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Institutional anomalies of developing new general-purpose technologies in the early period of digital economy in Russia

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***Abstract* — The paper analyzes institutional anomalies arising in the process of introducing innovative technologies to wider public in the early period of digital technologies. It reveals the problems of transition to a new level of post-institutional economy. The presented research identifies the transformation trends in the institutional environment resulting from the introduction of information and communication technologies enabling to establish new types of open and equitable organizational structures.**

Keywords— institutional anomalies, digital economy, post-institutional economy, artificial intelligence, general-purpose technologies

I. INTRODUCTION

The overwhelming majority of experts assumes that robotics and artificial intelligence will penetrate people's daily life, which is of paramount importance for a number of industries, such as healthcare, transportation and logistics, customer service and household servicing. But even when they are largely consistent with their predictions concerning the evolution of the technology itself, there is still no unanimity about the ways in which advances in artificial intelligence and robotics may affect the economic and labour market prospects over the following decades.

II. METHODOLOGY

The paper applies innovative methodology of post-institutional analysis based on multi-paradigm and interdisciplinary synthesis developed by Professor D. Frolov. The approach suggests an evolutionary transition to overcoming the monoaspectness, dichotomousness, and dogmatism of many concepts of classical institutionalism, including conceptual shifts: from overestimating the role of certain types of institutions to understanding their combinatorial and bricolage nature; from opposing institutions ("game rules") and bodies ("players") to analyzing institutional configurations and ecosystems; from institutionally neutral concepts of sectoral development to reconsidering industries and sectors as stakeholder communities united by technologically related institutions.

The stage of considerable public support, complex formal institutionalization and expansion of GPTs (general-purpose technologies) involves developing strategic documents (initiatives, strategies, programs) of research and infrastructure development, including new GPTs in the priorities of scientific and technical development as well as relevant changes in the policy of budgetary and extra-budgetary (grant and venture) fundng and establishing specialized structures (centres, institutes, departments, etc.) and development institutions. This stage presupposes the risks of public "failures", including incorrect determination of budgetary support priority directions. Even foresight forecasts based on attracting a wide range of experts are not able to realistically anticipate the future of emerging technologies due to the fundamental uncertainty of their development prospects, areas of practical application and commercialization. Foresights are frequently assumed to become a kind of "translators of intellectual fashion", i.e. a pertinent set of inflated expectations in respect to the most rapidly developing technologies ("mass technological mythology") [2, p.20]. Similarly, the 1960s witnessed expectations concerning rapid space exploration, colonizing the Moon and establishing orbital industries as well as the economic development of the ocean bottoms and supersonic passenger air travel, etc. In the 1970s, expectations of an intensive "green revolution" and a solution to the problem of famine on the planet prevailed [2, p.20]. In the 1980s, mass expectations were associated with creating artificial intelligence and large-scale application of

robotics both in production, service and daily life. These high expectations as irrational stereotypes of public consciousness are fixed in stable abnormal forms of mental institutions. Moreover, various interest groups associated with the new GPTs tend to lobby for specific areas of research and development, where they have a competitive advantage, rather than seek to create an objective view of technological development in the course of foresight. As V. May emphasizes, the lack of objective criteria for the identification of technological and sectoral priorities of public support "can only result in prioritizing the sectors possesssing the maximum lobbying capacity" [15, p.74], which will distort the trajectory of the economy technological development affected by the rent-oriented behaviour of industry lobbies. This stage is also characterized by a high probability of misuse of institutions, including manipulation and disguise of their research and business activities that are fairly indirectly related to the new GPTs. This is intrinsically due to the fact that any innovative technologies are the result of technological evolution and are normally of a multi-generational structure. Insufficient consideration of this fact at the stage of formal institutionalization of GPTs results in the fuzziness of institutions (including laws, strategies, etc.), enabling them to be opportunistically manipulated and receive budget support for research and development of a rather conventional nature. Specifically, the classification of bioindustry applied in China takes into account biotechnologies of different generations – conventional, modern and future ones: for example, the former ones include zymolysis technology (enzymes), traditional Chinese medicine (extracts, ointments, etc.) and biologically active additives (nutrients, functional foods, etc.), while the advanced (future) biotechnologies involve bicipitalis, cloning, genome technology, nano-biotechnology, bioenergy, development of bio-computers, etc. [24, p.32]. It is obvious that the volumes and forms of public support for the relevant industries differ significantly. In contrast, the Comprehensive program for the development of biotechnologies in the Russian Federation for the period up to 2020, distinguishes between bioindustry and biotechnology solely in terms of industry type, which obviously creates the risk of dispersing budget funds to support fundamentally different generations of biotechnologies. One of the specific forms of institutional anomalies in the field of high technologies is abnormal collaboration. Collaboration is a creativity-based cooperation in the innovation sphere associated with joint research and development resulting in obtainig a common intellectual product. However, the confidentiality of commercial information and the proprietary (based on private property and patent law) nature of convergent technologies is a major barrier to cooperation which stimulates opportunistic behaviour. However, achieving promising results in fundamental and applied science is hardly possible without collaboration of technological companies, including the involvement of universities and research institutes, since innovation processes in the IT industry are capital-intensive and require the collective use of advanced and costly equipment, as well as building teams of researchers, engineers and marketers to develop marketable ideas [13]. Therefore, distorted models of collaboration are being formed, which are based on the intricate balance of cooperation, opportunism and fraud.

