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Modern experience in the use of organizational & economic mechanism of regulation of the process of fundamental scientific knowledge' production

Introduction

FSR – primary research, experimental or theoretical work carried out by curious researchers (curiosity driven research) to obtain new knowledge about the basic properties of phenomena and observed facts without any specific purpose, which are regarded as a pure public good (Oslo manual, 2005). Characteristic features of the current stage of formation of the knowledge economy are the transformation of FSR from a kind of peripheral elite activity to the main reference point for the development of postmodern cognitive society.

The process of institutionalization of FSR begins in the ancient period with the introduction of the practice of critical discussion of the conditions for obtaining true knowledge. The central problem for the philosophers of ancient Greece, Rome, Babylon, Egypt, China (to one degree or another) is the relationship between knowledge of different kinds: objective, problematic, illusory, erroneous, unreliable.

The development of the theory of cognition in the New Age, the search by thinkers of this time for reliable knowledge, a radical renewal of the FSR paradigm is explained by the fact that they need a thorough justification of the whole body of accumulated knowledge, their evaluation by truth. Analysis of the problems of the theory of cognition in relation to the peculiarities of the implementation of FSR in the philosophy of the twentieth century also characterized by several features.

Although the Marxist-Leninist current of philosophy declared classical German philosophy one of its sources, its classics substantiated the fundamental difference between dialectical materialism (Marx & Engels line) and epistemological idealism (Kant & Hegel line) in matters of the development of the theory of cognition directly related to cognition.

From the point of view of modern theorists and practitioners – Karl Raimund Popper (1902–1994), Imre Lakatos (1922–1974), Thomas Samuel Kuhn (1922–1996), Paul Karl Feyerabend (1924–1994) – the potential of FSR is the ability to intensify the processes of purposeful, costly, long-term nonlinear, multi-stage and cumulative learning, which leads to interactive, technologically specialized, and culturally innovative academic activities. The purpose of FSR is the formation of pure public goods of knowledge, which are characterized as social, indivisible, total and non-exclusive, non-overloaded, indiscriminate in consumption, non-competitive, localized by the elite scientific community, associated with interdependent advance funding, temporary indefinite uses however, potentially capable of its unlimited accumulation. FSK is an asset with an expected high potential for value added, accompanied by a social effect in the case of use, relatively low costs of restricting access to it for consumers. Effective provision and dissemination of FSK takes place with the mixed participation of innovative institutional agents of the national economy, and the benefits of its use in the case of disclosure are shared throughout society, regardless of whether individuals want to buy it or not.

The modern landscape of research on the peculiarities of the implementation of FND is also formed under the influence of the theoretical positions of the supporters of neo-Kantian "pure epistemology" identification of philosophy with the theory of knowledge (Bogomolov, 1969); their critics from the camp of transcendental phenomenologists-ontologists (Husserl, 1994), psychologists-empiricists (Frank, 2007); representatives of the conglomerate of idealistic empiricism and ontology – empiriocritics, English neorealists, "sensibilists", American neorealists (James & Russell, 2010; Bogomolov, 1962); linguistic analysts (Gryaznova, 1993); followers of the line: positivism (Narsky, 1961) – neopositivism of scientific logical positivism (Ayer, 1959; Achinstein & Barker, 1969) – linguistic philosophy (Charlesworth, 1959) – logical pragmatism of the variability of truth (instrumentalism, fallibism, anti-realism, radical empiricism, verificationism) (Dewey, 2001) – postpositivism (Panin, 1981; Carnap, 1971).

The main currents of modern epistemology in the field of FSR are quite fully represented by the followers of the cognitive-evolutionary approach to the process of cognition (Piaget, 1971; Lorenz, 1978); interpreters of the phenomenon of knowledge from the standpoint of natural selection and epigenetic rules (Ruse, 2009); interpretation of cognition as a result of biological evolution (Vollmer, 1998); reconstructs of the growth of scientific knowledge on the basis of evolutionary theories (Campbell, 1980; Toulmin, 1978; Holton, 1988; Laudan, 1966; Polanyi, 1985; Hanson, 1970).

