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The Institutional Factors of Strategic Development and the Tactical Regulation of Nanotechology

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Abstract:

The analysis of influence of institutional factors on development of technologies is carried out. The generating role of institutions in technological progress is proved. The general logic of an institutionalization of new technological way is presented on an example of nanotechnologies.

Institutes are the "weak link" of the concepts and theories of the evolution of technology and technological structures. Most modern theorists of evolutionary economics are focused mainly on the study of the dynamics and forms of scientific and technological progress, especially the mechanisms of nucleation and diffusion of large "clusters" of innovation.

In their turn, the institutional economists have concentrated on the analysis of factors and ways to minimize the transaction costs sustained interaction of agents and their organizations "in the high-tech world with a huge degree of specialization and division of labor other than impersonal exchange" (North 1997).

In their works only relate to the institutional structure and infrastructure of innovative development, although, as noted by Nelson (2002), the concept of national and regional innovation systems is institutional in nature just on this fact is rarely emphasizes the attention of scientists. As a result, institutional forms and mechanisms of technological evolution is very poorly understood, and their analysis is based on very general ideas about the institutes and institutions.

Keywords*: institutions; general purpose technologies; institutionalization; technological progress; nanotechnologies; NBIC-convergence.*

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Introduction

Institutes are the "weak link" of the concepts and theories of the evolution of technology and technological structures. Most modern theorists of evolutionary economics are focused mainly on the study of the dynamics and forms of scientific and technological progress, especially the mechanisms of nucleation and diffusion of large "clusters" of innovation. In their turn, the institutional economists have concentrated on the analysis of factors and ways to minimize the transaction costs sustained interaction of agents and their organizations "in the high-tech world with a huge degree of specialization and division of labor other than impersonal exchange" (North, 1997).

While various concepts of technological evolution are partly considered the impact of institutional conditions and factors, this aspect of the research is developed mainly as a residual principle. Therefore Dementyev (2009) in his review of the institutional circumstances of the long-wave dynamics was forced to appeal only to the concepts of Glazyev and Perez, (2008). Leading representatives of the evolutionary theory of technological development. In their works only relate to the institutional structure and infrastructure of innovative development, although, as noted by Nelson (2002), the concept of national and regional innovation systems is institutional in nature just on this fact is rarely emphasizes the attention of scientists. As a result, institutional forms and mechanisms of technological evolution is very poorly understood, and their analysis is based on very general ideas about the institutes and institutions.

Literature Review

According to the approach of Glazyev (2008) "the substitution of technological structures requires as a rule corresponding changes in social and institutional systems that not only remove the social tension, but also contribute to the mass introduction of technologies of the new technological order, its corresponding type of consumption and lifestyle". The institutional structure of technological structures, according to the scientist's opinion includes national and international modes of economic regulation, the basic economic institutions and institutional processes, as well as ways of organizing innovation activities, but their special analysis is not carried out.

According to the concept of innovative paradigms of Hirooka (2006) the diffusion of new technologies, initiating output of the economy on the path of development and expansion of markets, is accompanied by "specific institutional changes which, of course, are important, but not fundamental. Institutions only form a framework that supports or hinders the expansion of the main innovations (Hirooka 2004). Polterovich (2009) draws attention on the role of the institutional effect of path dependence in technology driven global crisis accentuating along with "innovation pause" the value of the current evolutionary "reckless belief in continuous technological progress, supported by a long preceding period of rapid development and exchange mechanisms".

Influence of institutions is considered by the concept of techno-economic paradigms, developed by Perez (2009) through the enhanced technological systems of Freeman's concepts (1992) and the technical paradigm developed by Dosi (1982). The author proceeds from the thesis that "every new technological system modifies not only the business environment but also the institutional context, and even culture" (Perez, 2009) creating powerful externalities and resonance effects to the environment. The "long-term fluctuations, which we call the long waves are the result of successive clutches and breaks of two system fields: techno-economic on one hand, and social-institutional on the other" (Perez 2004). Thus, institutional factors are derived overseas of the economic system and rely exogenous variables of its evolution, and social-institutional system seems like a system "of environmental type."

