ISSN 0798 1015

REVISTA ESPACIOS

Vol. 39 (# 06) Year 2018. Page 33

New foresight potential in innovative economics

Nuevo potencial de previsión en economía innovadora

Yuri Petrovich FIRSTOV 1; Olga Alexandrovna MOISEEVA 2; Dmitry Sergeevich AKULOV 3; Ivan Stanislavovich TIMOFEEV 4; Pavel Leonidovich FEDOROV 5

Received: 06/10/2017 • Approved: 20/10/2017

Content

ABSTRACT:

This article illustrates the study of new possibilities of foresight in Innovation economics. Its main feature is the application of technological modes theory, which is growing in popularity in the Russia. The issue of foresight method coordination can be solved through interrelated complexes of production, products and institutions (economic and technological modes), formed via mass technology of new generation. The accuracy of foresight is primarily achieved as an effect of mechanisms, enabling the integration of technological and economic modes. It is necessary to study the processes that affect the development of such mechanisms. The article offers a study of an example of technological mode development for microelectronic signal processing (a segment of microelectronics industry), which demonstrates the process of foresight simplification and reliability improvement in innovative development. The obtained results can be used to manage the foresight of technological and economic systems within the innovative development modes.

Keywords: Foresight, innovation, economics, economy, model, technological mode

RESUMEN:

Este artículo ilustra el estudio de nuevas posibilidades de previsión en la economía de la innovación. Su principal característica es la aplicación de la teoría de los modos tecnológicos, que está creciendo en popularidad en la Rusia. El tema de la coordinación del método de previsión se puede resolver a través de complejos interrelacionados de producción, productos e instituciones (modos económicos y tecnológicos), formados a través de la tecnología de masas de nueva generación. La exactitud de la previsión se logra principalmente como efecto de los mecanismos, posibilitando la integración de los modos tecnológicos y económicos. Es necesario estudiar los procesos que afectan al desarrollo de tales mecanismos. El artículo ofrece un estudio de un ejemplo de desarrollo del modo tecnológico para el procesamiento de señales microelectrónica (un segmento de la industria de microelectrónica), que demuestra el proceso de simplificación de la previsión y mejora de la fiabilidad en los innovadores desarrollo. Los resultados obtenidos pueden ser utilizados para gestionar la previsión de los sistemas tecnológicos y económicos dentro de los innovadores modos de desarrollo.

Palabras clave: previsión, innovación, economía, modelo, modo tecnológico

1. Introduction

In modern economics (Innovation economics) market properties, technologies and economic relations are constantly changing (Zlotin and Petrov 1999; Tonn 2004; Kharitonov and Glazyev 2009). In order to synchronize these multiple future changes, foresight and prognosis are used (Bussey 2014). Still, applications of already known methods have limitations as experts do not have enough time to conceptualize the multitude of all rapid changes in its entirety. Frequent changes of system models reduce the effectiveness of statistical methods. In addition, in highly integrated environment, indirect (not obvious) connections can be more imperative than direct, which further complicates the modeling process. To enhance method effectiveness, it is essential to consider the particular aspects of Innovation economics.

An image of the future is formed pursuant to two types of methods. In the first method, the scenarios are created by simulating the system options on formal logical basis. The simulation results, associated with various logical systems of reality comprehension, are built and compared. Then, the discussions with the purpose of correcting the approaches are held (Bussey 2013). All of this leads to alteration of formal models that shape up the image of the future. With rapid changes in economic environment, element properties and modeling rules quickly lose their touch with reality, which leads to insufficient reliability of obtained research results.

The second method is the systems approach. Under this approach, the patterns for decision making process are determined. These patterns include concepts and standards which control the coordination (order) of cognitive development processes (Bussey 2014; Bussey 2013). The foresight process is implemented through expert methods. However, for highly integrated systems such methods have serious limitations. Adherence to several patterns of decision-making can create conflict in creative and cognitive processes; and, there is no guarantee that the amount of applicable patters (and indicators) will be sufficient. Thus, systems method and expert assessments may lose their credibility.

