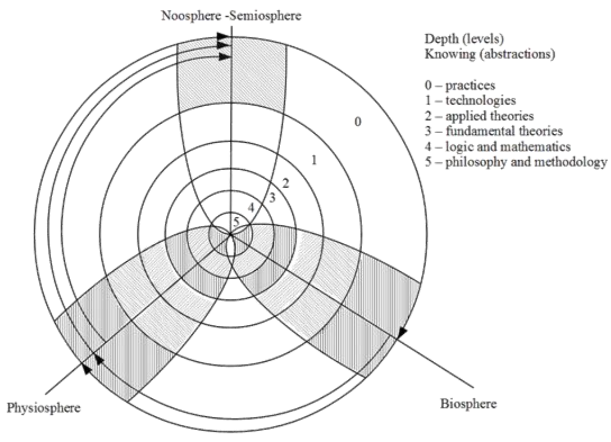

Figure 2. Quasi-physical model of the object of cognition.

By comparing the views of Peirce and Vernadsky, we can draw a conclusion about the fundamental role that signs play in the noosphere and in the world. The pansemiotism of Peirce and Vernadsky's belief in the power of knowledge is also justified by the hidden potential within information technologies so far. Therefore, it is important to know the ontology of signs. For this it is necessary, first of all, to separate non-physical phenomena from physical ones and to find out how they differ in principle from each other.

The practical basis for addressing non-physical phenomena is information. In natural language, the word information is synonymous with message words. However, since Claude Shannon applied it in the sense of one of the measures of the recipient's attitude to the message, in science it has been used as a homonym. Therefore, in order to avoid ambiguity, particularly in fundamental matters, non-physical phenomena can be called signs or sign bodies, since messages (information) actually consist of signs.

In order to not limit knowledge to philosophizing, only strongly formalized sign formations ought to be included in the empirical base of integral knowledge. Let these be called sign constructions. Today, computer programs and the data they process are maximally formalized.

Thus, the physical effect is a fragment of the meonal environment (potential being). Consciousness perceives it as a whole, consisting of physical components interconnected by physical connections. Physical effects can be natural or artificial (artifacts) objects. Natural objects are also products of at least cognitive activity, although cognitive and creative activities are difficult to separate. An example of creative activity alone can be the replication of patterns.

Consciousness in the process and as a result of cognition transforms being. Biological phenomena and their corresponding effects possess all the properties of physical phenomena and effects. Therefore, by skipping the biological effects, one can immediately switch to the quasi-physical effects.

A quasi-physical effect is a fragment of actual being. Consciousness only perceives it as a whole, consisting of two physical or quasi-physical components, which, unlike physical effects, are connected in the mind by a collaborating relation. Between physical and quasi-physical effects (objects) there is no insurmountable gap. For example, in the case of a computer program, by connecting parts (by loading program text and data into a computer system), an object created as a quasi-physical thing is transformed into an autonomous physical thing. This is a computer that operates under the control of the signals within the text of the program, printed on a machine-readable medium. Of course, in order to take liberties to think and speak this way, it is necessary to postulate the existence of temporal objects (things-processes), which are characterized by structure and states.

Thus, a quasi-physical object consists of physical objects that fall into two parts, interconnected by means of consciousness with a collaborating relation. In certain phases of its existence, a quasi-physical object can become a physical object.

B. Model of Paradigm Innovative Development (PIDev)

The PIDev model (Figure 3) resembles Kuhn's structure of the scientific revolutions, but with fundamentally different characteristics.

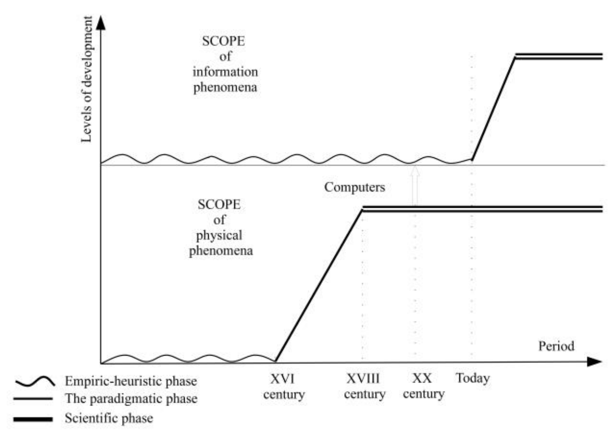

Figure 3. Model of Paradigm Innovative Development (PIDev).