Revealing the nature of technological revolutions, Perez (2009) introduces the concept of the institutional reshuffle or institutional re-composition as a necessary phase of the implementation of synergies from the interaction of production and financial capital, coming after the collapse of the financial "bubble". At the same time, "the main task of the institutional re-composition is to create conditions for the expansion of markets and establishing control over productive capital. The duration of the recession will depend on the ability of society and the authorities to establish direction and institutional changes to restore confidence and the shift in emphasis on the creation of real wealth (Perez 2002).

It is noted that in comparison with the techno-economic sphere, the social-institutional sphere is more resistant to change, and slowly adapt to the changing conditions by the institutional inertia (Perez 2002). The depletion of old and the formation of a new techno-economic paradigm under the influence of economic and social incentives to the progressive changes leads to the development and diffusion of the new ideology, which initiates social and political processes of reconstructing the institutional structure. This process is chaotic with hardly predictable results.

Substantially developing the ideas of Perez and Sergienko (2009) proves that the evolution of techno-economic paradigm is accompanied by the change in the relation of formal and informal institutions. In the phase of nucleation of a new wave of technological innovators experience an acute shortage of financial resources, which motivates them to cooperate and to create informal institutions. Depletion of the potential of old technologies creates incentives for the expansion of bank lending to innovators and innovations in the financial system, but "due to the spread of financial and institutional innovations, investment opportunities innovators cumulatively expanding" (Sergienko 2010). Then the "innovators are tear the established informal ties and begin fierce competition" in the new institutional environment (Sergienko 2010).

In general, it must be noted that the heuristic potential of institutional theory in the analysis of the global evolution of the technology is involved underserved. Especially strange that after the classic works of North (1994), aimed at creating a general theory of technological and institutional changes, there is a pronounced loop evolutionary economist on technology as the main factor of growth, although this approach is neo-classical in nature and goes back to the works of Solow (1950). Technological determinism is not only a major methodological obstacle to improvement and enrichment of the institutional and evolutionary economics, but also complicates an already extremely complex analysis of the development and competitiveness of general purpose technologies.

Therefore, careful attention should be given to the position of Nelson (2008) about the need to integrate institutional and technological determinism in the theory of economic growth. He offers two-class technology to differentiate, "resuscitating" the classification of North and Wallace (1994). This point of view in his later work supported by Eggertsson, 2009).

Physical technologies include technology in the tradition understanding that is the ways and means of production of material goods. Social technologies by Nelson (2000) cover all major forms of economic institutions[4] common "rules of the game" (North, 2008), "management methods" (Williamson, 2004), as well as a collective choice and action procedures (Buchanan, 2005; Nelson, 2002) which ensure the reduction of transaction costs in the economy (according to the normative version of the "Coase Theorem). The apparent advantage of this classification is the possibility of expanding the purely technological concepts of economic evolution by their additions institutions in an equal epistemological status with the technology.

The downside can be considered a metaphor of the concept of "physical" technology, shielding their chemical, biological and converged species groups. In addition, reduction of institutions to social technologies distort their actual content, that recognizes Nelson (2008) itself, separating finally the concept of "social evolution of technology and institutions that support them is a much more complicated and uncertain process than the evolution of the physical technologies. The stranger is that evolutionists ignore the tremendous role of management,

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[4] *We continue to insist on the need of the categorical differentiation of institutes and of institutions (Inshakov and Frolov, 2010; Inshakova, 2010; Frolov 2008). Institutions are separate kinds of activities, which are status functions of their agents. Institutes are interrelated complexes of institutions and organizations, concomitant their regulations and procedures that form the regulatory mechanisms of the transaction (for more details see: Frolov and Inyutina 2010).*

marketing, brokering and financial technology in the progress of the market economy. These waves have clearly different dimension than the wave of traditional technologies and require special studies.

Through the idea of "compromise Nelson" the principle of co-evolution of "natural" and social technologies (Nelson, 2008) in fact implies conventional preserving of the dominant status of technological determinism in the theory of evolution in its substantive institutional expansion. But the technology in a general sense are interrelated ways to use the methods and tools to improve the efficiency of certain activities, from the nature of which should come their classification. Therefore, it is methodologically more correct is the delineation of transformation (Tf) and transaction (Ta) technology based on the theory meta-production function (Inshakov 2007).