Regardless of the theoretical position, researchers unanimously recognize the proactive nature of the functions of the FSR, which are the constant expansion of public consumption resources and the formation of knowledge-intensive sources of increasing the level of collective welfare; promoting consolidated and sustainable development (Arsawan et al., 2020); management of the design and structure of the complex of unproduced assets of national wealth; goods produced by the real sector

of the national economy / services provided by the social sector of the economy; tangible and intangible assets with high potential for value added production.

At the same time, research conducted in this direction provides for the sharpening of attention on the practical implementation of the processes of formation of high-tech services based on the use of basic concepts and meeting consumer expectations in them; development of logically substantiated fundamental science theory of formation, updating and use of FSK, concepts and sensory-image models of "scientific picture of the world" with possibilities of further use in public practice; increasing the level of trust and reciprocity, improving the physical and psychological well-being of members of online communities by establishing relations of understanding and mutual support of social and scientific capital – participants in the formation of intellectual potential of local social networks of institutional agents of post-industrial knowledge economy.

Methodology

The research methodology is based on the implementation of the approach according to which the OEMR FSR is considered as a structured system of means of administrative and indicative influence on management entities whose activities focus on heuristic aspects of cognitive mobility to promote processes of systemic objectification of basic structures of nature, society and thinking, verbalization of conceptual components, cyclic updating of subject content of branch subsystems of knowledge, assistance of process of creation of objective representations of reality, formation of abstract images of reality with observance of dynamically updating value criteria of rationality of results of research programs. Substantive regulation is subject to the goal of improving the level and quality of meeting the vital needs of society in the process of providing public goods, adequate reflection of the objective picture of the universe, organizing on this basis effective practical and transformative activities to form the maximum possible level of welfare economy, increase of social capital of multilevel innovation-oriented socio vital ecosystems (IOSVES) of post-industrial economy. The peculiarity of OEMR FSR is the subordination of economic tools of management influence of regulatory entities – conjunctural policy of short-term countercyclical regulation, means of medium-term and long-term targeted regulation of structural policy and general stimulation of growth in the long run – cyclically organized organizational activities in the field of strategic R&D and stakeholders of poetic activity, portfolio management, process, R&D functions in order to consistently go through stages (a) encouraging prone to informal FSR; (b) introduction of a formal FSR management system; (c) institutionalization of structures for the promotion of FSK.

Results

The form of public regulation of FSR is defined as a means of influencing the subject of regulation on its object, which is embodied in a specific way of implementing

immanent/delegated powers to streamline the activities of social networks (SN) to encourage the desired model of social competencies and inclusive competencies by carriers of disconnecting exclusive social capital (DESC) within the functioning of multilevel IOSVES (Malakhovskyi et al., 2018).

Specific forms of regulation of FSR can be represented by (I) means of direct administrative influence, formal solidarity, external value orientation and motivation of FSR entities, aimed at using the power of competence to form and use basic competencies in the field of production of FSK; (II) methods of indirect regulatory influence, contractual solidarity of FSR entities within the functioning of voluntary / temporary professional SN production of FSK, internal value and identification orientation of FSR performers, stimulation of measures to implement global standards of practical and transformative competencies of FSR entities in the field of FSK formation (Fig. 1).