Two methods, discussed above, need to be merged to create an integral whole without any limitations and boundaries. There have previously been attempts to create hybrid research forms, which would combine the two methods (e.g. (Adegbile and Sarpong 2015; Bussey 2013; Inayatullah 2004). Yet, it should be recognized that their accuracy remains not very high when analyzing swift processes of Innovation economics.

The essence of the problem is not in the shortcomings of analytical techniques but in the peculiarities of reality creating processes. One should expect that new qualities of Innovation economics will provide for the solution of this problem and the emphasis should be on defining these qualities.

The features of Innovation economics are defined by an increasing variety of mass technologies of various magnitude and nature (e.g. industrial, organizational, informational, financial, etc.). Their influence provides for high correlation of changes.

The advancement of mass technology (or a product) develops within a system of consumers, contractors, institutions etc. [the technological mode (Glazyev 1993; Sneed 2015). It exists in unity with the changes of mode structure. Thus, the issue of coherence is solved within a framework of a technological mode (Thagard 2007); and, that is how the question of modeling and expert research integration may be resolved. The accuracy of a foresight requires balancing and coordination of technological mode system of mass technologies. Hence, at first, one must perform the foresight of technological modes; and, subsequently, proceed to the foresight of project realization.

This article focuses on study of new opportunities of foresight in Innovation economics. Its main feature is the application of technological mode development models. Such foresight approach is not sufficiently developed in existing literature. The examination of application possibility of technological mode theory is currently of interest as it constitutes the theoretical basis for the Development Program of Russia (Glazev 2017).

Further, the article analyses the characteristics of forecasting and discusses a general model of technological mode improvement and its interpretation in electronics industry development. A simple example demonstrates the establishment of a condition set, which secures the consistency of method application. It is shown that the accuracy of foresight in Innovation economics is determined by the qualities of technological and economic environment. Rise in modern economics and mass technology development provides a solution to the problem of foresight method application coordination and accuracy increase.

The obtained results demonstrate that the characteristics of Innovation economics provide for the solution of many foresight issues and increase their reliability. The results can be used for the creation of information systems for management of innovative industry development.