The first (Tf) are related to different types of reform activities aimed at changing the physical properties of the impact object. Just this group of technologies is the focus of evolutionary economists, who probably embraced too literally the common phrase Veblen that "the process of cumulative change that must consider the economic science is the sequence of changes in the methods of making cases that is methods of treatment of the material means of existence" (Winter, 2004). The second (Ta-technology) are related to the implementation of the interactions of economic agents, helping to improve the efficiency and effectiveness of their communications and transactions. These include the legal (and increasingly institutional), managerial (organizational in general), financial, trade, transport, marketing, information (including cognitive) etc., the classification system of which is not yet developed.

We emphasize that TF- and Ta-technology are used in the production and circulation, and consumption, so Ta-technology is not rigidly attached to the activities carried out within the framework of the transaction sector. In this context, technological progress should be understood as the co-evolution of transformational and transactional technologies, their clusters and generations at all levels of the structure of the global economic system. It is necessary to transfer to Ta-technology research emphasis, because until now, "the science base, which gives the social sciences social technologies is insufficient. Therefore, attempts to export the institutions from one country to another and to legitimize them in the last often unsuccessful as organ transplantation, because they do not have enough knowledge about the principles of social institutions. The knowledge of the principles of social technologies is also very superficial" (Eggertsson, 2011).

As shown by Eggertsson (2008), new communication technologies, increasing the efficiency of transactions, generate innovative models of organization (Pisano, 2006), which "opened the way" transformational innovation. Thus, according to Lux Research, enterprise social networks today are the powerful "catalyst" for the development of environmentally-neutral chemical technologies, ensuring effective cooperation and coordination of laboratories, startups, universities, corporations and financial institutions (Corporate Social Networks, 2011). It becomes obvious expediency of special attention of researchers is not only to the change in the dominant technologies of transformation, much to their accordance with transaction-consistency in the development of technology.

Indirectly Zworykin (1962) a prominent historian of technological progress paid attention to this problem, using the only possible for the time of Marxist terminology: “It is impossible to understand the development of technology, apart from the relations of production a particular socio-economic system. It is impossible to explain the contradictions in the development of technology in the conditions of modern capitalism, if not start from the capitalist relations of production”. He cited the example of Polzunov, (2005) nominated in the middle of the XVIII century the brilliant idea of replacing the water wheel heat engine, which (despite the Herculean efforts) did not receive the application in Russia, as the economic institutions of feudalism did not create effective incentives and motives for the introduction of technological innovations. In contrast, in the UK institutional environment contributed to innovations that allowed the steam engine of Watt (2004) induced deep industrial revolution.

In this regard, it is difficult to support the point of view Perez (2011), accentuating exclusively “inertia and resistance to change social institutional framework” but leaving out of sight of the innovative functions of the institutes. The “improvement of production (transformation -*Ed.*) technologies opens new business opportunities, and this gives rise to complementary social (transaction -*Ed.*) technology. The reverse process when social technologies lead to industrial innovation is possible” (Eggertsson, 2011). Thus, in the case of nanotechnology which is positioned by many scientists as a new basic innovation (Mensch, 2004), a key role acquires complementary institutional and integrated marketing technologies. Currently, nanotechnology - a new generation of innovations problem with potentially huge, but uncertain potential, numerous and virtually unstudied risks, requiring huge investments without explicit guarantee of market success (Frolov and Stratulat, 2010). Their widespread use should be accompanied by the priority development of the regulatory framework and proactive marketing, inattention which has been a key reason for the collapse of the commercial engineering technology of genetically modified organisms.

The main methodological problem of technological determinism is the substitution of the real content of economic evolution, the progress of the social division of labor and cooperation, the system integration and the differentiation of types and forms of human activity, improving the ways, the methods and the tools for their implementation. “The methods of doing business” obscure and shift to the background activity itself, the implementation of which they contribute. At the same time, from the point of view of Metcalf (2007), “one important aspect of innovation is namely the addition of new activities within the framework of individual consumer behavior" including the consumer of investment goods. Running people (individually or in organizations) of different status of life functions (institutions) (Inshakov and Frolov, 2010) objectively requires specific methods and the use of tools. Technologies are not significant in themselves, but as ways of implementing institutions. Because each economic agent is included in different parallel planned institutions as Lousbi (2007) rightly remarked "cumulative set of interrelated types of consumer activity can be represented as a result of the analysis as the identifiable style of life" and the corresponding to it the "common way of thinking" (Veblen 1984), forming a system of "shared beliefs" agents (Aoki, 2007).

