Linguo-combinatorial Modeling of the Multipolar World of the Information and Network Economy

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***Abstract*— The features of the information and network economy that determine the trend of the global multipolarity, as well as changes in the process of material production, caused by the growth of the global and spatially-localized cooperative networks are considered. Proceeding from the thesis that the information and network economy is more complex and uncertain, which puts forward new requirements for decision-making support systems, the opportunities for linguo-combinatorial modeling for ensuring sustainable development in the conditions of the information and network economy and digitalization are considered.**

Keywords*— *information and network economy; digitalization; linguo-combinatorial modeling; multipolar world; cooperative networks; sustainable development

I. INTRODUCTION

The revolution in information and communication technologies (ICT) led to the rise of the information and network society and the information and network economy, the main coordination mechanism and the most important resource allocation regulator in which are the cooperative networks. This is in contrast to the previous coordination and distribution mechanisms that predominantly have been based on the market and hierarchical organization. There is nothing new in the networked organization of the society and the economy. It dominated in primitive societies, which were very sustainable entities. As technology evolved, these societies were transformed, becoming divided into social classes, and the network organization was pushed into the background by a hierarchical and market organization. By the beginning of the 19th century, the market mechanism had become established to such an extent that for economists of the time, such as Adam Smith, it seemed to exist always, as the only possible since the time of primitive civilizations. Meanwhile, both historians' research and the ancient documents, such as the Bible, testify to the significance of a networked organization in the society.

Subsequently, with the progress of technology, market and hierarchical mechanisms have shown greater efficiency, and the latter manifested for initially in the state economies of antiquity and the Middle Ages proved to be much more viable than it seemed to the classics. In the 20th century it not only had the key importance in the planned economy, but hierarchically organized transnational corporations became the key economic actors in the capitalist economies. According to the widely accepted views of O. Williamson since the 80s, the combination of market and hierarchical organization was the most effective, in the proportion determined by economy on transaction costs [1]. The revolution in ICT and, first of all, digitalization changed the situation have revived since the mid-1990s the value of network organization. The development of a network society has undermined the hopes of some political circles for the world domination and turned the prospect of a multipolar world-the Pluriversum, according to K. Schmitt [2], into reality. The emergence of a network organization, as the main force for the development of modern society, requires the developing the approaches to the decision-making support that meets the principles of understanding the complex systems which are characterized by the multitude of heterogeneous elements and complex interrelations, including those characterized by causal ambiguity. In this publication, the capability of linguo-combinatorial modeling of poorly formalized systems to meet the major challenges of the decision making support in the information and network economy under digitalization are considered.

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II. INFORMATION AND NETWORK ECONOMY AND DIGITALIZATION

Information and network and digital economies are closely interconnected, but different concepts. The digital economy may not be information-based, and vice versa. Digital products, for example, computer software designed for the production of investment goods and services, or audiovisual products for the end users, can be produced without network cooperation and implemented through traditional distribution channels in the consumer market. At the same time, it was digitization that restored the long-lost positions to the network organization, and facilitated the transformation of information and information exchange into an important economic resource [3].

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And, similarly, without the turning information (that is most effectively transmitted digitally), into the most important economic resource, and the capability of networks to transmit information in digital form, the development of the digital economy would not be the top priority, set by the leading countries, including the Russian Federation [4]. According to M. Castells [5], the information and network economy causes contradictory trends of globalization and localization. ICT brings about a deep division of labor through the development of a networked organization in industry and global value chains, allowing the spatial distribution of intangible and tangible productive assets. Networks in the real sector of the economy allow to combine material and non-material resources belonging to different enterprises and organizations quickly and with minimal transaction costs. According to N. Negroponte - the founder of the concept of "the digital economy", it is the economy that produces digital products that do not have weight, do not require raw materials, but capable to move instantly and globally [6]. He contrasted digital products as the superior to the real things. This is fundamentally incorrect, since the growth of wealth occurs when a part of digital products is directly or indirectly embodied in material products, since people can not live in the intangible world and consume digital goods only. They need to eat, dress and live somewhere, and these needs outside the social circle to which Negroponte himself belongs are far from satisfied. Therefore, the digital, information and network economy should be viewed holistically and in conjunction with material and non-material production.

III. GLOBAL SOCIOCULTURAL CYCLE

Information and network economy is a complex self-organizing system. After the great geographical discoveries of the 15th-16th centuries, a global sociocultural cycle developed [7], [8]. Everyone can be a creator. Creators produce inventions, works of art, business projects, etc. These inventions, after approbation in microenvironments, after passing through censorship, through the mass media have become available to the multitudes of people, historically first through the print media, then through television, causing associations in some part of the audience leading to the birth of new ideas, and, in finally, the part of them was embodied in innovation (Fig. 1).