Another aspect which is worth stressing is the risks of a specific inter-institutional "gap" in the GPTs evolution at the stage in question. As Y. Sergienko points out, in the course of the emerging technological mode (and the corresponding GPTs) innovators act in the conditions of tough resource and, more specifically, financial restrictions that trtigger their cooperation as well as creation of informal groups and institutions. With the expansion of the new GPTs information field and strenthening public support, creditors (banks, venture funds, etc.) are increasingly turning to innovators and providing regular support for their projects. As a result, the innovators' need for institutions of informal cooperation is deminishing as they move to competition in the formal legal framework [21, pp. 66-73]. The success at the stage of the new GPTs institutionalization depends to a greater extent on the costs of transition from dominating of informal institutions to prevailing of formal ones.

The stage of attrating large private capital and arising "techno-bunkum" and "herd effect" involves a qualitative increase in the investment activity of private business against the excessively optimistic forecasts of the GPTs development, a sharp increase in the number of stakeholders (from researchers to speculators), a start-up "boom", emergence of new markets and their niche structure deepening. This translates into reassessment of the GPTs potential, feasible adjustment of forecasts and rationing the volume and structure of the investments. The major institutional anomaly at this stage is the market "meltdown", the venture capital market and the stock market in particular. Thus, in the late 1990s, affected by general euphoria in anticipation of the onset of the "new economy", predicted by numerous experts, share prices of Internet companies (dot-com companies) skyrocketed followed by the 2000 NASDAQ index slump. Furthermore, investors were willing to invest in virtually any projects related to information technologies (IT) and e-commerce, while start-ups channeled a major portion of the attracted investments to advertising and brand promotion. According to K. Peres, this trend is peculiar not only of IT, but also of all emerging technologies claiming the status of GPTs [19, pp151-166]. Inflated expectations, based on the unconditional belief in continuing technological progress [20, p.9], cumulatively increase and result in inflating financial "bubbles" which subsequently has a negative effect on the GPTs rates and development trends. Along with that, this stage undergoes high risks of the innovation commercialization mechanism dysfunctions based on the new GPTs, which, in their turn, are characterized by the overshooting effect. The essence of this effect consists in supplying the market with the goods whose technological parameters significantly exceed the needs of target audiences [9]. In N. Karr's view, for instance, users' needs in the IT field do not comply with Moore's law, according to which the computers performance is increasing exponentially and doubles every two years [12, p.54]. As a result of this discrepancy, excessively functional models of computer equipment become unclaimed at some point and are squeezed out of the market by cheaper analogues. This is where the loopholes and vagueness of the regulatory framework and

development institutions dysfunction may appear, which is due to considerable slackness and, as a consequence, low adaptability of the institutional structure, as compared to the technological structure of the economy.

The following stage of social institutionalization is associated either with social recognition and "entrenchment" of GPT or its rejection and survival. At this stage of institutionalization of the new GPTs its compliance with public expectations, ideas, beliefs and values is vital. Hence, it is hardly possible to overestimate the major role of image, reputation and social capital (i.e. the resource to support a loyal social base). In the case of a new GPT, people face (as in the case of any new phenomenon) considerable uncertainty at the stage of its large-scale implementation and application in various spheres, which spurs mental anomalies: irrational beliefs, negative stereotypes and technophobia.The 1980s, in particular, witnessed pervasive "radio-phobia" and expectations of "curtailing" research and projects in the power industry [2, p.20], while in the 1990s destructive stereotypes arose in relation to genetic engineering and genetically modified organisms, thus dramatically hindering the progress in biotechnology.