Methodology

The enormous potential of information and communication technologies of wide application is associated just with the creation of an array of new institutions – highly qualified professions (Internet-related activities) (Internet matters, 2011) and sustainable forms of leisure activities. In fact, "The Internet has offered a new set of social situations, and people immediately rushed for the new masks" (Lewis, 2004), and "specific economic masks people is just an impersonation of economic (institutional -Ed.) relationships, as carriers of which these faces opposed to each other" (Marx 1951) and interact with each other.

From the standpoint of evolutionary realism, the basis not only transaction, but the transformation technologies are those institutions, the implementation of which they serve. Radical technological innovation is determined by whether it creates a new activity or only facilitates the implementation of already existing institutions. The scope of application of new technologies related to how many agents carried the kinds provided by its activity, what the place and the role of these institutions in the economic system, are and thus "the demand for goods is thus based on the demand for the implementation of certain activities" (Metcalf 2007).

This requires further development of the Schumpeterian concept by expanding the concept of innovators, they are not only entrepreneurs engaged in "new combinations", but also consumers, because progress often "does not depend on technological innovation in the usual sense, but from a user innovation" (Metcalf, 2007) associated with unplanned use of innovations. The institutionalization of technological development is expressed not only in the creation of new technical regulations and standards, industry standards and infrastructure, but, above all, the emergence and expansion of institutions provided innovative technologies relevant to their patterns, norms and behaviors (Frolov, 2011).

Consequently, the change of the leading technological structures, "clusters" and "paradigms" of content presents the process of competitive economic institutions. Each technology of wide application corresponds to the "institution-related", that is functionally separate and technologically interdependent activities, which agents seek to defend and strengthen its strategic associate status. Macro and mega generations (Majewski, 1997) as a generational group of technology-related industry of institutions of national and global scale are the "conductors" of basic technologies and "institutional entrepreneurs", they are stiff competition for scarce resources, including the entering cooperative relations and forming a complex alliance.

Scientific search for high-tech is not an institutionally neutral process. New technologies are not created hermit scientists in ivory or ebony towers. The huge capital intensity of business research requires the active search for additional financial resources and cohesive lobbying their research programs, based on the support of the state and / or the large business. The field of high-tech science is the arena of the hard clash of interests, sophisticated competition "related groups" of influence and pressure, abounding PR-shares, intrigues, distortion and opportunism. It takes place intertwining and the merging of status interests of various "stakeholders" of the new technology: researchers, research foundations and industrial business, politicians, venture investors, rating agencies, expert organizations, marketing companies, media, etc.

An example is the story of lobbying the idea of nanotechnology as a key factor of competitiveness of the United States (Loc, 2010; Joaquim and Plever, 2009). Governmental decisions are the result of the competition of sectoral and cross-industry lobbies, thus, the introduction in Russia of tough measures to combat tobacco reflects not so much the state cares about the health of its citizens, as the defeat of lobbyists tobacco industry to compete with transnational pharmaceutical business (including Pfizer, Johnson & Johnson, GlaxoSmithKline and others) and supported by major retail chains.

Technological progress is inextricably linked with the social division of labor or institutogenesis - occurrence of the process, "rooting" and the spread of new institutions in the economy and society. The diffusion of new technologies does not happen by itself, in isolation from the society. To become a norm in the consumption and use, technological innovation must gain a strong social base. Each technology generates extensive use of complex "related institutions", agents that use it in their vital activity, earning income and gaining. Any "basic innovation", on the one hand creates a lot of jobs and generates new needs, on the other hand, destroys the existing professions devaluing older skills and knowledge, starts structural unemployment. Technological development in this sense is a complex and sometimes extremely painful social process. The success or the failure of new technologies is primarily due to the support of stakeholders in its social groups. Change of technological structures is always a tough process of institutional competition.

Results

Let's consider the example of nanotechnology as a generalized multi-stage logic institutionalization of the general-purpose technology (GPT) in the context of globalization and state monopoly capitalism, especially since according to Roco (2010) now they can reasonably be classified as GPT:

1. Informal stochastics institutionalization inevitably accompanies the birth and the formation of a new technology in a series of "break-through" experiments carried out by the action (often informal) groups of researchers based on unsustainable resources and unstable channels to attract them, in terms of fuzzy goals and an implicit intellectual cooperation strategy.