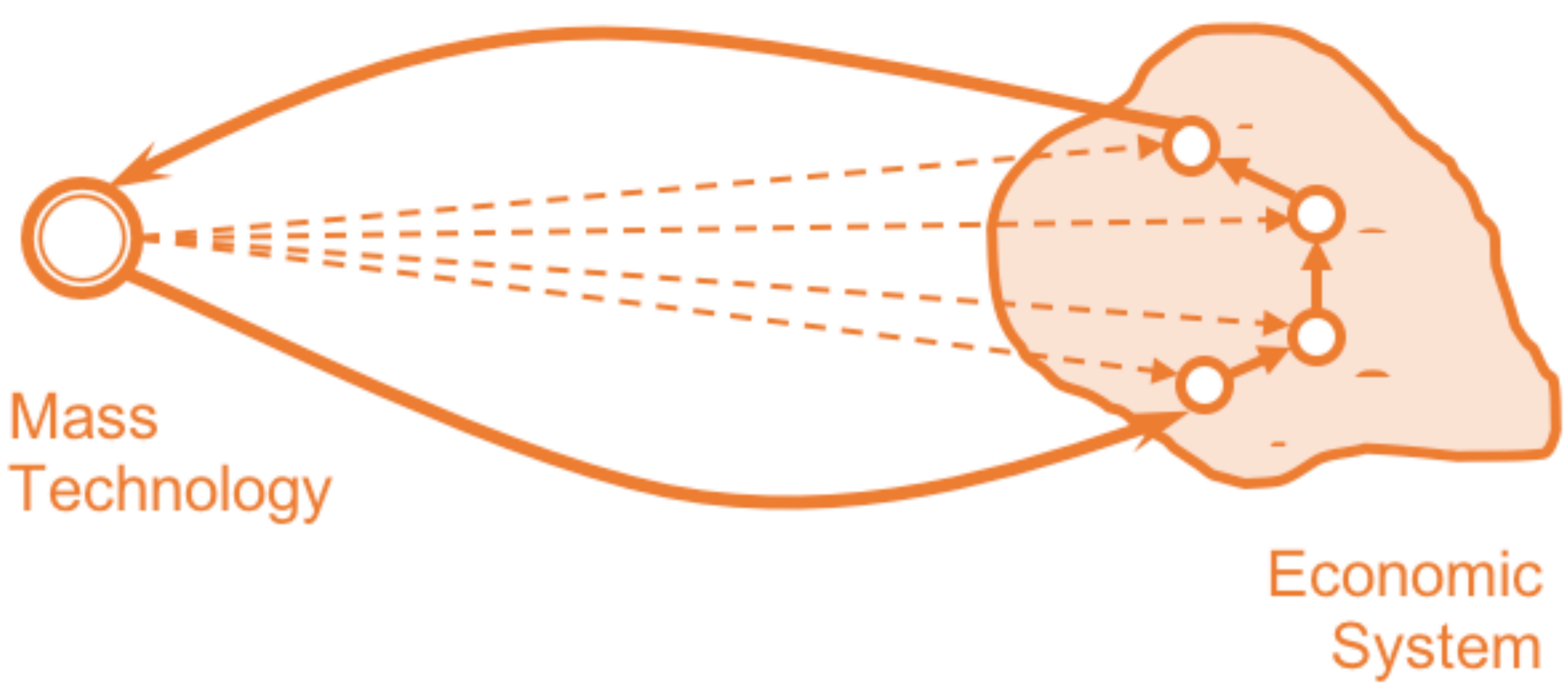
Authors are grateful to Academician S.J. Glazyev, Professor G.N.Azoev, Professor I.A. Lazarev, Professor V.V. Kharitonov et al. for helpful discussions about control over the formation of new technological paradigms in collaboration with the National Research Nuclear University "MEPhI".

2. Methods

2.1. The Features of Foresight in Innovation Economics

In modern world, newly emerging Innovation economics in changing the definition of many objectives and issues, calling for correction of analytical process. This is one of the consequences an intensified integrative influence of mass technologies has on cognitive processes in economic environment. Mass technologies and microelectronics products, for example, simultaneously affect multiple consumers and producers (Figure 1), correlating their changes with the development of microelectronics and, therefore, amongst themselves (Firstov, Akulov, Fyodorov and Timofeev 2017). Such coordination generates a flow of financial, technological and other resources which advance the technology (or the product). And so, develops a technologically economic mode (Glazyev 1993; Kharitonov and Glazyev 2009), a coordinated set of consumers, contractors, suppliers etc., which is continuously improved along with mass technologies. The process of foresight should follow their joint development.

Figure 1
Technological Mode Formation: 1,2,3,
The Elements of Technologically Economic Environment.



There is a multitude of mass technologies: the Internet, composite materials industry, Nano electronics etc. There are many extensive production (and consumption) methods, associated with these technologies; and, appropriately, many modes overlap, unlike in the past, when one dominant technology (a steam engine for example) defined a global technological mode (Glazyev 1993).

The maintenance of coordination change in a technologically economic mode becomes a necessary condition for the continuous optimization of technical solutions. These solutions (the practical elements) maintain the mode coordination throughout the process of change (i.e. perform the system functions). Any other scenario will cause the improvement process to cease.

Let us consider the following example: a new integrated system (IS) is created. Its existence causes certain changes on the market – new consumer qualities, technological options etc. Consequently, the IS is going through the process of improvement, which is followed by the changes of the market. At the same time, the changes is IS should not disturb the business processes of economic environment. As a result, we see that an integrated system manages the coherence of market changes and the technological and systems features of a market should always be coordinated.

