PROSPECTS FOR GOVERNMENTAL SUPPORT OF CONVERGENT TECHNOLOGIES DEVELOPMENT IN THE WORLD AND UKRAINE

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Abstract
The aim of the article is to study modern trends for governmental support of convergent technologies development (based of NBIC-technologies) under conditions of a new industrial revolution in the World and Ukraine. In the article modern trends of infrastructure for support of innovative development in the countries of the world are analyzed. The prospects for the creation of the US infrastructure of convergence of knowledge, technology, and society are showed. Formation of a joint research area of the European Union as a mechanism for implementing convergent technologies into the economy is characterized. Reconciliation of European Research Area Roadmap 2020 and the Roadmap on the Ukrainian National Research Area realization on the assumption of ERA's implementation in Ukraine by 2020 is made. The list of priority measures and European partner organizations for the implementation of the Roadmap 2015-2020 ERA in Ukraine were designed.

Keywords: convergent technologies, convergence of knowledge, technology and society,government support, innovation ecosystem, European Research Area Roadmap 2020, Ukrainian National Research Area.

Introduction

Development of theconvergence of technologies (first of all NBIC-technologies) is the basis for XXI century innovative technologies and enable significantly accelerate the development of social sphere and take it to a qualitatively new level. Revolution in NBIC-technologies sphere as well as global challenges and crises also contribute to modifying traditional innovation policies and research infrastructures of the industrially developed countries.The named problem was tackled by many renown scientists, including M. Roco, W. Bainbridge, B. Tonn, G. Whitesides (2006, 2013), R. Campano(2006); R. Silberglitt, P. S. Anton, D. R. Howell (2006); R. Voyer, N. Makhija(2004); L. Stenberg, H. Nagano (2009), and Organization for Economic Co-operation and Development (2014); National Intelligence Council (2012), who studied the issues of knowledge, technologies and society convergence.And also Russian scientists A. Kazantsev, V. Kisilev, D. Rubvalter, O. Rudenskiy(2012), together with Ukrainian scientists M. Kyzym, I. Matyushenko, O Khanova (2011, 2012, 2014, 2015, 2016) et.al. dealt with the development and prospects for NBIC-civilizationunder conditions of a new industrial revolution.

In general, a variety of mechanisms, namely areas of science, science parks, technology parks, industrial parks, research and innovation centers, transfer centers, technological and business incubators, startups, spin-off companies, venture capital and "seed" funds are used for institutional support of the scientific and technological development of countries. Particular attention of scientists was paid to study the interaction of specific mechanisms to support research and innovation, especially in these quite new infrastructure elements: (1) clusters (J. Bekatini, A. Marshall, M. Porter); (2) networks (M. Castells); (3) technological platforms (scientific departments of the European

Commission) that received a rapid development in major countries, technology leaders in the first decade of the XXI century.

For the first time,the positive effect of clustering industry was found by Schumpeter (1939). More modern concept of clusters was outlined in the work of such scientists, as George Bekantini (1979) about the benefits of “industrial districts”, A. Marshall (1980) about the geographical concentration (metropolitan area) economic activity, M. Porter (1998) about the model of competitive advantage. The majority of scientists consider clusters as part of industrial policy and, in this context, for example, modern Ukrainian scientists M. Kyzym(2011) and V. Khaustova (2015) give in their papers the following definition: “... the cluster is a group of geographically localized interconnected companies, organizations, and institutions that complement each other and enhance the competitive advantages of individual members and the cluster as a whole” (Khaustova, 2015, p. 196).

At the same time, the development of innovative systems theory formed the basic concept of “innovation clusters”, namely: (1) regional innovation systems dealing with institutional support of innovation in the region (Asheim,2005); (2) the clusters themselves as geographic concentration of interconnected companies (Porter, 1998); (3) triple helix as interrelated subjects of industry, universities, and public authorities as to creation of innovation (Etzkowitz, 1997); (4) sectoral innovation systems as industrial innovation systems arising during their development, implementation and using (Malerba,1999).