In the most ordinary day in March 1981 future Nobel laureates in physics G.K. Binnig and H. Rohrer after little more than two years after it was formulated the basic concept of a scanning tunneling microscope (STM) by their experiments have proved the presence of characteristic exponential dependence of tunneling current I_t from distance σ_z the tip –as a sample. This event has become a kind of "Big bang" for a new "nano-Universe", using terminology shaped by Perez (2011). The developed device not only allowed to identify individual atoms and molecules, but also gave the opportunity to manipulate with them (this ability STM was discovered in 1989). However, in 1995, at the atomic level manipulation around the world only 5 small research teams engaged in it.

2. The recognition, the first recognition and the beginning of lobbying. Attracting the attention of government officials to the potential of the new technologies requires favorable political conditions and the presence of a charismatic proselyte actively advocating GPT. With the support of influential politicians, the first "pressure groups" are created and developed by the preliminary forecasts and reports on the prospects of a new GPT, and gradually more active discussions start.

In the summer of 1992 enthusiastic for environmental issues, Senator Al Gore organized in the Senate hearings on the development of new technologies for sustainable development, where a famous scientist and science fiction writer E. Drexler, supported the senator and later received from the press the title of "father of nanotechnology." Shortly before this event (in 1991), he received his doctorate in molecular nanotechnology. His convictions and ardent speech (in which the speaker skillfully quoted Nobel Laureate R. Feynman in 1959) was devoted to the prospects to produce "molekulmachines", capable of creating any materials and devices from single atoms, "brick by brick", "bottom-up". With the support of Al Gore has created a group of lobbyists idea of sustainable development, and soon after his appointment as a vice-president in charge of new technology, a report was published "Science at the service of the country" (1994), which proclaimed the strategic importance of nanotechnology for the development of electronic, chemical and pharmaceutical sectors of US industry. The fore industrial lobby on the front edge of nanotechnology propaganda came to Roco (2010) and replaced by Drexler (2008). The director of the National Science Foundation (NSF) H. Lane, and especially an adviser to President Bill Clinton on economic issues T. Kalil promoted his nomination. It is through the latter M. Roco when he put together a working group, which by 1999 had prepared a draft of the National Nanotechnology Initiative (NNI), where nanotechnology was treated as strategically important, qualitatively new ways of miniaturization, close to the nanometer measurement range.

3. State support, the formal institutionalization and expansion. At this stage, the new GPT acquires national development strategies and programs, formed the institutional framework and infrastructure, is formed there is a budgetary and legislative consolidation of the relevant strategic priorities, as reflected in the policy research grant funds and lead to an increase in the number of researchers. Supporting informal institutions gradually are formalize and get innovative technologies and "overgrown" complex institutional arrangements. Many formal and informal optimistic forecasts. Appear the first examples of fraud, are identified which are inherent of new GPT risks and the debates on its security begin. The international competition in the high-tech market, taking the character of "race" activates.

In March 1999, was approved by the NNI budget ($300 million in 2000), and its implementation, which began when Clinton officially announced January 21, 2000. A new group of lobbyists rallied around the Nobel Prize winner in Chemistry R. Smalley, the discoverer of fullerenes who during his speeches in the House of representatives of the congress (1999-2002) contributed to the expansion of nanotechnology and the treatment capacity of budgetary financing of American research in the fields of chemistry and materials science. Serious illness of Smalley in 2003 once again brought to the center of the lobbying Roco, who spoke with a new idea of NBIC-convergence, even the key term "nanotechnology". Increasingly "NNI was reduced to a very uncertain and the general program of a variety of materials research" (Plever, 2009) with a parallel increase in its budget (Table 1).

Table 1. *Dynamics of budget NNI (2000-2012), $ million*

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
~300	464	697	760	989	1200	1351	1425	1554	1695	1912	1850	2130

Source: *http://www.nano.gov/about-nni/what/funding.*

NBIC-convergence is, first and foremost, an ambitious mega-project cross-sectoral integration of large, high-tech, high-tech business, and not an "objective" process of integration and synergy of natural nanoscience. Painted by Roco (2003) and co-authors "boom NBIC" was aimed at lobbying to the further increase budget expenditures for a wide range of research in the sphere of high technologies and their effective "development". The project NBIC-convergence had alternatives: GNR (Genetics, Nanotechnology, Robotics), GRIN (Genetic, Robotic, Information, Nanotechnology), GRAIN (Genetics, Robotics, Artificial Intelligence, Nanotechnology), BANG (Bits, Atoms, Neurons, Genes), and others. The final choice was obviously dictated by the widest area of research and development, in which the implementation of almost any possible capital-intensive research projects was possible.