In this regard, there is a number of foresight features that need to be mentioned. First of all, the foresight process should focus on the effect of mechanisms, which are created by mass technology and maintain the coordination in mode changes (Thagard 2007). The study of these mechanisms is facilitated by already existing criteria of optimal mode development. Modes, formed by microelectronics technologies use Moore's Law (Bobkov and Kireev 2007; Kharitonov and Glazyev 2009). If the coordination is maintained (i.e. stable positive feedback on Fig. 1), than the change of dominant technological parameter must occur in accordance with an exponential function. Accordingly, one should foresight only the development options (technology, products, institutions, relationships, etc.) which support the implementation of Moore's Law.

For this purpose, the relationships and properties, which optimize mode development, must be defined.

The main property is the attainment of optimal coordination of cognitive processes of past, present and future (Bussey 2014; Bussey 2013; Inayatullah 2004; Firstov, Akulov, Fyodorov and Timofeev 2017). This safeguards the optimization of development process (Firstov, Akulov, Fyodorov and Timofeev 2017). Hence, there occurs the coherence of modeling and expert research along with the accuracy of foresight. Now, the models, which create the coordination processes, must be determined.

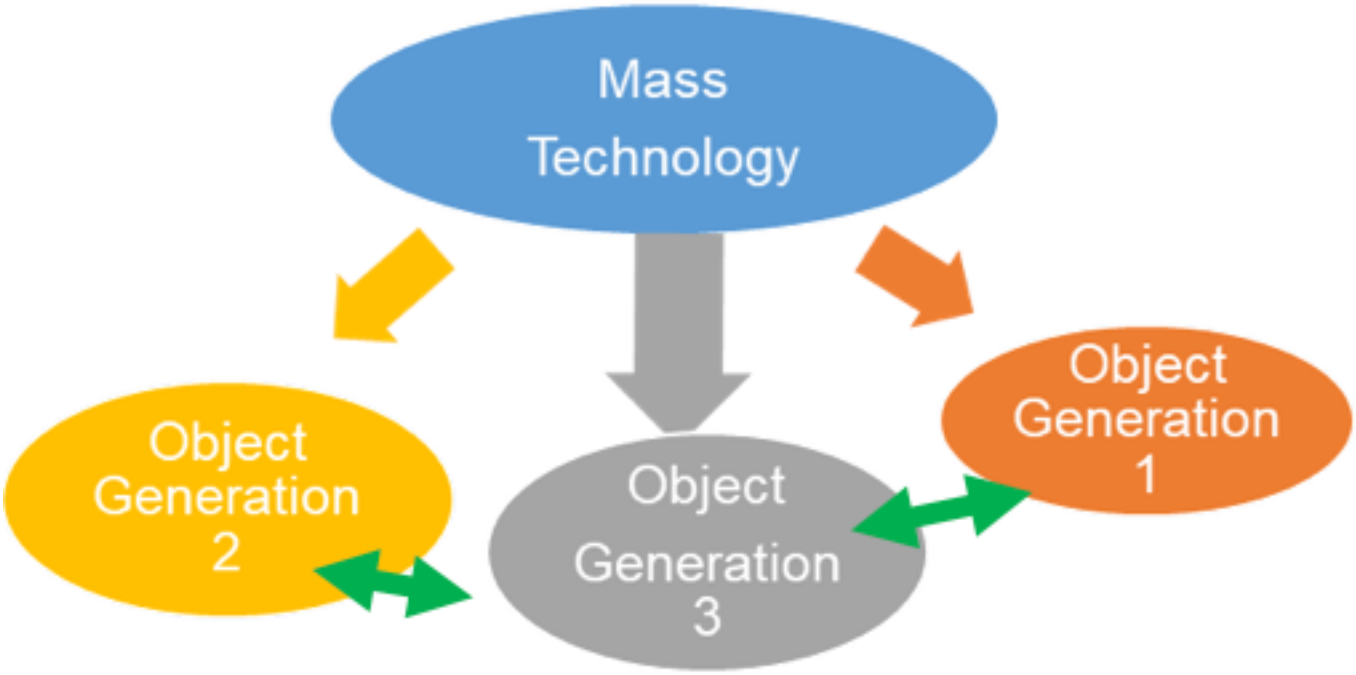
2.2. General Model of Foresight Ensuring Processes

On the market, there are objects which possess system properties, related mostly to the processes of the past. There are also certain objects, system properties of which primarily support the cognitive processes of the future (Figure 2, table 1).