First, PIDev is an integral model. Its objects of knowledge are macrostructures. These are the spheres of phenomena or their components. The PIDev model allows us to differentiate and compare them according to the degree of maturity of knowledge. In addition, the PIDev model combines several phases of cognition within the sphere of phenomena. As an integral model, PIDev could be called a model of the phylogenesis of knowledge.

Figure 3 compares the PIDev models, one relating to the physiosphere and the other to the infosphere. The wavy line indicates the empirical-heuristic (pre-paradigmatic) phase, the oblique does so to the paradigmatic, and the double line represents the scientific (post-paradigmatic) phases.

The diagram shows that computers emerged in the physiosphere in the scientific phase of its development. They are applied to information practices (effects of sign phenomena) which are related to the empirical-heuristic phase of the development of the infosphere. The knowledge of the infosphere falls behind that of the physiosphere. Therefore, IT is a physical data processing technology applied to information practices. To solve the problem of the disintegration of IT and business, it is necessary to bridge the gap between the development of knowledge of physical data processing technologies and information practices.

Secondly, the fundamental features of cognition identified by Kuhn were based on the experiences of matured natural sciences in the scientific phase of development. In contrast, the PIDev model begins with the formation of objects of knowledge and the science corresponding to it. In this case, the knowledge of such a sphere of phenomena emerges in the form of innovative development, and this depends more on innovative business than on official science. Business forms the empirical base needed for scientific knowledge of the infosphere. Business may not, however, be aware that this clears the path to knowledge. If the integration of knowledge and business is done purposefully, it can serve as the archetype of innovative development, termed the "knowledge economy".

Thus, thirdly, the PIDev model is an integration of knowledge and management (business). The cooperative development of management and knowledge is innovative development. In the empirical-heuristic phase, its main driving force is enterprise personnel, from workers to top managers. Vernadsky [33], who studied the history of knowledge in Europe, drew attention to the important role of the masses in preparing the natural-science revolution.

Fourthly, the main task of the pre-paradigmatic phase of innovative development is to formalize existing practices. In doing so, they use methods based on experience (analogies) or guesses (heuristics). An example is the digitalization of information practices through data processing technologies. Although IT is called information, it still exists without proper philosophical and scientific justification in terms of information, more precisely, signs. Moreover, attempts to form it are constantly repeated. However, we are not able to solve this problem within the new conditions of the development of the infosphere using existing humanitarian models of cognition, whether explicit or hidden, or with models borrowed from the natural sciences. For the scientific revolution of the infosphere to be possible, an act of "destruction - reconstruction of understanding" must occur [18]. Only then can a cognitive model relevant to the problems of developing the infosphere be formed.

The model mentioned above may consist of known parts, while at the same time give an unexpected overall picture of what is happening. Cognitive structures such as Marx's transformed forms of consciousness, quasi-physical effects of non-physical phenomena [19], ascent from the abstract to the concrete [11], Firstness, Secondness and Thirdness [21], information, sign, knowledge, innovation, etc., can be viewed in a new light, pose questions and suggest answers, in accordance with graphic representation of QPMC, PIDev, VIK, ontology of sign and corresponding references. Such a model can become an effective tool for strengthening innovation. A striking example is evidenced in Mendeleev's periodic table of the elements.

C. *Vertical Integration and Parabola of Knowledge*

Phylogenesis, or macroscopic development of knowledge regarding the sphere of phenomena, occurs as a result of the accumulation of "micromutations" in the bodies of the infosphere, including programs, data and knowledge bases, enterprises. These are individual innovative acts. They can even use deeply abstract philosophical or scientific innovations, but at the same time they must result in a concrete practical, including commercial, result. The logic behind the development of an empirical knowledge base is crucial.