Since 2000 national initiatives, strategies and nanotechnology development program after the United States took more than 60 countries, during the past 11 years, governments have invested in nanotechnology research and development more than $ 67.5 billion and a global "nanorace", economic and ideological confrontation of developed and fast-growing countries of the world for excellence in the field of nanotechnology began. This is a converted form of "arms race" in peace time (recall that in the history of mankind dreadnought race was at the beginning of the XX century and the nuclear missile of the USSR and the United States in the race was during the "Cold War").

According to the calculations Cientifica Ltd., the index of significance of nanotechnologies (Nanotech Impact Factor) has significant country variations. Thus, the availability of the highly developed infrastructure in the UK negatively offset by the low level of investment, while Russia has not only ranked third in the world in terms of funding of nanotechnology (yielding in 2010 only to China and the US), but gives them the monopoly status of the national mega-project in the field of innovation. At the same time, the index of capacity for the development and exploitation of emerging technologies (Emerging Technology Exploitation Factor), which reflects the capacity of countries in the aspect of transfer and diffusion of innovation, provides a different balance of power (Table 2). Despite the ambitious goals, and large-scale funding, Russia in the medium term is likely will remain a player of the "second league" of global nano industrialization because of the sheer catching-up in terms of development of converged technologies, inefficient institutional mechanisms of the national innovation system and preserving a problem of "brain drain". "Accelerated development" of the national nanotechnology industry requires the science demands optimization of strategic control.

Table 2. *Indexes of the importance and potential application nanotechnology (2011)*

Country	*NanotechImpactFactor*	Rating	*EmTechExploitationFactor*	Rating
USA	100	1	5,00	1
China	89	2	4,30	7
Russia	83	3	3,57	10
Germany	30	4	4,93	2
Japan	29	5	4,88	4
EU	27	6	4,23	8
SouthKorea	25	7	4,60	5
Taiwan	9	8	4,90	3
UK	6	9	4,55	6

India	5	10	3,95	9

Source: *compiled by the author based on (Global Fundings, 2011).*

From the standpoint of the contract theory of money (Tambovtsev, 2009) the currency of the leading countries can be regarded as being in the process of execution of the contract for the supply of advanced technology of wide application (general purpose technology) (Dementiev, 2009). In our view, the reserve currencies are the futures contracts for the development of the technology of global application (global purpose technology), one of which now nanotechnology are along with the synthetic biotechnology and the computer technology of the "fifth generation" (from the mobile 4G and the semantic web to quantum computer and virtual reality). All "nanotechnology race participants closely watch the actions of each other" (Dementiev, 2009), which undermines the illusion of institutional neutrality of the investment processes in the field of nanotechnology. Governments of the competitor countries, increasing the budgets of nanotechnology programs largely decide the status and ideological objectives, forming a mutual expectation about the future configuration of forces in the global economy.

4. The Connection at the large private (venture) capital, the "techno-blizzard" and the "herd effect". Under the influence of government policy initiatives, the increasing of the budget funding and venture capital investors optimistic forecasts the investors significantly increase the share of investments in the new GPT in their "portfolios." Despite the efforts of skeptics, the media begins "techno-hype" the one-sided flow of positive pseudo expert information about the new technology and its "rainbow" prospects. Revaluation of GPT is accompanied by lack of risk-based and lack of objective analysis that leads to euphoria and boom on the stock exchanges, the massive fraud, the formation of "bubble" in the stock market the crisis and the correction of the market potential assessment, the optimization and the rationalization of investment flows.

The steady growth of private investment in nanotechnology during 2000s.Was caused solely by strategic programs, and huge amounts of research funding in this area by the governments of the leading countries. In 2004 (Global Funding, 2011), or according to some other sources, in 2007 (Global Funding, 2008) the private capital on a global scale for the first time invested in this sector more than the states.