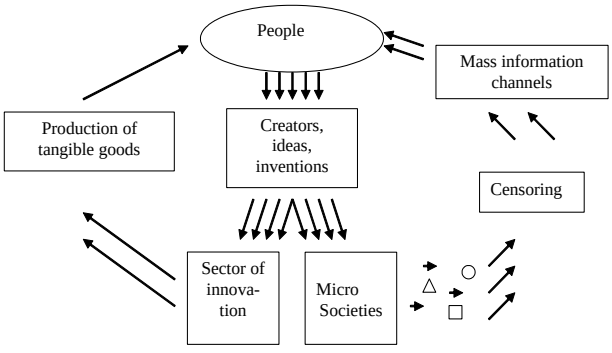

Fig. 1. The Global Sociocultural Cycle

Thus, the cycle was repeated many times. With the emergence of the Internet in the 1990s, the process of dissemination of ideas has been facilitated dramatically, the flow of new ideas is literally falling upon the network users, often occurring in real time, and the emergence and dissemination of such methods as crowdfunding, and more recently ICO, with advent of the blockchain technology, can quickly implement the original ideas in innovation.

In the digital economy, a growing number of innovations are represented by intangible products that are consumed directly by people, for example, in the form of computer programs, or become a production factor of the tangible goods. As an example, one might propose ... the same computer software for the production process. Part of the new ideas, goes through the process of product development and implementation in the innovation sector and then embodies in the new products (transforms into things) in the sector of tangible goods production (in industry, construction, agriculture), bring people up to the new level of the material wellbeing. Microcommunities are organized as topical forums, online interest-based communities, local, often closed social networks. Traditional media - print and television, are increasingly replacing the global Internet network, youtube and social networks (in Russia, prevails in VKontakte, in a number of CIS countries - Classmates, in Iran - Cloob, in China - QZone, in Vietnam - Zing, the rest of the world is dominated by Facebook).

In the information and network economy, the entire humanity is immersed in this sociocultural cycle, and a continuous stream of innovations becomes an integral element of the modern way of living in the world and, even furthermore, promotes the enhancing of the consumerism whose unrestrained development leads to the exhaustion of non-renewable natural resources and spiritual degradation. Thus, despite the high self-organization and self-regulation ability of the information and network economy, there remains the need for managerial action to neutralize unfavorable trends and ensure sustainable development. Translate this English-language term into Russian "ustoitchivoe razvitie", with the transfer of the precise original meaning, is difficult if possible, since it sounds there like steady but actually it is "supportive development", when the achievement of the current growth does not undermine the prospects for growth in the future. In medieval religious literature, this term meant how to walk along the fine line between paradise and hell. To solve the problem of modeling the multipolar world of the information and network economy among numerous models of the socio-economic processes, linguo-combinatorial modeling is one of the most promising. Its main advantage is the opportunity to support the management decisions under the condition of complexity and uncertainty inherent to the global networks using qualitative information. Linguo-combinatorial modeling allows modeling complex systems that generate large information flows, including the use of unstructured big data, applying the key words, the basic concepts that are idiosyncratic to the subject domain.

IV. LINGUO - COMBINATORIAL MODELING OF WEAKLY FORMALIZED SYSTEMS

The linguo-combinatorial model includes three groups of variables: characteristics of the basic concepts, changes in these characteristics, and structured uncertainty in equivalent equations, which can be used for adaptation and management because only for a small number of real systems in the information and network society can be represented by purely quantitative models.

First of all, systems are described using natural language. A method of transition from a description in natural language to mathematical equations is proposed. For example, let there be a phrase (1).

$$\text{WORD1} + \text{WORD2} + \text{WORD3} \quad (1)$$

In this phrase we denote words and only mean the meaning of words. The meaning in the current structure of the natural language is not indicated. It is proposed to introduce the concept of meaning in the following form:

$$(\text{WORD1})*(\text{SENSE1}) + (\text{WORD2})*(\text{SENSE2}) + (\text{WORD3})*(\text{SENSE3}) = 0 \quad (2)$$

We denote AI as the words from English Appearance and meaning – as Ei from the English Essence, an asterisk * means a multiplication operation.. Then the equation (2) can be represented as

$$A1 * E1 + A2 * E2 + A\,3 * E3 = 0 \quad (3)$$

Equations (2) and (3) are models of phrase (1). The formation of these equations, equating them to zero is a polarization operation.