Misconceptions about the new GPTs tend to dynamically develop into mass stereotypes, the change of which is an extremely challenging task. Therefore, T. Eggertsson considers the belief aimed at creating new perceptions and changing established public ones to be a fundamentally important, although a commonly neglected tool for institutionalizing innovative technologies [10, p.12]. Social legitimization (recognition and approval) of GPTs means they possess a strong social basis, which, on the one hand, enables to exercise mass production of high-tech consumer goods in high demand, which will be maintained through establishing new norms, models and standards of consumption. On the other hand, the "entrenchment" of GPTs in society involves expanding activities based on or related to it (professions, consumption and leisure patterns, types of businesses, etc.), i.e. institutions. For example, the success of the Internet technologies is mainly attributed to their deep integration into the system of social division and life-sustaining cooperation, which has resulted not only in a wide range of specialties and professions, types of e-business and service, but also in the numerous forms of Internet-related behaviour (web-surfing, online shopping, online banking, blogging, role-playing online games, social networking, the use of mobile applications for self-development, etc.). Consequently, these technologies have formed the basis of routinized (habitual) practices of most people’s daily life. However, new GPTs often generate destructive patterns of behaviour. For instance, "the Web is able to emphasize negative behavioural patterns or even create unpredictable social pathologies" [14, p.107], such as grabbing (interception of Internet traffic), spamming (mass mailing of advertising messages), physhing (illegal acceess to logins and passwords), trolling (posting provocative messages), carding (theft of funds from electronic accounts and bank cards), etc.

For evolutionary economists, economic or social systems are more complex than biological ones [1, pp. 79-88]. The basic element of the institutional economy is the institution, whether it is explicit or implicit, structured or informal. Currently, the most important aspect lies in the fact that due to the massive introduction of digital technologies, automation and robotics of various processes, there arise many institutional anomalies as well as changes in the concept of the structure and meaning of an institution. The problem of an institution formation, commonly known as mechanism changes or market changes, is a broad subject covering mathematical models in economics [16], behavioural economics [23] and experimental economics [22]. However, the essence of the problem touched upon by Ostrom [17], is the following: if the persons developing and changing the rules do not understand in which way specific combinations of rules affect the actions and results in a particular ecological and cultural environment, changes in the rules can cause unexpected and sometimes disastrous effects. In our view, it is this aspect which is crucial for building the post-institutional economy.

To solve the problem caused by technological and economic changes, one should develop fundamentally new views on building a post-institutional system. Despite the prevailing inequality among countries, many of them become even more affluent due to the introduction of new technologies into production. In this regard, one trend is obvious – a greater opportunity for building social production or P2P economy facilitated by economic mechanisms as a promising opportunity to open previously unavailable economic capacities and provide people with something significant in the automated future. In P2P systems, production belongs to the collective, it is horizontal and focused on social value, with accounting being transparent, distributed and pluralistic, thus being beneficial for a society. This process is known as commons-based peer production (CBPP) or social production, a term coined by lawyer Yochai Benkler [5] who describes a way to create and distribute value. P2P infrastructure enables people to communicate, organize themselves and ultimately create the value together in the form of digital knowledge, software and design. Wikipedia, free open-source projects like Linux, Apache, Mozilla Firefox or WordPress, open source communities like Wikihouse, RepRap and Farm Hack can serve as examples.

The "peer partner" model is an encouraging model for post-labour or post-capitalist societies, as it does not necessarily require the proper functioning of markets and monetary transactions. Peer-to-peer production can be defined as a distributed network of free participation of equal partners [18, 31-51]. Participants are engaged in the production of shared resources without monetary compensation as a key motivating factor. Peer-to-peer production creates "Commons" (shared, free resources) that rely on social relationships rather than on pricing mechanisms or management teams to allocate resources.

Since the formation of P2P system is based on informal social relations, its organizational model can be described as an open type of cooperation of self-organizing communities. Based on the literature review [11, pp. 535-547], open collaborations are described as systems that 1) support collective product manufacturing, 2) through a technologically mediated collaborative platform, 3) represent a low barrier to entry and exit, and 4) support the emergence of resilient but malleable social structures. The collective production of a product often tends towards originality, which implies that the