At the level of state regulations the concept of “innovation cluster” was defined in the 2008 report of the European Commission “The Concept of Clusters and Cluster Policies and Their Role for Competitiveness and innovation”, namely “innovation cluster is a group of independent companies, innovative startups, small, medium and large enterprises and research organizations that operate in a particular sector and region which purpose is to stimulate innovative activity by promoting intensive interaction, providing logistics, exchange of knowledge and experience, and by promoting effective technology transfer, education and dissemination of information networks among companies in the cluster” (European Commission, 2008).

This innovative clusters became the basis for the European strategy to strengthen the role of regions in the definition of innovative policy-based intelligent specialization of regions, which means “... choice in regional areas where they can make the greatest contribution to economic development by supporting research, development, and innovation within the identified areas of specialization” (European Commission, 2008).

Among the modern Ukrainian researchers A. Simson should be allocated. She offers a vision of innovation clusters in the form of institutional innovation infrastructure, such as “... a partnership contract forms of association interests of local communities, industrial and other enterprises, financial institutions, research institutions and organizations within certain industries (in technology) and territory (region) aimed at stimulating innovation by establishing intensive interaction between partners by territorial proximity, a common material base, networks, exchange of knowledge, experience and information, as well as state support of the territory cluster” (Simson, p. 386).

Another area of studying interactions institutes generation and commercialization of knowledge has become a paradigm of the network of scientific innovation in the post-industrial economy, the implementation of which was made possible by the rapid development of information technology. The Castells’s works describe the processes of formation of network management based on realization the benefits of spatial structures (Castells, 1998). Thus, M. Castells defines a network structure as a set of interrelated information technology units - business units but the enterprise network as a specific entity that is able to generate knowledge and process information effectively, adapt to changing market conditions, to be flexible for rapid organizational changing of economic instruments influenced by rapid cultural, technological and institutional changing, innovate as a major competitive advantage (Castells, 1998).

In the course of these investigations in the works of L. Voronina and C. Ratner (2010) introduced the concept of scientific innovation network as “... a set of interconnected nodes that represent the research, design, engineering, marketing and testing institutions (their divisions, creative teams) and industry (companies) that are organized on the principle of network” (Voronina, 2010). Such networks provide realization of the full innovation cycle - from knowledge generation to their implementation in a particular product or technology - within the design chain shaped within the network, providing the most effective implementation of the initial stages of the innovation cycle, and develop in the process of passing the competitive stage of the innovation cycle for beyond.

The aim of the article is to study modern trends for governmental support of convergent technologies development (based of NBIC-technologies) under conditions of a new industrial revolution in the World and Ukraine.

Methodology

Content analysis has been used as the main method of research, which allowed making a meaningful analysis of classic papers and researches of modern economists-practitioners devoted to the peculiarities of modern trends for governmental support of convergent technologies development (based of NBIC-technologies) in the World and Ukraine. General scientific methods make up a methodological foundation of the research. They include: description, comparison, statistics review, system analysis and others, which help characterize this phenomenon development in a more comprehensive way. We also apply the methods of dialectic cognition, structural analysis and logic principles that provide for making authentic conclusions as regards the investigated topic.Official statistical data of the state institutions and international organizations, publications of reference character, analytical monographs, annual statistical bulletins, Ukrainian National Academy of Science reports serve as an information grounds for our research.

Results and discussion

Modern trends of infrastructure for support of innovative development in the countries of the world

All innovation structures aimed at combining science, business and government in the form of a triple helix to address economic, technological and social challenges based on coordination and applied research and technology transfer to achieve competitiveness and economic growth of a country in the future. This relationship of science and innovation networks of clusters was carried out mainly at these levels (Voronina, 2010):

- At the regional cluster, which involves the concentration of interconnected companies close one or more industry specializations within a small geographic area. This level corresponds to the embryonic stage of formation of research and innovation network - at the level of applied knowledge diffusion and distribution of the licensed technology;
- At a regional innovation network, which causes more organized cooperation between companies based on contractual relations, aimed at the development of innovative activity of the company, this level of joint research network provides an exchange of intermediate results;
- At a regional innovation system, which provides active cooperation between innovative companies and organizations in various environments generate knowledge for the joint preparation and using of knowledge. This level determines the joint establishment and the object of research infrastructure, databases, the results of basic and applied research and distribution of research work.