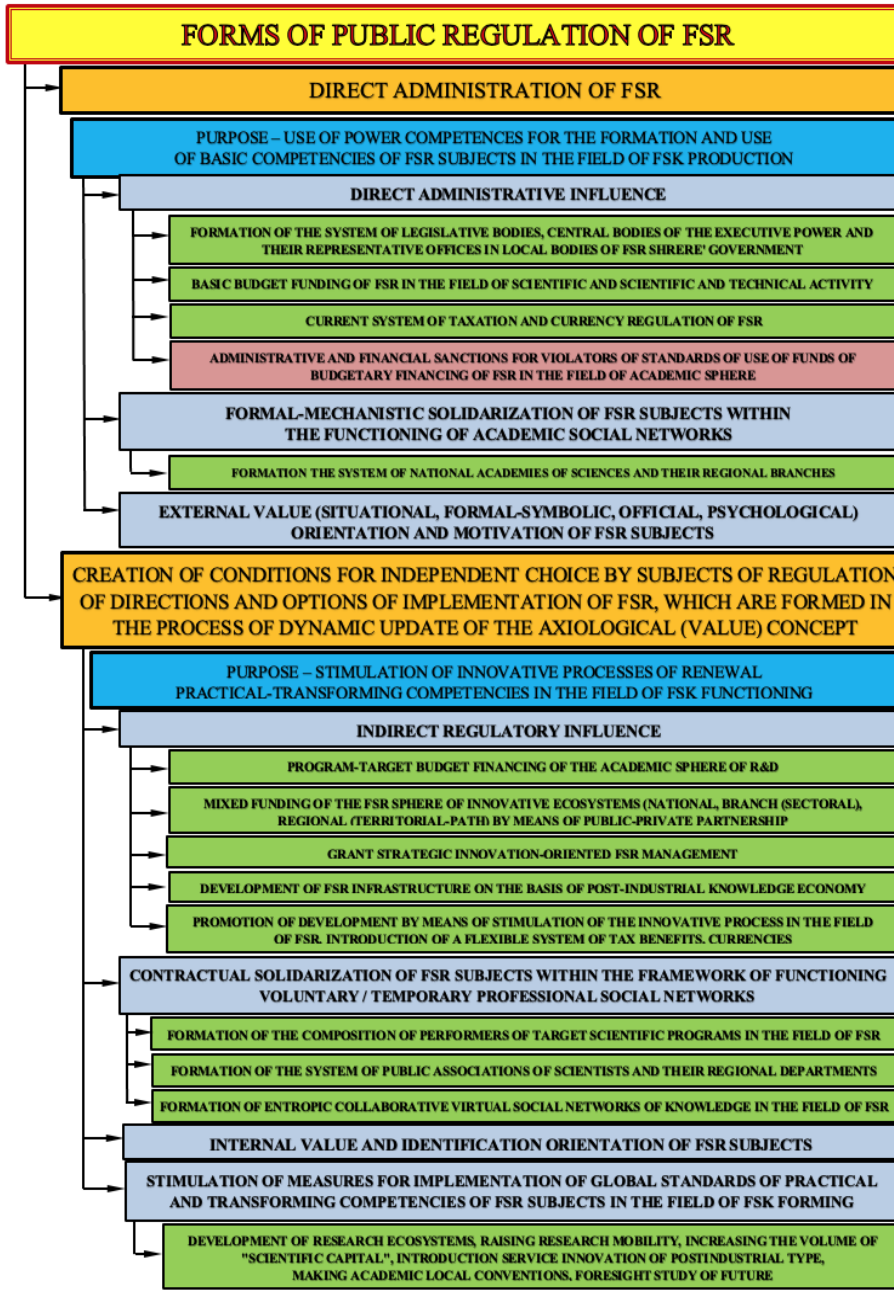

Figure 1. Forms and content of levers of public regulation of the FSR sphere

Source: Author's illustration.

National models of FND' regulation fully consider the specifics of the use of forms of direct & indirect influences, largely determined by the characteristics of science & technology policy of the state, as well as the framework of accepted models of national policy in the field of socio-centric professional networks in public sphere of national economy (Fig. 2).