products are not aimed at the mass market, but rather at small audiences who share common tastes and values with the community of producers. This points to a future where the public sphere of labour and the economy merges with the private sphere of leisure - producers and consumers will not be separated to the extent they are today. Producers and consumers will become a common community. This uniqueness of products co-production can transform into an attractive opportunity to create a common market. Budhathoki and Haythornthwaite [6, pp. 548-575] put forward a common "unique idea" of outstanding ideals, values, beliefs and feelings in open cooperation projects as one of the key incentives for participation. Open collaboration usually takes place on technology-mediated platforms, as network communications enable participation of numerous users, efficient distribution of tasks and highly developed specialization. However, "closely related" tasks that require iterative feedback between participants may require physical interaction instead of mediated interaction. This means that the more unique the products are, the more open collaboration takes place in physical environment. This indicates a future where work is organized around communities rather than around "jobs." Mild division of labour ensures demand for the niche while several barriers to entry and exit in open collaboration still exist. Such state of affairs ensures easy access to work. Newcomers choose to visit frequently and are internally motivated, for example, by building a reputation, pleasure or need for a product. As the project continues, active participants tend to develop a common identity and are increasingly guided by the community, collaborative learning and professional development. However, this creates a problem for the socialization of newcomers, for whom the norms, social structures and things to be done are still difficult to understand. Open collaboration can sometimes be exclusive. This implies new inequalities in future work, where lifestyles and values become a qualification instead of an "objective" competence. Open cooperation is based on permanent but flexible social structures. This emphasizes the importance of communication flows between participants. Social structures of this kind are commonly achieved through negotiation and revision of community norms and administrative structures. Such structures require leaders, as any organization does, but leadership is often shared among the process participants. This implies a future organization of work based on ubiquitous and distributed communication, as well as the growing symbolic nature of the work. Joint training and open collaboration are expected to become more common in the future, especially due to economic, technological and cultural factors. Economic value is increasingly growing from intangible production and creative industries (the economic driver). A wide application of information and communication technologies enables to create new types of open and equitable organizational structures and place the means of production in the hands of citizens (the technological driver). People's values shift toward self-expression and internal incentives in their professional occupation (the cultural driver). Open collaboration includes such motivators as self-development, recreation and entertainment [6]. According to the research conducted by Benkler [3, p.429], joint, non-market and non-proprietary production may become not only a possible, but also a dominant form of production and organization in the future which is based on the assumption that human creativity and the information economy have become the major structuring approach of our economy. Such production will arise as the third way of organizing production along with the market and bureaucracy due to the nature of information. In markets, the distribution of products is carried out by means of price signals, while in the bureaucracy it is achieved through management decisions. In the peer-to-peer model, the distribution is self-organized: manufacturers decide what they do, in which way and who with. Benkler argues that self-organization is the most effective way of dealing with information products. Information and culture are social resources by their nature as they are not scarce and their consumption does not prevent others from consuming them - they are not rivals. Thus, the marginal costs of information products are close to zero. Supply and demand, which set the price for a product, impose certain limitations. Since information is not scarce and uncompetitive, intellectual property rights have been established to provide information products to the price. This, however, leads to reduced use of information. If the information is free or of low price, it is more widely disseminated and used more efficiently. The production of new information is based on the information available, and therefore, the more information is available, the better product will be manufactured. The insufficient resource that remains in intangible production is human creativity, which is best applied under conditions of free information and self-organization. This can be explained by two features. Since creativity and culture are based on existing human capital and cultural resources, the more cultural content is available, the better they nourish creativity and the creation of a new culture. Self-organization of manufacturers provides a free flow of information better than traditional organizations that seek to store information for themselves. Secondly, creativity is very difficult for managers to standardize and administer. People know their creativity and, thus, the best way to organize creative work is to let people decide which projects to work on and how. Moreover, when the flow of information is free, potential producers and suitable projects can be effectively coordinated.

III. CONCLUSION

This "new economy" of joint production and open cooperation also extends to the sphere of culture and values. According to Benkler [4], an open network information environment will make culture more democratic, participatory, transparent and malleable. As for the network society [7], we are bound to witness the emergence of a new folk culture, where, by participating in the creation of a common culture and finding a meaning, self-organizing citizens will also create a culture that is much more of their own than the industrial type of mass media [4]. As identities and values are commonly co-built, and effective ICTs enable people to communicate in a more flexible way, people can better form communities with like-minded people [8]. In the new "people's culture" the identity will be based on such mass communities rather than on a nuclear family and industrial organization. To conclude, people and their communities will be empowered as the major driving force of the network information economy.

IV. APPLICATION

The results may be applied to distributing the new model of implementing the interests and rights of the digital economy subjects in the process of neo-industrialization within the whole country. This might ensure increased efficiency of the Russian society's response to major challenges, taking into account the interaction between the person and nature, person and technology, and social institutions at the present stage of global development.

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