It is important to acknowledge that the properties of an object are determined by the cognitive processes of the past, present and future (Figure 2). These properties link the object and the system.

All these objects must be perfected as a unified whole (Firstov, Akulov, Fyodorov and Timofeev 2017). They must maintain an undivided ongoing cognitive process. In Innovation economics this is supported by the mechanism on Figure 2 (Firstov, Akulov, Fyodorov and Timofeev 2017). As a result of new mass technology operations, there occurs a simultaneous change in segments (products etc.) of past, present and future.

Figure 2
The Model of the Perfection under the Influence of Mass Technology



Indeed, all existing and technological barriers to perfection are removed and the possibilities of continuing the cognitive processes emerge in the segments. The coordination of cognitive processes in different segments is provided through integrated operation of mass technologies (Figure 2).

Cognitive processes associated with different time stages (past, present and future) coexist as a coherent, unified whole. The table below shows a set of businesses, which are a part of one mass technology, establishing a technological mode. For instance, segment A (products and technologies of a traditional type) is perfecting its mass production. Its market is highly integrated and cognitive processes are highly coordinated. Expert (systems) methods would be the most effective to apply if changes are to be implemented. Such segment connects mass technology with economic processes of the past.

Table 1
Industrial Cluster Businesses

	Segment A	**Segment B**	**Segment C**
Production Type	Large Mass Production	Sustainable New Technology Production	Innovative Production
Consumer Type	Traditional	Stably Developing	New
Dominant Properties	High coordination of multiple technological processes and product requirements	Perfection of the most popular technological options and products	Improvements for specific new trends
Place in the process of mode development	Maintaining the connection to cognitive processes of the past	Perfection of sustainable trends	Solutions for shaping up the future system
Predominant Methods	Expert methods	Mixed	Formal/Logical

Segment C maintains cognitive processes of new generation. Its market is poorly integrated and cognitive process practices are rather limited. Therefore, to maintain coordination of changes in a modest number of areas, a formal (logical) method should be used.

For segment A, the most effective approach is the expert method; and, for segment B – modeling methods. It is important to maintain the coordination of different segment business properties, ensuring the unity of their development processes.

Here emerges an obvious criterion. The amount of new, medium and traditional type segments must be balanced. If there are too many of new type of segments, the mistakes will begin to accumulate. When there are too many of traditional types, erroneous development standards will be formed. In such cases, technological mode will collapse. The balance is expressed by the conformity of segment amount to the Zipfian distribution (Malevergne, Saichev and Sornette 2013). This discussion can be further followed in literature (Firstov, Akulov, Fyodorov and Timofeev 2017). Now, we will examine the model analysis on a concrete example.

3. The Results. Model Analysis.

Consider the process of integrated circuits perfection for signal processing systems. This field has a very high innovative potential. Its development transpires as simultaneous and coordinated expansion of technology and circuit design within the framework of a microelectronics technological mode (Bobkov and Kireev 2007). In course of a foresight process, there must be the concordance of modeling and expert studies. Next, let us explore the solution mechanism for this issue.