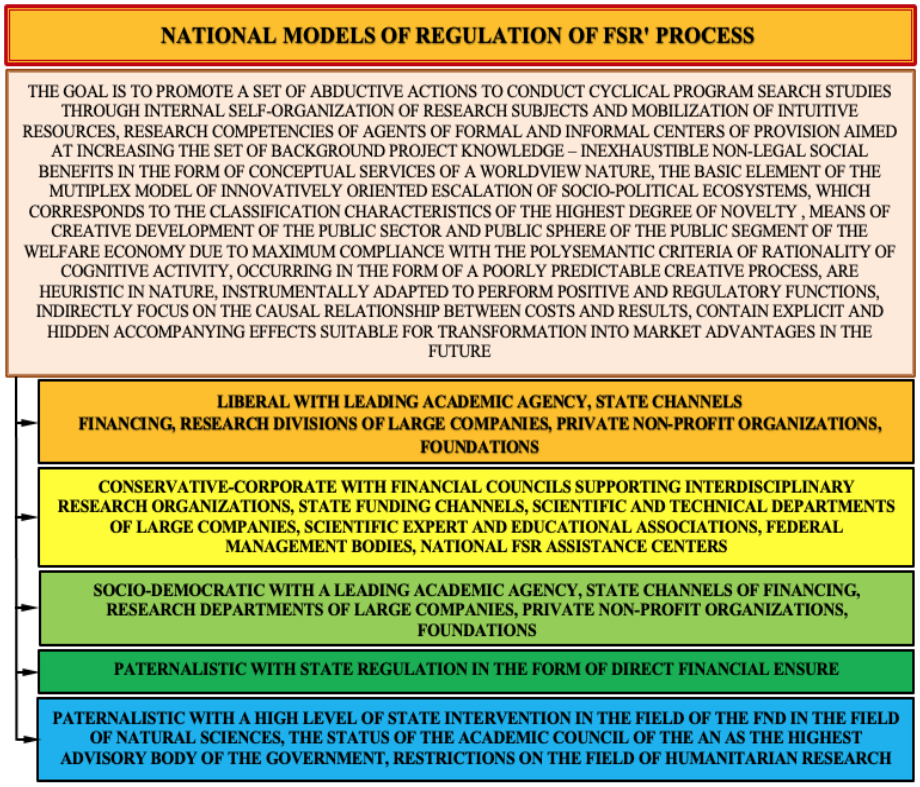

Figure 2. Features of national models of FSR regulation

Source: Author's illustration.

Liberal national models of FSR regulation, which act as the basic elements of the national innovative system (NIS) in USA, Canada, Australia, New Zealand, Taiwan, provide for the functioning of a complex system of cooperation between institutional agents of national economy, which are represented by central academic agencies with methodological and regulatory functions, mainly state funding channels, as well as partial delegation of certain areas of the R&D of large industrial companies, noncommercial organizations, self-governing scientific funds (Filstein, 2016; Shapira & Youtie, 2010). The peculiarity of the models is a powerful infrastructure in the form of banking institutions, noncommercial organizations in the form of

institutions for the protection of intellectual property rights, standardization, development of norms and standards. Representatives of models from the demand side are consumers (B2C), producers (B2B), central executive authorities (B2G), supervisory public bodies (B2nC). Framework agreements on the implementation of the FSR are determined by functioning taxation systems, values and peculiarities of organizational culture of activity, peculiarities of labor market segmentation, specific activities of public/professional associations of researchers.

For example, activities in the field of FSR in the USA are concentrated mainly in the scientific departments of 10 leading universities (17% of all completed works). At the same time, the 100 largest higher education authorities master about 80% of all the costs of fundamental and applied science in system of higher education in country. R&D outside the 235 largest U.S. healed cities is virtually non-performing. The current strategic policy for conducting the FSR is governed by the U.S. Competitiveness Act (Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science – COMPETES Act 2007), which streamlines the organization of research by higher education institutions and state R&D laboratories, the implementation of tax/credit programs in the field of FSR, training of highly qualified scientific and engineering personnel.