The process of formation of innovations, which can be called the "ontogenesis of knowledge", is presented in Figure 4 by the model of Vertical Integration and the Parabola of Knowledge (VIK).

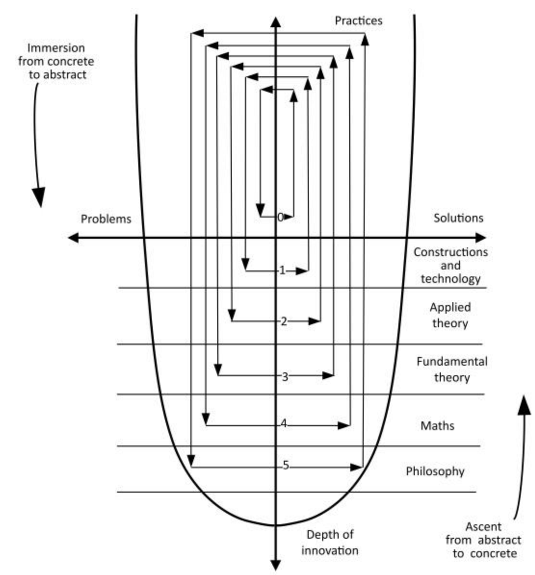

Figure 4. Model of Ontogenesis of Knowledge (VIK).

The zone of the upper half of the figure is reserved for specific (practical, materialized) knowledge. In this case,

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specific processes are considered to be temporal things. This upper half corresponds to the zero level of abstraction.

The lower zone is reserved for abstract knowledge, which does not refer to individual things but to their sets, ignoring the uniqueness of each elements within the set. The zone is divided into five levels of abstraction: structures and technologies; applied theories; fundamental theories; mathematics; and philosophy, including methodology.

The zone of the left half is occupied by problems, and on the right are solutions. The right branch of the parabola symbolizes the ascent from the abstract to the concrete [11]. Moreover, the shape of the parabola (the left branch) suggests the need to supplement the Hegelian figure of knowledge with a symmetrical figure, which is an immersion from concrete to abstract.

The inline rectangles in the figure are innovative cycles. If innovative changes only affect practical knowledge, then innovation is characterized by a zero level. The digitalization of information practices is at such a level. It is based on physical data processing technologies, the formation and development of which is within the responsibility of the physiosphere, and not the infosphere.

Figure 4 shows inline innovation cycles of different depths. In these cycles analysis (immersion from the concrete into the abstract) alternates with synthesis (the ascent from the abstract to the concrete). The Ranganathan model [26], called the spiral of knowledge, reduces to a similar alternation. The concurrence reinforces the fundamental importance of this pattern. Additionally, both the VIK graphic model and Hegel's “ascent” depict the concrete above the abstract. This coincidence, which also manifests at the figurative level, is not accidental. The empirical base of knowledge is inexhaustible and is constantly expanding. At the same time, levels of abstraction are limited to one center.

As illustrated in Figure 4, the VIK model expands the interpretation of the term “innovation”. According to the model, innovations are changes that can occur at any of the six levels of abstraction shown in the figure. The depth of innovation is determined by the maximum level of abstraction. Innovations that influence philosophy, methodology, mathematics and/or fundamental theory are paradigmatic. VIK is not so much a classification of knowledge as it is a unit of knowledge with meaning, fullness and completeness. It is not pertinent to divide knowledge into scientific, educational and professional subjects until the vertical of knowledge is formed in accordance with the levels of abstraction.

Scientific revolutions can occur in fields both old and emerging. As development accelerates, the time intervals between them ought to be reduced. Prior to a scientific revolution, problems are constantly arising that need to be addressed. Old sciences struggle with them, creating new scientific subjects. We are then to wait until some “invisible college” finds a radical solution to address the problem. In this case, the inevitable question is the formation of organizational structures to carry out the vertical integration of knowledge. The prototypes of such structures may be research networks where appropriate vertically oriented associations can be created.

The VIK model clearly demonstrates the usefulness of QPMC. It is an alternative to elemental empirical, heuristic and associative cognition. The VIK model shows that abstractions are the result of simplification of practical knowledge and, in turn, are used to systematize them.