On the one hand, this milestone event confirms the trend of intensive growth of commercialization of pre-production stages of the development of the nanotechnology industry (Inshakov, 2011). On the other hand, it reflects the cumulative effect of the emergence of "herd behavior" of investment institutions (venture capital funds, etc). It would be naive to believe that the actions of these structures are rational, even though the total volume of the investments are measured in billions of dollars. At the end of the 1990s investment institutes and overestimated the scope of IT and e-commerce (on the background of hysteria of numerous experts, portending the imminent advent of the “new economy”), causing a boom and the collapse of “dotcom”. It is likely that this situation will repeat with nanotechnologies. So far, the commercial prospects of nanotechnology, are “fueled” extremely the exaggerated prognosis, the inventors of them are difficult to recognize the independent experts. Specialists in this field are still insufficient, and the agents of investment institutions obviously do not possess the necessary expertise to evaluate the projects and the competences, this deficit compensated by trend-following strategy, which leads to herd behavior.

As Perez (2011) shows unrealistic economic expectations in respect of new technologies often lead to financial bubbles and the reverse reaction, adversely affecting their further progress. It looks symptomatic of the fact that in 2011 the new commodity exchange began to work, Integrated Nano-Science and Commodity Exchange (INSCX), providing a wide range of nano-commerce, from basic nanomaterials and ending with the “advanced” (Nanopolymers, photonics, and so on). Apparently, the day of the introduction of a new stock index *NASDAQ Nanotechnology Index* after the *NASDAQ Biotechnology Index* (for the biotechnology and pharmaceutical industries companies) is coming.

Confidence in the bright future nanotechnology industry is primarily based on size and market projections, the range of the variation of which is impressive (Table 3).

Table 3. *The forward field of the world market of nano-production ($ bn.)*

Developerandyear forecast	2010	2011	2012	2013	2014	2015	2020
LuxResearch (2006, 2008)	-	-	-	-	2600	3100	-
BCC (2008, 2010)	-	27	-	-	-	26.7	-
Cientifica (2008)	-	-	263	-	-	1500	-
RNCOS (2006)	1000	-	-	-	-	-	-
Wintergreen (2004)	-	-	-	-	-	750	-
MRI (2002)	148	-	-	-	-	-	-
EvolutionCapital (2001)	700	-	-	-	-	-	-
NSF (1999, 2001, 2010)	-	-	-	-	-	1000	3000

Source: *compiled by the author based on (Palmberg, Dernis and Miguet 2009; Roco, 2010, Nanotechnology Research Review, OECD Science, Technology and Industry Outlook 2010).*

While all forecasts adjusted the global economic crisis, it is important not so much to their accuracy, as the estimates order. Note that all forecasting organizations use different definitions of nanotechnology and the nanoproducts, as well as poorly comparable calculation methods. In this sense, the comparison of the various projections is not possible, that is often overlooked by researchers. Thus, the most optimistic forecasts appeal to the final price of products with nanocomponents, although it is more correct would be to consider just the price of nanocomponents and the price difference with the “Not nanotechnological” analogue item which shows the amount of value added nanotechnology. In addition, in many forecasts (Lux Research) are manifested the error of double counting when consistently accounted for nanotech prices of raw materials, semi-finished and finished products. Obviously inflated estimates of future production volumes of nano industry global market still being in its infancy, derived from “budget oriented” as reports M. Roco - “Nano-1” (1999) and “Nano-2” (2010). It was the first of them the fascinating figure of $ 1 trillion by 2015 was first performed, which was the starting point for almost all future projections (with the sole exception of Wintergreen). Barsukova (2010) truly says: “Nanotechnology has long turned into a synonym of PR technologies”.

Even the global assessment of the current state of the nano market is absurdly widely varied from modest $ 12 billion (The Big Downturn in 2010, III) to whopping $ 254 billion (Roco, 2010). This is not surprising. In the absence of clear rules for registration and marking nobody really knows the actual number of products containing nanoparticles and manufactured using nanotechnology. However, estimates of Lux Research, appealing to the maximum values of the scale became the most cited. This proves the primacy of institutional factors nanotechnology “boom”, enhanced by the action sociological mechanisms. But the methodology applied Lux Research, is very far from the perfect. It is based on the idea of nanotechnology “adding value chain» (value chain), which has exceptional potential of “inflating” of the final estimates. For example, if the installer sets in the home kitchen work surface, which comprises antibacterial silver nanoparticles whether the contribution of nanotechnology should be understood as the amount of silver nanoparticles, throughout the working surface or the whole house? It sounds absurd, but Lux Research would summarize all three options (Roco, 2010).