At the same time, cluster formation is the main mechanism of innovation development in developed countries since 2003 the EU began to form the concept of technology platforms (TP) and combining them with formed local clusters (A Europe 2020 Initiative, 2012; ETP 2020, 2013). In general, the technology platform is a mechanism for the unity of efforts to create a common development strategy of specific direction in the interests of all parties and is a tool that structures the interests of the various parties in specific industry areas in the context of addressing global and specific national problems (Khaustova, 2015, p. 214). This network platform aims to create links to determine the purpose and support research and development (Djezhina, 2013).

TP is a new communication platform to discuss the most important projects of technological development, production and sales of long-term priorities of innovative development of various economic sectors. TP enable participants to focus interests innovation in promising areas create “breakthrough” innovations. As a tool of innovation management TP should be used in cases where business interests are not clearly structured and strategic choice of innovation activities, including the financing of specific R&D, actually carried out by the state without business community participation. Thus, TP can be effectively integrated into the industrial and innovation policy which is an important advantage of TP in comparison with other instruments of innovation management without replacing the existing instruments of state scientific, technical and innovation regulation. At that, TP enable to clarify the priorities of innovation, create new scientific and industrial ties, coordinate mechanisms for

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the implementation of budget programs implemented in terms of public-private partnerships (Khaustova (2015),Djezhina (2013),Opit ES (2014)).

Thus, the following main forms of partnership can be highlighted in modern innovation policy of the EU: the European Innovation Partnership, European technology platforms, contractual and institutionalized public-private partnerships, cluster-network structures of the European Institute of Innovation and Technology, European Industrial Initiatives, public partnerships (Khaustova, 2015). The main policy measures in the field of clusters and technological platforms interaction support in a number of OECD countries include: (1) the creation and consolidation of clusters through government programs, and promotion of network structures and services for entrepreneurs in order to coordinate clusters; (2) creation of network platforms using links within science (promotion of joint research centers and centers of preferences), connections “science – industry” (promotion of public-private partnerships), communication within the industry (promotion of sectoral networks); (3) internationalization – with programs of clusters of competitiveness and clusters of benefits (Khaustova, 2015, p. 216-218).

At the same time, the model of three coils of interaction “power - science – business” elected by a majority has led to that the most interesting and promising TP and clusters created as an incubator for innovative ideas and development of small businesses have begun to be absorbed by transnational corporations and strengthen tycoonization of a national economy. At that, leading countries, technological leaders, allocate huge funds out of their budgets to develop and support their innovative infrastructure. For example, the US federal budget anticipated allocation of 2.78 billion dollars for 2017 (out of 145.7 billion dollars of all funding for research and development) for the acquisition, design, construction or major repair (or redevelopment) of objects of research infrastructure and physical material for using in the research of matter whether these objects will be used by the government or private entity, and regardless of ownership (Research Infrastructure in the President’s 2017 Budget, 2016).

In the 2004-2015 the rapid growth of interdisciplinary research in most major industries and wide spreading of convergent technologies and NBIC-formation on the basis of advanced manufacturing technologies that have the greatest commercial prospects for 2020, led to the need for more general use, than technology platforms, tools of innovation management. At that, approaches to the combination of convergent technologies’ implementing tools into economies of different countries can vary”.Since 2013 the EU, US, Japan and South Korea as the world technological leaders began to build their science and innovation policy based on the model of four helices “power - science - civil society - business” which has many players and prevents absorption one structure (even powerful TNCs). In this model, the main element is not cluster or TP and innovation ecosystem. In particular, Ukrainian scientists L. Fedulova and A. Marchenko define innovation ecosystem as a “... a set of organizational, structural and functional components (institutions) and their relations involved in the creation and application of scientific knowledge and technologies that determine the legal, economic and social conditions innovation process and ensure the development of innovation at the enterprise level as well as at regional and country on the principles of self-organization” (Fedulova, 2015, p. 26).

The prospects for the creation of the US infrastructure of convergence of knowledge, technology, and society

In 2013 experts from the World Center for Technology Assessment (WTEC) and interested experts proposed a mechanism of implementation envisaged benefits of the convergence of knowledge, technology and society (CKTS) at the example of national CKTS initiatives that can be arranged in the form of centers of educational and research institutions, technology platforms, programs and organizations, and relevant communication and coordination with state authorities (Roco, 2013).