IV. The Innovative Potential of Noospheric Thinking

Considered by Polyakov et al. [24], Marx's thesis on practice as the main criterion of truth in a series of fundamental philosophical abstractions takes the last place (in order, but not in meaning). Consequently, noospheric thinking (such as QPMC), like any model or theory, should be evaluated in terms of its innovative potential.

The explanatory power and prognostic ability of models and theories are closely associated. The explanatory power of the cognitive model allows us to understand what is happening with the knowledge of today’s sphere of phenomena. Predictive ability helps anticipate what events may occur in the development process.

As a communal (common) intellectual capital, the cognition model should have theoretical and practical productivity and serve as an environment for the formation of fundamental and applied theories, as well as for the development and application of structures and technologies that can be of a physical, combined or sign nature.

A. *Examples of explanatory power of noospheric thinking*

Noospheric thinking uses well-known abstract statements and formulations of practical problems. The use of many of them is not limited to the infosphere. In this case, QPMC clarifies their meaning.

1) *Plato's allegory of the cave.*

Plato’s Cave is often used as an argument in defense of idealism. Mamardashvili [24] saw in it the formulation of the problem of the fundamental philosophical abstraction of the embodiment of the understood. From the QPMC standpoint, this allegory is a paradigm of knowledge that has not yet lost its relevance. It is linked to the zero-innovation cycle as part of the VIK model and parabola of knowledge.

2) *Hegel's ascent from the abstract to the concrete.*

In the VIK model Hegel’s imaginative vision and logic are explained and developed. If concreteness is an ascent, then abstraction is an immersion in the essence of things, and not a separation from them. Therefore, in the VIK model, abstraction is also a movement toward the foundation, an immersion in depth. Indeed, it is a method of immersing from the concrete into the abstract. This method, based on the empirical basis, forms paradigms, systematizing the results of empirical-heuristic knowledge. Thus, in the VIK model, Hegel’s imaginative vision and logic are explained

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and developed. Indeed, abstraction is an immersion in the essence of things, and not a separation from them. Then concretization can only be an ascent.

3) Unnatural modeling is a simplified version of the Hegelian ascent from the abstract to the concrete

The VIK model and the parabola of knowledge enables us to see a simplified version of the Hegelian ascent from the abstract to the concrete in non-natural modeling methods, particularly in the mathematical modeling of information phenomena. The simplification consists of the absence of transitional steps between abstractions and practice

The use of QPMC as a tool to move from modeling to cognition based on understanding is considered by Polyakov et al. [22].

4) IT status today

The logical-conceptual apparatus of QPMC can be used to determine the status of IT today. It follows that IT can be called technology if it is data processing technology. It is also possible to apply the term “information” to IT, if we mean information practices. Thus, IT today is a physical data processing technology applicable to informational (noospheric) practices.

5) What is a program?

A program is a well formalized sign effect of a non-physical programming phenomenon. To understand the program, one must understand the sign. To understand the sign, one need to understand the program. It is therefore no wonder that after hundreds of monographs and dissertations on the topic of “what is a program”, this problem does not disappear from the registers of scientific papers [36]. It should be noted that to understand in this case means to find a suitable abstraction - the key to each of the many diverse objects. Such an abstraction should make the diverse and complex array of objects uniform and simple.

6) What is data?

Within the structure of the sign paradigm from the QPMC model, data is defined as the designating part of sign construction [23]. This, above all, allows to eliminate the perception of data as local phenomena, inalienable from consciousness.

7) What is an organization?

Organization, in particular, business can be determined through the program. Indeed, a software application for economic purposes is a model of a fragment of an economic organization. All agreed upon programs for all fragments of the organization would form a complete model of the organization. The data structure reflects the architecture of the organization. The data processing algorithms correspond to the organization management function implemented by data users. A similar idea about the similarity of programs and organizations was expressed by Brödner [5]. The Quasi-physical Model of Cognition opens the possibility for its application.

8) What is the economy?