The new version of the Law of 2011 envisaged the introduction of certain innovations in matters of the FSR, namely: strengthening the orientation of federal allocations to promising developments, establishing the Partnership for Advanced Manufacturing Technologies Management Council 2.0 (AMR 2.0), forming a nationwide network of industrial innovations, strengthening control by the US Congress on the FSR grant distribution system funded by the National Science Foundation (NSF) with a focus on the implementation of priority research. The area of interest was limited to the special provisions of the COMPETES Act 2015: "Increasing economic competitiveness"; "Improving the health and well-being of society"; "Training of national stem personnel (Science, technics, engineering & mathematic), which is competitive in the international market"; "Improving the level of scientific education and involving the public in science and technology"; "Expanding cooperation between the scientific community and the industry of the country"; "Ensuring national defense of the country"; "Promoting the progress of science".

In the formation of FSR policy, the leading role belongs to the National Academy of Sciences of the United States (USA' NAS) – a union of three academies (sciences, engineering and medical), which relies on the role of consultant on solving complex social and scientific problems. The main providers of funds for the implementation of the FSR are the central government of the United States and individual governments (60% of the total funding). The FSR moderators are the National Institutes of Health/State Department of Health and Human Services (NIH/HHS) of the United States (46% of the FSR), as well as the NSF (13.5% of the FSR). Fundamental researches are carried out in the following areas: (a) branches of science (computer, environmental sciences, life sciences, mathematics, physics, psychology, social sciences, general sciences) (79%), (b) engineering research (aviation, biology,

biomedicine, chemistry, electrical engineering, electronics, mechanics, materials science, general engineering) (16%), (c) other areas (business, management, communications, education, humanities, legal research, social sciences, art) (5%).

Conservative corporate, otherwise, continental models with financial councils supporting interdisciplinary R&D organizations, state funding channels, scientific and technical units of large companies, scientific and educational associations, federal management bodies, national FSR assistance centers are practiced in the UK, France, Germany, Argentina, Malaysia, Poland.

The FSR in the UK has an extensive complex structure, the regulation of which is carried out on the basis of a number of key documents in the field of science and technology of the country in recent years:

- Innovation and Research Strategy for Growth 2011, which set benchmarks for current initiatives and the government's science, technology and innovation program;
- The UK Industrial Strategy, adopted in September 2012, proposes a number of measures aimed at promoting entrepreneurship, as well as to settle support for fundamental scientific research by the government;
- New Strategy "UK Growth Plan 2014–2024: Science and Innovation" (Our Plan for Growth: Science&Innovation) of 17 December 2014, developed by the UK Ministry of Finance (Treasure) together with the Ministry of Entrepreneurship innovation and craft. In March 2014, the Annual Innovation Report was published, and the UK Growth Plan was supplemented with a evidence paper containing reference information supplementing the main provisions of the Strategy. Closely related to the updated industrial strategy, the Growth Strategy is based on the "Vision of Scientific Research in the United Kingdom" – a document on the prospects for the development of the country's research infrastructure by 2021, which includes long-term scenarios for financing FSR megaprojects within the framework of the "Innovation Union" and Program "Horizon 2020".

In the context of activities in six main areas of "creating the most favorable environment for science and business in the country" for the next decade: (i) development of priorities; (ii) "growing" scientific talents; (iii) investments in scientific infrastructure; (iv) state support for scientific research; (v) accelerating the innovation process; (vi) participation in global scientific and innovative cooperation, continues to implement joint interdisciplinary initiatives of the country's research councils, which receive significant financial support in the areas of the FSR: aging: lifelong health and well-being; digital economy; stable energy; food security; global uncertainty (security); living under conditions of environmental changes; nano science: from development to application of results.