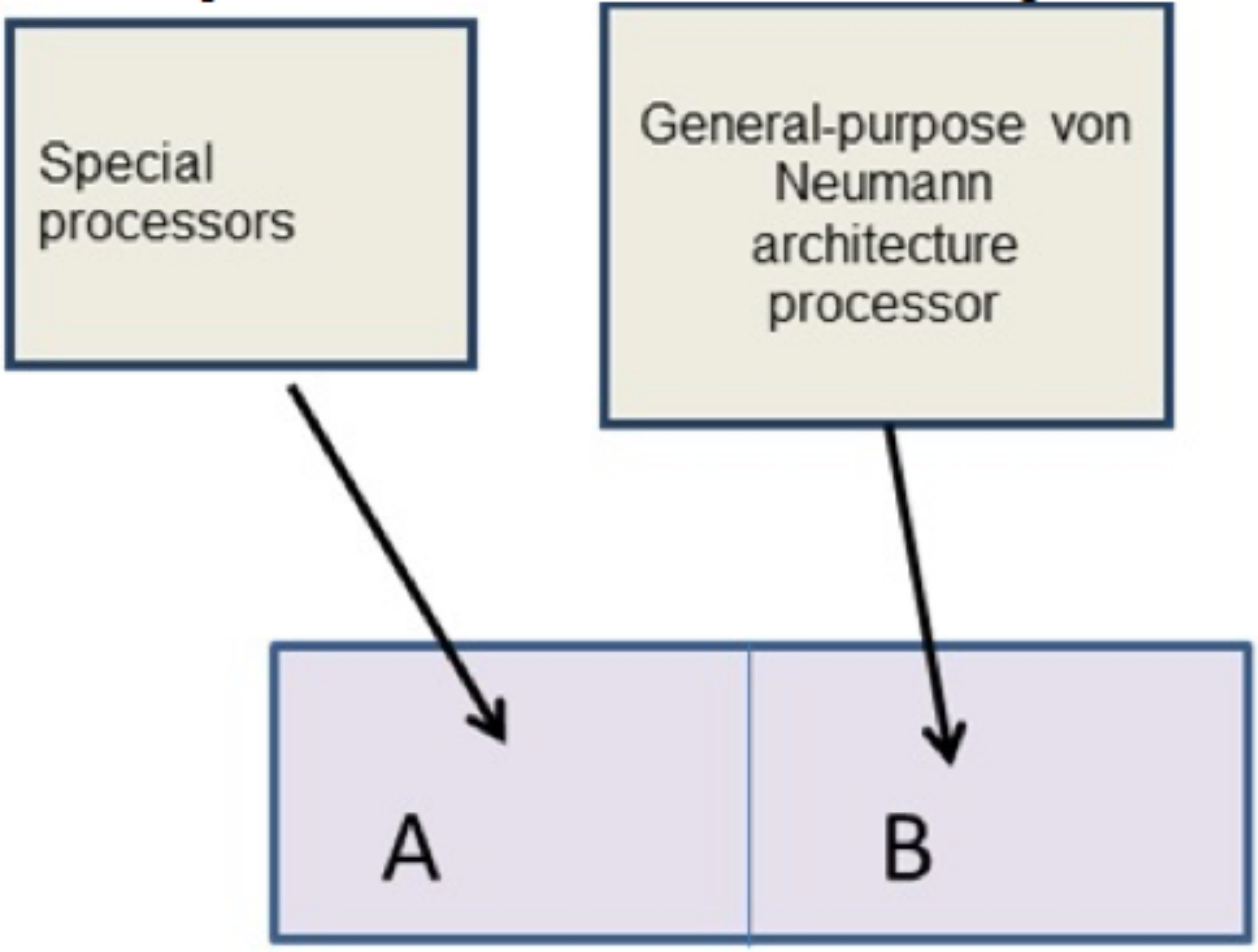
Technological environment development (Figure3) proceeds as shown in simplified model in Figure 2.

For the optimal solution of already well-studied tasks, integrated circuits of special processors are created. Circuit hardware adequately reflects the processing algorithm characteristics and the application options of mass production. A variety of well-coordinated physical effects, engineering solutions, special algorithms etc. is used. This creates 'resonance' in knowledge development of physics, circuit design and their applications and corresponds to the "past" phase of technological environment development process.

The coordination provides high quality of ongoing processes and systems approach is the most effective for the purpose of development management. Expert research and simple examples are of convenient use here; and, the development occurs due to a large number of inventions. These inventions are quickly studied by automation design systems and deliberation and knowledge integration take place in a large occupational information network. Development is maintained through management methods of inventive activities (Glazyev 1993), management standards and solution pursuit.