Pursuing their status interests, analytical and marketing companies serve the economic interests of big business in the field of nanotechnology, de facto speaking as its agents and losing the status of independent experts, while ignoring the function of providing objective assessments of market trends. Similarly, when science becomes an object of big business interests inevitably there is a transformation of affiliated scientists in its people. Such an institutional merging is seen in the most areas of modern high-tech businesses, for example, in the pharmaceutical industry (Shell, 2004). There is the mass demonstration replication of strategies in the scientific community related to purposeful imitation belonging to Nanotechnology by adding the names of the projects and works grant-capacious prefix “nano” in order to update them in order to gain the funding (Berube, 2006). An example is the Large Hadron Collider, during which the news that “scientists are faced with an unexpected effect” or “discovered a fundamentally new phenomenon” appear punctually. Thus, in September 2010, an international collaboration of CMS sent to the Journal of High Energy Physics the publication that describes the unusual effect in clashes “high multiplicity”. However, according to experts, this phenomenon in general is hardly new, it is adequately interpreted based on known physical laws and theories, rather representing a PR-action to maintain interest in the "Geneva monster" (Oganesyan, 2010). Investors "customize" researchers and explorers mislead the investors by imaginary results. If for "pure" science "a negative result is the same result," then the modern capital-scope of R & D is there almost no margin for error: the investors and the grantors do not give it practically.

5. Social institutionalization: public recognition or rejection or rooting and survival. At this stage, the key factors of success of the new technology become are its image and reputation. Public recognition enables the mass production of high-tech consumer goods (due to the formation of new norms and standards of consumption), and the social rooting (embeddedness) GPT characterizes the processes of routinization and normalization of the related techniques and the ability for life images, as result this technology becomes the basis of various institutions. On this basis, it may arise and start to expand nano industry, institutionally specified, organized on a large scale, mass production of standardized goods and services with nano things almost all spheres of human life (Inshakov, 2010b).

On the contrary, the rejection of the new GPT (despite the extensive research and the investment process) becomes a consequence of the neglect for the marketing and the institutional policies on pre-production stages and is due primarily to concern society risks of innovative products for the consumer health and environmental hazards in their production. Rejected GPT, however, has the prospect of convergence with other, socially neutral technologies.

For the role of the mental ("social" in his terminology) models in the mass social adaptation of new technologies Eggertsson (2011) attracts his attention. In the case of biogenetics in Iceland, he shows that "to promote their own ideas about the proper social model can be achieved by the way of an honest exchange of ideas or because the subjects often mislead others through the deliberate falsification of the information with a view to profit". So far it is not strange that not a single developer of the projections of the future nanotechnology industry "consider in his development scenarios approval of the problem of the nanotechnology by the society, although a lesson should be learning from the history of previously arisen revolutionary technologies such as nuclear power and genetically modified organisms" (Hulman, 2009). Such scenarios are not even articulated to avoid self-fulfilling predictions.

Conclusion

Probably not by chance in 2008 Drexler with his explained vaguely reasons officially renounced the concept of "gray goo" asserting the possibility of self-replicating nanomachines and the global nanotechnology catastrophe. Perhaps the father of nanotechnology heeded the appeals of Roco, who since 2003 in his interviews and articles constantly called him to refute his concept, harming the image of the nanotechnology industry. However, "now nanotech lobby is clearly in a state of fear. Its representatives fear that their PR-activity may result in an even more spectacular failure, than the one that occurred with the genetic engineering" (Allhoff, 2009). Note that, despite their obviously negative image, the cumulative profits of transnational corporations engaged in the development, production and marketing of GMOs more than $ 3-5 billion., And by 2020 can reach $ 50-100 billion. Rejected by the society biogenetics technology to successfully embed to the format of new GPT (in line with the NBIC-convergence) as a nanobiotechnology

Institutional nano industry development logic expresses the non-equilibrium dynamics of the chaotic motion to the order with inevitable mi suboptimal equilibria ("traps"), allowing to understand that in the evolution of technology, as well as "in nature there are no jumps precisely because it is composed entirely of leaps" (Engels, 1953). System interconnection of the technological and socio-economic systems determine the endogenous nature of the institutions (Inshakov, 2007) as a complex factor of the progress of the new technologies of wide application, including nanotechnology.

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