According to the Law of the French Republic on Higher Education and Research of June 22, 2013, the country implements a plan for the transition to a system of medium-duration contracts, which are based on the plans of institutional

development agreed by the government and universities within the functioning of the FSR system of a number of related countries' IO(A)NE:

- Ministry of Higher Education and Research (Ministère de l'enseignement supérieur et de la recherche) as a center for identifying and implementing policies of national FSR and innovation activities;
- other ministries participating in the FSR: Ministry of Environment, Energy and Seas (Ministère de l'Environnement, de l'Énergie et de la Mer), Ministry of Economy and Finance (Ministère de l'Économie et des Finances), Ministry of Agriculture, Food and Forestry (Ministère de l'Agriculture, de l'Agroalimentaire et de la Foret);
- Strategic Council (Conseil stratégique de la recherche) under the Prime Minister, whose functions include orienteering the National Strategy in the field of the FSR and participating in their assessment;
- High Council for the Evaluation of Research and Higher Education (Haut Conseil de l'évaluation de la recherche et de l'enseignement supérieur), which is relied upon by the functions of analyzing the activities of the Research Institute in the field of FSR, individual research teams and higher education institutions;
- National Council of Universities (Conseil national des universités), which evaluates the activities of professors.

Socio-democratic with a leading academic agency, state funding channels, research departments of large companies, private non-profit organizations and funds models are common in the system of 5 Royal academies of Belgium and the Royal Lyège Scientific Society; Academy of Sciences and Arts of Bosnia and Herzegovina, Academy of Greece, Academies of Sciences of Denmark, Institute and 9 Branch Academies of Spain, systems of academic institutions in Italy, Cameroon Academy of Sciences, National Academy of Sciences of Kenya, Royal Dutch Scientific Society and 2 Royal Academies of Sciences of the Netherlands, Academy of Sciences of Lisbon and Portuguese Academy of History, Slovakia, Swedish Academy, 5 branch sciences and academic Society of naval sciences of Sweden.

The paternalistic model of FSR state regulation in the form of direct financial support is used in Indonesia, South Korea, the Russian Federation, Singapore, Uganda, Japan, and Ukraine.

In the system of management of social and economic development of the Republic of Korea, one of the key bodies is the Ministry of Science, ICT and Planning of the Future, which is responsible for the development, implementation, coordination and evaluation of the results of the implementation of state policy in the field of FSR. At the parliamentary level, effective governance is ensured by joint actions of the Committee on Science, Technology, Broadcasting and Communications (competence issues of the Ministry of Science, ICT and Future Planning), as well as the Committee on Trade, Industry and Energy (competence issues of the Ministry of Trade, Industry and Energy). At the same time, the Ministry of Science, ICT and Future Planning are concerned with the development of the FND and the

management of 25 state-funded research institutes, coordinating the processes of distribution of financial resources together with the National Scientific and Technological Council. Significant resources of the FSR are also at the disposal of the Ministry of Trade, Industry and Energy; Ministry of Health and Welfare; Ministry of Environment; Ministry of Defence; Ministry of Agriculture, Food and Rural Affairs; Ministry of Maritime Affairs and Fisheries.

The Korea Research Council for Fundamental Science and Technology and the Korea Research Council for Industrial Science and Technology have been established to effectively manage the activities of organizations implementing the FSR. The consultants of their activities are the Korean Foundation of S&T Societies, the Korean Academy of S&T, academic associations in the field of science and technology. The Science and Technology Policy Institute is actively involved in the development of innovation policy.

South Korea's scientific and technological priorities in the field of FSR are: increased investment; development of original key technical solutions; creation of an international zone of science and business; further development of the FSR in the field of nuclear safety; autonomous creation of a Korean space launch vehicle; creation of artificial satellites of the Earth; creation of world-class research universities. Korea's cooperation with world-class laboratories is supported by means of implementing its own "Global Research Laboratory Program" with the possibility of obtaining funds in the amount of up to 585 thousand $ for successful researchers who need cooperation with foreign laboratories annually for up to 6 years.