Today’s answer to this question is ambiguous. Martens worked with many emerging economies in the world. To better understand how they will respond to external influences (assistance, loans or investments), he represented them through the abstraction of a knowledge-producing information machine. He considered such an abstraction to appear productive [20].

Indeed, the economy is controlled through information, and all that it accomplishes is knowledge embodied in things or processes. Institutional science in this case can be considered as outsourcing. QPMC actually implements this idea in a detailed and in-depth format. It offers a convergence of cognitive and economic activities.

B. Examples of prognostic ability QPMC

Based on QPMC (noospheric thinking), we can make the following predictions:

1) A decrease in the intensity of innovative ideas in the physiosphere may occur, which may require the search for new areas of phenomena suitable for intensive innovative development. One such area is the infosphere. Opinions that its potential has been exhausted do not correspond to facts;

2) The stocks of semantically simple, rarely changing information practices suitable for digitization by existing data processing technologies are near exhaustion;

3) There is both a need and an opportunity to create an ontological theory of signs on the empirical basis of programs and data for economics and business;

4) In the near future, it is possible to develop (“upgrade”) existing IT to a state of truly informational, that is to say, sign technology;

5) Creating methods to increase the flexibility of data structures and to bring them closer to the status of an infrastructure resource in the near future is likely to happen; and

6) As the quasi-physical approach develops, modeling as a tool for the innovative development of the infosphere will give way to inventions based on ontological theories.

C. Noospheric thinking (QPMC) as the intellectual capital of a knowledge corporation.

When there are scientific revolutions, business organizations that claim to be the “knowledge corporation” cannot tarry. They accumulate empirical knowledge, thus it must be systematized. To accomplish this, corporations must have relevant cognitive models capable of solving the current theoretical and practical problems in the development of the infosphere.

D. Examples of possible theoretical productivity QPMC:

1) Formation of the paradigm of ontology of the sign and the theory of sign construction on the empirical basis of computer programs, databases and business organizations;

2) Formation of the paradigm and theory of computer programs based on the paradigm of ontology of the sign;

3) Formation of the paradigm and data theory based on the paradigm of ontology of the sign;

4) Formation of a paradigm (architecture) and the theory of economic organization based on the paradigm of ontology of the sign; and

5) Formation based on the theory of knowledge economy as a semiotic machine that produces knowledge in sign and reified form.

E. Examples of QPMC practical productivity should be:

1) The development of flexible, unified data infrastructures that reduce fragmentation of a single data field, from the enterprise level to the global economy scale;

2) The development of information and software tools to support intellectual activities in terms of imparting meaning to textual works;

3) The optimization and integration of computer program architectures; and

4) The optimization and integration of business organizations architectures.

V. Conclusion

QPMC is based on the concepts that form a hierarchical structure. The peak of this hierarchical structure is the architecture of the QPMC, followed by: the structure of the noosphere; PIDev and VIK models. Further, VIK, for example, is based on the division of objects of knowledge according to the levels of abstraction and integration of levels within the framework of the Hegel's concept of ascent from the abstract to the concrete, which is supplemented by immersion from the concrete to the abstract.

The real contributions of QPMC are:

- to establish a connection between many ideas from literary sources. (The generality of these literary sources is not obvious);
- to establish a connection between these ideas with the empirical base of the infosphere.

The implementing of QPMC consist in controlling the transition of infosphere cognition from the pre-paradigmatic to the post-paradigmatic phase of development.

The main result of the formation of QPMC is the creation of tools for the theoretical and practical solution of the problems of the infosphere; for example, the architecture of programs and organizations and the usefulness of ICT depends on the problem of fragmentation of data. For this, with the help of QPMC a paradigm of ontology of a sign has been developed, the concept of data and programs have been defined. See section IV of this article as well [22] [24].

The first iteration of the formation of QPMC, which can be considered as an independent topic, is completed, but in this case it is considered only as one of the stages in understanding the sphere of information phenomena.

From the point of view of cognitive activity, QPMC represents a fairly complete core (paradigm) of the theory of knowledge, connecting the empirical base of information phenomena and a number of basic ideas. The sources of its further development will be the results of practical application (replenishment of the empirical base) and the deepening of ties with basic ideas.

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