High interdependence of information system improvement spheres of this segment makes the application of mathematical models rather difficult. The decrease in influence of this problem occurs due to certain properties of technological environment. For example, high level of operation concurrency (achieved through high adequacy of tasks and algorithms) simplifies the organization of hard and software support and reduces the number and feedback intensity. Expert research is now simplified and its accuracy is increased. This allows for the use of expert assessments in mathematical modeling.

Figure 3
The Model of coordinated of technological
mode for the methods of signal processing



Still, as the complexity of segment A increases, it becomes much harder to consolidate the system of knowledge in a unified whole, meaningful and sensible, according to experts. It is, therefore, necessary to vary the model of further development which will lead to changes in foresight processes. The newly emerging model is discussed below.

The scope of tasks expands, creating an additional segment B (Figure 3). Particular calculating environment, oriented toward solving segment A tasks, will not be able to meet new challenges of segment B. Without sufficient experience in segment B problem solving, an additional specialized processor will be impossible to find. There is a threat of market halt. For this reason, a universal processor, which is capable of solving segment B problems, must be introduced. In the simplest case it can be a general-purpose von Neumann architecture processor, which consistently performs same-type minor tasks. Here, we witness a simplification of schematic, architectural and technological solutions with the use of generic algorithms that do not require special circuitry, algorithmic, etc. advances. This allows for possibilities of physics and circuitry experiments with higher quality results. Thus, segment B represents the area of the 'future' in the process of technological and economic development.

The introduction of universal general processor leads to the increase in consumer quantity, which in turn, leads to the increase of financial inflow. Additional funds, among other things, open the possibility for additional research. As a result of algorithmic and circuit solution simplification, its production process can be improved relatively independently from the changes in circuitry and algorithms. Such separation of algorithm improvement, circuit design and technology perfection processes enables the application of mathematical methods of foresight development in segment B.

Hereby, different methods are effective in different segments. And, segment properties must ensure the coordination of results from the application of these methods.

---

4. Discussion

Segment B represents a research tool of the future; and, segment A formalizes the coordinated knowledge (brings the 'past' into the process of systems development). Systems (expert) methods are primarily effective in segment A, while modeling methods are more efficient in segment B. It should be clear that both segments must change simultaneously and consistently.

Algorithmic and technological solutions produced in segment B create decision-making patterns for segment A. Solutions, obtained in segment A, develop factors that maintain the perfection of segment B. So, the segments support the perfection processes within each other.

Each segment has its own criteria for the optimal development process. For instance, for segment A evaluation (high level of integration), expert assessment may be used. On the other hand, for segment B, it is more advisable to use Grosch’s and Moore’s Laws (Bobkov and Kireev 2007; Thagard 2007). The latter is due to the simplicity of circuitry architecture, the size of transistor is the main parameter of von Neumann’s universal processor. And, there is always the requirement of coordinated and unified segment development (Sharov and Schreider 1985; Firstov, Akulov, Fyodorov and Timofeev 2017).

Modeling and systems methods are thus united, and there is no need to invent another hybrid method. Integration occurs due to structuring of reality. The system is formed as a set of segments, each of which effectively operates with only one method. As a result of mass technology operations, segment development unifying and coordinating mechanisms emerge. The consistency of foresight results increases if the conditions of segment coordination are kept. Surely, the process of technological mode development is much more complex.

Foresight method perfection should transpire in consideration with the examined properties. It is important for the development of long-term projects in Innovation economics. Market, technologies and relationships are constantly changing; and, long-term projects should continuously improve in course of their execution. In this case, the applicable solutions must allow for coordinated (coherent) project modification. Coordination is supported by the balance of technological mode organization. Accordingly, at first, it is advisable to conduct a foresight of technological modes of mass products and technologies, associated with project execution (Sharov and Schreider 1985). The results will help with the development of project details. The accuracy of prognosis for these details is supported by foresight accuracy of technological modes of mass technologies.

5. Conclusion

In Innovation economics, the perfection of analytical instruments creates the key resource for accelerated development.