A paternalistic model with a high level of state intervention in the field of FSR in the field of natural sciences, the status of the Academic Council of the National Academy of Sciences as the highest advisory body of the government, the restriction of the field of humanitarian research is implemented in Afghanistan, Guatemala, the People's Republic of China, Colombia, Philippines, Sri Lanka.

Over the past 20 years, China has made a significant breakthrough in the field of science and technology. Annually, the funds directed to finance the Fed increase in the country by 20%. Instead, Chinese scientists made several important discoveries. For example, in the field of FSR, these may include the discovery of quantum abnormal Hall effect, high-temperature superconductivity in Fe-based materials, a new type of neutron oscillation, the method of induction of plurypotent barrel cells and the crystalline structure of the human glucose carrier GLUT1, the space program of manned flights (Petrova et al., 2020).

The leading role in the implementation of the FSR regulation policy in the PRC is played by the implementation by the Ministry of Science and Technology of the list of strategic tasks for the implementation of which the tools of key National programs are used: (I) Technological Sciences and Developments (National Key Technologies R&D Program); (2) High-Tech R&D Program; (II) Projects in the field of fundamental research (National Program on Key Basic Research Projects), as well as accompanying programs (i) "Creation of scientific and technological infrastructure"

(Construction of S&T Infrastructures), (ii) "Creation of scientific and technological industrial environment" (Construction of S&T Industrial Environment).

Conclusion

Although the national models of the FSR regulation differ slightly in terms of principles, goals and constituent elements, they comprehensively take into account the specifics of the use of direct and indirect forms, largely determined by the peculiarities of the state's science and technical policy, according to the final account, the framework of adopted models for the implementation of national policy in the field of formation of the social capital of sociocentric professional networks of the public sphere of national economy. Such, as follows from the research of manifestations of FSR phenomenon, differ national varieties of neoliberal, conservative-corporatist (continental), socio-democratic and paternalistic model of optimization of transformational costs from circulation and final consumption of goods /services of institutional actors of multi-complex market economy at the level of its public sector in the context of implementation of socio-economic policy of the state with a conscious focus on the level of decommodation, stratification of society, the degree of interference of central executive bodies and local self-government bodies in regulation of markets. The characteristic features of the models are objectively limited opportunities for using the market mechanism of public private partnership, attracting innovative models of FSR financing, specific features of the application of the principles of strategic and production management by the activities of partnership entities, ensuring stakeholder requests, the need for retrospective and informational support of FSK production processes with the involvement of the academic environment, the use of intensive exchange of scientific information, tools of futurological technological intelligence, Foresight research et al.

Abstrakt

Nowoczesne doświadczenie w stosowaniu organizacyjno-ekonomicznego mechanizmu regulacji procesu wytwarzania podstawowej wiedzy naukowej

Przedmiotem badań są międzynarodowe porównania modeli organizacyjnego i ekonomicznego mechanizmu regulacji (OEMR) procesów wytwarzania podstawowej wiedzy naukowej (PVN) podczas organizacji podstawowych badań naukowych (PBN) przez instytucje akademickie. Ostateczny cel rozwoju OEMR i zadanie prowadzenia PBN jest sformułowany. Hipoteza o możliwości skutecznego wdrożenia OEMR PBN w przypadku jasnego zdefiniowania podmiotów i form regulacji jest uzasadniona. Teza o celowości strukturyzacji OEMR PBN z wyodrębnieniem poziomów systematyzacji wiedzy naukowej jako przedmiotu regulacji, elementów pojęciowych, zawartości przedmiotowej podsystemów PVN, elementów cyklu formowania PVN w procesie rozwiązywania częściowych problemów poznawczych podstawowych teorii naukowych (PTN), zasad i kryteriów poziomów funkcjonalnych oraz

kryteriów zapewniających skuteczność niemonotonicznego PBN, wyróżniająca narzędzia do stosowania funkcji analitycznych i regulacyjnych.