The Lingvo-combinatorial model is an algebraic ring (operator ring) where three operations are used – addition, subtraction, and multiplication according to the axioms of algebra, and we can resolve equation (3) either with respect to AI or with respect to AI by introducing a third group of variables-arbitrary coefficients Us:

$$\begin{aligned} A1 &= U1 * E2 + U2 * E3 \\ A2 &= - U1 * E1 + U3 * E3 \\ A3 &= - U2 * E1 - U3 * E2 \end{aligned} \quad (4)$$

or

$$\begin{aligned} E1 &= U1 * A2 + U2 * A3 \\ E2 &= - U1 * A1 + U3 * A3 \\ E3 &= - U2 * A1 - U3 * A2 \end{aligned} \quad (5)$$

where U1, U2, U3 are arbitrary coefficients that can be used to solve various problems on a multiform (3). If you substitute equations (4) or (5) in equation (3),, it will be identical to zero at any Us . For the first time uncertainty was constructively introduced in quantum mechanics.

In general, if we have n variables and m varieties, constraints, the nu`mber of arbitrary coefficients S will be equal to the number of combinations of n by m + 1, [1],

$$S = C_n^{m+1} \quad n > m \quad (6)$$

TABLE I. ILLUSTRATION OF THE ADJUSTABLE PASCAL TRIANGLE

n /m	1	2	3	4	5	6	7	8
2	1							
3	3	1						
4	6	4	1					
5	10	10	5	1				
6	15	20	15	6	1			
7	21	35	35	21	7	1		
8	28	56	70	56	28	8	1	
9	36	84	126	126	84	36	9	1

This is the basic law [8]. The number of arbitrary coefficients is a measure of uncertainty and adaptability.

Linguo-combinatorial simulation is that in a particular subject area and identifies the key words are combined in phrases like (1) on which are built the equivalent system of equations with random coefficients. Linguo-combinatorial modeling includes all combinations and all variants of solutions and is a useful heuristic technique in the study and composition of new musical material. Table 1 illustrates Pascal's shifted triangle, which is related to the Fibonacci numbers and the Golden section.

V. CHALLENGE OF MODELING OF THE MULTIPOLAR WORLD OF INFORMATION AND NETWORK ECONOMY

The linguo-combinatorial approach can be extended to a multipolar world, which emergence is conditioned by the development of the information and network economy. Paradoxically, the digital economy with its attributes such as the transformation of information into the major commodity, even the elements of a network organization and a multipolar organization of the world, turned into economic reality several decades ago in the financial sector. And that time the contradictory nature of this process was manifested in full. This process brought about the two opposing forces: globalization with domination of power in one center and multipolarity, with the emergence of a number of large international financial centers. It was in the financial sector that a massive application of computer systems and networks began. Introduction of computer networks for stock trading have dramatically increased the number of the stock market participants. Such innovation as the invention of a credit card, made possible by the development of digital technologies and computer networks in the 1970s and 1980s, made it possible to reorient the economies of regions and even some national economies from supply to demand, regardless of the level of their productivity [9], which gave a further push to the consumerism, similar to the one that the information and network economy has given to this phenomenon nowadays. As a result, the virtual financial world began to generate the amount of money that many times exceeds the amount needed for the circulation of the real consumer and investment goods. This was the source of numerous scams, Ponzi schemes and money laundering which required fundamental changes in the methods of financial and, in particular, banking regulation. Despite the formation of international financial centers from Frankfurt to Hong Kong, virtualization and the creation of an extensive network of financial organizations have created the foundation for the US dictate due to the control over the key elements of the digitalized network infrastructure, such as the SWIFT. Until

the mid-1990s, global computer networks and the digitization of the business processes developed only in a relatively closed financial sector. With the advent of the Internet, they embraced the whole of society. Nowadays, we see a further deepening of digitalization and network connectivity, which are beginning to transform education, applied science, material production [10] because of the emergence of such innovations as the Internet of things. In other words, in the sector of tangible production, currently we observe the trends of the deepening of digitalization and the transformation of the network organization into a dominant form, similar to those that took place in the financial sector in the 1980s. This creates both opportunities for achieving a new level of labor productivity and the development of a decentralized multipolar world, as well as the challenges from the new forms of fraud and misuse of economic power. To meet these challenges requires support systems decision making in poorly formalized systems such as the information and network economy.

VI. CONCLUSIONS

The digitalization of the economy and the exponential growth of the capabilities of ICT, on the one hand, and the increasing complexity of the control in the conditions of the information and network economy, on the other, make it urgent to enhance the forecasting capacity and establish of compulsory preliminary modeling of the consequences of the significant decisions [3], [11]. This will prevent many mistakes which costs are multiplied with increase of systemic risk within the global cooperative networks of the multipolar world. Both the individuals which are the primary nodes of cooperative networks, and networks of local and global levels are the self-organizing systems, the effectiveness and sustainability of those are enhanced through the use of various methods of internal and external regulation. Linguo-combinatorial modeling provides a promising tool for supporting these methods.

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