In particular, Innovation economics establishes unique modes of development, where the issue on modeling and expert assessment unity is solved naturally. Technological and economic environments begin to take shape as a set of coordinated technological modes. They cultivate interconnected segments, which use different methods of foresight (modeling and systems). At the same time, the coordination of these segment properties ensures the consistency of their combined use. Discussed above models and example demonstrate that the accuracy of foresight is determined primarily by the properties of technological and economic system.

Long-term project planning should begin with the foresight of technological modes of mass technologies, involved in project implementation. This will define the terms for the development of project perfection scenario.

References

Adegbile A. and Sarpong D. (2015). Managerial Engagement with Scenario Planning: A Conceptual Consumption Approach. *Foresight and STI Governance,* 9 (4): 73–80.

Bobkov S.G. and Kireev B.S. (2007). The Transition of Microelectronics into Nanometric Size Regions. *Nano and Microsystem Technology,* 21(5):11-18.

Bussey M. (2013). Causal Layered Analysis: Towards a Theory of the Multiple. *Foresight Russia,* 7(3): 73-75.

Bussey M. (2014). Conceptual Frameworks of Foresight and Their Effects: Typology and Applications. *Foresight Russia,* 8 (1): 75-78.

Firstov Y.P., Akulov D.S., Fyodorov P.L. and Timofeev I.S. (2017). The Choice of Solutions and its Features for Long-Term Projects in Innovation Economics. *Economic Systems Management*, 97 (3): 10-15.

Glazev, S.Y. (2017). *Strategy for russian growth in the context of the global economic crisis.* Moscow: Economy, pp. 245 .

Glazyev S.Y. (1993). *Theory of Long-term Economic Development.* Moscow: VlaDar, pp. 391 .

Inayatullah S. (2004). *The Causal Layered Analysis (CLA) Reader: Theory and Case Studies of an Integrative and Transformative Methodology*. Tamsui, Taiwan: Tamkang University Press, pp. 247

Kharitonov, V.V. and Glazyev, S.Y., (2009). *Nanotechnologies as a Key Factor of a New Technological Mode in Economics.* Moscow: Trovant, pp. 256.

Malevergne, Y., Saichev, A. and Sornette, D. (2013). Zipf's law and maximum sustainable growth. *Journal of Economic Dynamics and Control,* 37:1195-1212

Sharov A.A. and Schreider Y.A. (1985). *Systems and Models*. Moscow: Sov. Radio, pp. 357.

Sneed, A. (2015). Moore's Law Keeps Going, Defying Expectations. http://www.scientificamerican.com/article/moore-s-law-keeps-going-defying-expectations/ (Accessed 31 May 2015)

Thagard, P. (2007). Coherence, Truth, and the Development of Scientific Knowledge. *Philosophy of Science,* 74: 28–47.

Tonn, B. T. (2004). Research Society: Science and Technology for the Ages. *Futures,* 36(3): 335–346

Zlotin E. and Petrov V. (1999). Introduction to the Theory of Inventive Problem Solving. Tel-Aviv: TRIZ-Isr@bigfoot.com© , pp. 351.

---

1. National Research Nuclear University "Moscow Engineering Physics institute" 115409, Russia, Moscow, Kashirskoye shosse, 31; E-mail: firstov_y@mail.ru

2. National Research Nuclear University "Moscow Engineering Physics institute" 115409, Russia, Moscow, Kashirskoye shosse, 31, E-mail: oam0703@gmail.com

3. National Research Nuclear University "Moscow Engineering Physics institute" 115409, Russia, Moscow, Kashirskoye shosse, 31; E-mail: akulovds@mail.ru

4. National Research Nuclear University "Moscow Engineering Physics institute" 115409, Russia, Moscow, Kashirskoye shosse, 31; E-mail: tis12693@gmail.com

5. National Research Nuclear University "Moscow Engineering Physics institute" 115409, Russia, Moscow, Kashirskoye shosse, 31; E-mail: walgecore@gmail.com

---

Revista ESPACIOS. ISSN 0798 1015
Vol. 39 (Nº 06) Año 2018