Metoda badawcza polega na uogólnieniu cech krajowych modeli publicznej regulacji PBN, które różnią się proporcjami i kombinacją metod bezpośredniej administracji oraz stwarzają warunki do samodzielnego wyboru kierunków i opcji BSP pod wpływem dynamicznej aktualizacji koncepcji aksjologicznej PBN. Istnieją metody wykorzystania kompetencji władzy do formowania i wykorzystywania podstawowych kompetencji badawczych podmiotów PBN w zakresie produkcji PBN – bezpośredni wpływ administracyjny, formalno-mechanistyczna solidarność podmiotów w ramach funkcjonowania akademickich sieci badawczych, orientacja na wartości zewnętrzne i motywacja przedmiotów PBN. Lista metod stymulowania innowacyjnej odnowy kompetencji praktycznych i transformacyjnych w zakresie funkcjonowania PVN obejmuje metody pośredniego wpływu regulacyjnego, umowna solidarność podmiotów PBN w ramach funkcjonowania dobrowolnych/tymczasowych profesjonalnych sieci badawczych, wewnętrzna orientacja wartości i identyfikacji podmiotów PBN, światowe standardy praktycznych i transformacyjnych kompetencji podmiotów PBN w zakresie tworzenia PVN.

Wynikiem badania jest identyfikacja głównych typów modeli ze szczegółowym opisem praktycznych zasad wdrażania PBN w krajach, które je reprezentują. Różnica w potencjale wdrożenia PBN zależy od zdolności instytucji krajowych do organizowania procesów prowadzenia cyklicznych badań programowych w celu zwiększenia tła wiedzy projektowej o najbardziej uniwersalnym charakterze.

Słowa kluczowe: podstawowe badania naukowe (PBN), modele PBN, formularze PBN, mechanizm organizacyjno-ekonomiczny regulacji PBN

Abstract

Modern experience in the use of organizational & economic mechanism of regulation of the process of fundamental scientific knowledge' production

The subject of the research is cross-country comparisons of models of organizational and economic mechanism of regulation (OEMR) of processes of production of fundamental scientific knowledge (FSK) during the organization of basic scientific research (FSR) by academic institutions. The ultimate goal of the development of OEMR and the task of conducting FSR is formulated. The hypothesis about the possibility of effective implementation of OEMR FSR in the case of clear definition of subjects and forms of regulation is substantiated. The thesis on the expediency of structuring OEMR FSR with the separation of levels of systematization of scientific knowledge as an object of regulation, conceptual components, subject content of FSK subsystems, elements of the FSK formation cycle in the process of solving partial cognitive problems of fundamental scientific theories (FNT), functional levels principles and criteria for ensuring the effectiveness of non-monotonic abductive FSR, distinguishing tools for providing analytical and regulatory functions.

The research method is to generalize the features of national models of public regulation of FSR, which differ in proportions and combination of methods of direct administration and create conditions for independent choice of subjects of directions and options of R&D under the influence of dynamic updating of axiological concept of FSR. There are methods of using power competencies to form and use basic research competencies of FSR subjects in the field of FSR production – direct administrative influence, formal-mechanistic solidarity of subjects within the functioning of academic research networks, external value orientation and motivation of FSR subjects. The list of methods of stimulating innovative renewal of practical and transformative competencies in the field of FSK functioning includes methods of indirect regulatory influence, contractual solidarity of FSR subjects within the functioning of voluntary/temporary professional research networks, internal value and identification orientation of FSR subjects, global standards of practical and transformative competencies of FSR subjects in the field of FSK formation.

The result of the study is to identify the main types of models with a detailed description of the practical principles of the implementation of FSR in the countries that represent them. The difference in the potential of FSR implementation depends on the ability of national institutions to organize the processes of conducting cyclical program research in order to increase the background design knowledge of the most universal nature.

Keywords: fundamental scientific research (FSR), FSR models, FSR forms, organizational and economic mechanism of FSR regulation

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