Table 1 shows a proposed mechanism for the implementation of WTEC convergence of knowledge, technology, and society within national CKTS initiatives (Roco, 2013, p. 5).

The integration of these five main components of CKTS initiative includes the results of basic NBIC research, coming from the National Nanotechnology Initiative, Programme of research and development in the field of network and information technology, the Global Initiative on Climate Change, Global Earth Observation systems and other similar existing US projects. In turn, CKTS initiative will support these and other initiatives and programs.

Table 1

The implementation of CKTS mechanism in national CKTS initiatives

The elements of mechanism	The main focus of elements
Centers in educational and research institutions	Research and educational institutions could become a base for the centers and networks to support the development and improvement CKTS according to three priorities: 1. Theory and methods of measurement, evaluation and informational approaches to converged platforms and processes; 2. The decentralized educational network to influence the horizontal (interdisciplinary impact) and vertical (impact throughout life) CKTS-integration systems; 3. Centers for biomedicine, which combines biology, medicine, science and engineering in health care
Technology platforms	Platforms will be focused on areas of national interest: - Steel, decentralized NBIC-convergence technology of production, such as the local production of cyber-support, nanobiotechnology, and psycho-cyber-physical systems; - Cognitive society, brain research, and cognitive calculations; - Sustainable urban communities; - Environmental sensors; - Classification and data integration; - Strengthening the human potential
Programs and organizations	Integration is needed to support assessment methodology of converged ecosystems, the results of research and development to ensure the transmission of information from the brain to the human dimension of the earth, and to develop new paradigms for understanding and exchange of scientific knowledge, to monitor the increasing human capacity at all levels
Coordination of state bodies	The authorities will serve as evaluation and support opportunities for convergence within the national government and between national and local authorities in areas such as health, aging and decision-making processes. The national body CKTS-convergence will provide support and management of national initiatives and current situation

Sources: (Roco, 2013, p. 5)

Thus, experts from WTEC offer direct Governmental program of convergence on those areas that are of national interest, namely (Roco, 2013):

- “Convergence revolutionary technologies for personal services (CORTIS)” where personal service includes the providing and receiving personalized education, medicine, production and general services (based on the web or not), as well as create personal “smart” environmental and cultural environments;
- Cognitive society and lifelong well-being;
- The production of branched-based NBIC (production-centered convergence);
- The convergence in the field of Biomedicine (life sciences, physical sciences and engineering);
- Increasing human potential (convergence of human capabilities including the man-machine cooperation based on computer support, complementary robotics, communication type “from brain to brain” cognitive computing and creating maps of brain activity (mapping),
- Sustainable Earth system (new trends in the convergence of resources technology community, including the monitoring of global terrestrial dynamical systems and methods of influence on them, urbanization and other population movements);
- To promote creativity, innovation and analysis solutions in the field of value added;
- The Federal Bureau of Knowledge and Technology Convergence (CONEKT) which will focus on the approaches to convergence, and other federal agencies for priority platform of convergence (for example, government programs on science, technology and investment planning).

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Formation of a joint research area of the European Union as a mechanism for implementing convergent technologies into the economy

Since 2012 the EU and associated countries have become parties in the development of the European Research Area (ERA) in the framework of the priority of smart growth (the economic growth based on knowledge and innovation) of the Strategy Europe 2020, and flagship initiative "Innovation Union" involving the improvement of the conditions to access funding for research and innovation in order to transform innovative ideas for products and services that facilitate the creation and quality of job.

At that, the initiative "Innovation Union" envisaged a number of measures at the EU level, namely: (1) completing the ERA and the development of programs of strategic research that would focus on such issues as energy security, transport, climate change and efficient using of resources, health and an aging population, environmentally friendly production methods, etc.; (2) improving the framework conditions for innovative businesses; (3) introduction of the "European partnerships in the innovation field" between EU and national levels of the Member States to accelerate the development and deployment of technologies to address the identified issues and challenges; (4) strengthen and further develop the role of EU instruments promoting innovation (Structural Funds framework program of research activities (i.e. "Horizon 2020", "Competitiveness and Innovation Framework Programme" (CIP), Strategic Energy Technology plan (SET-plan), etc.) and at the national level of the Member states (PovidomlennjaEvropejskojiKomisiji, 2013).

Creating of ERA provides: (1) identification of major global challenges related to participating countries space; (2) creating a common research infrastructure to address them; (3) promote the mobility of researchers to the possibility of their participation in certain local research infrastructure; (4) through the wide use of electronic infrastructures (e-infrastructure) combination and development of local research infrastructures; (5) management standards harmonization of national innovation system based on a common assessment of projects and the general principles underlying the financing.

ERA is primarily based on Open Science paradigm. This paradigm is developed from 2013 and the basis of which is the total e-unified infrastructure with open access for researchers from anywhere. In particular, European Open Science Cloud (EOSC) provides combining technology and services to public and private users, and the system of free access to end users of the system (PovidomlennjaEvropejskojiKomisiji, 2013).

In May 2015 the Council of the European Union discussed the new Digital Single Market policy (DSMP) in terms of which the Open Science cloud will be opened, service-oriented, inclusive of all stakeholders and will raise the research to the next level namely: (1) not only promotion the development of advanced science and reusable scientific data, but job growth and increase of competitiveness in Europe; (2) lead to increased efficiency of pan-European investment in research infrastructure by promoting their mutual compatibility and interoperability of unprecedented scale; (3) suggest researchers from all disciplines open direct access to advanced digital capabilities, resources and expertise needed for cooperation and development of science-intensive data processing and computing; (4) attract researchers to the management, coordination and resource conservation in the interests of everyone; (5) ensure the use of public and private investment, invested over the past two decades in the e-infrastructure for the benefits of research and innovation.(Open Science at the Competitiveness Council, 2015)

The Council also adopted a number of decisions regarding the purpose of targeting the digital transformation of European industry and encourage the development of digital entrepreneurship (Draft Council conclusions on the digital transformation of European industry, 2015).

As part of the ERA the concept of open innovation is also implemented, particularly in the form of European technology platforms (YETP) in priority areas of innovation, namely the bioeconomy (7 platforms); Energy (8); the environment (1); ICT (9); production and processes (8); Shipping (5) (A Europe 2020 Initiative, 2012).

At the same time, for the realization and implementation of convergent technologies or, as they call Europeans "cross-cutting" technologies singled out three "initiative" (Cross-cutting ETP Initiatives), namely: NANOfutures initiative; ETPIS (the Cross-ETP Initiative on Industrial Safety); ConXEPT (Consumer Goods Cross-ETP). So, NANOfutures is a platform for technology integration and innovation, multisectoral, cross-cutting, integration platform, which aims to connect and establish cooperation and presentation technology platforms that need to nanotechnology for its production and products. ConXEPT takes into account the needs and desires of consumers, promoting the

development of innovative products and services arising from new materials and technologies, production systems and supply chains, business models, and work. ETPIS focused on security equipment and systems manufacturing industries: manufacturing (chemical, oil and gas processing, pharmaceutical industries), buildings and transport systems.

This performance-based ConXEPT work program H2020 LEIT ICT for 2016-2017 includes large-scale pilot projects to create the Internet of things, including (1) intellectual environment for a decent old age; (2) “smart” agriculture and food security; (3) garments for “smart” ecosystems; (4) reference zones in EU cities; (5) autonomous vehicles connected to the Internet environment; (6) water management to “stretch” (smart) cities (A Europe 2020 Initiative, 2012).The priorities of Horizon 2020 Programme also provide separate cross-cutting activitiesor focus areas: (1) Industry 2020 intheCircularEconomy; (2) Internet of Things; (3) SustainableCities(Cross-cutting activities, 2013).

On 27-28 May 2016 there was a ministerial conference of the EU in the framework of the next meeting of the EU competitiveness which, in particular, was made following final agreements (ERAC Work Programme 2016–2017 (2016), Competitiveness Council. Meeting #3470 (2016)):

I) in “Internal Market - Industry - Space policy”: (1) a single digital market, including (a) the main principles of providing online content services in the internal market, were agreed; (B) conclusions were adopted on the technology development of a single digital market and the modernization of public services; (C) the impact of digitization on the performance of the services sector to study competitiveness was discussed; (D) the ways of improving the using of space data from European space programs to create growth and jobs were discussed; (2) improving the competitiveness adjustment in order to guarantee receipt of future benefits from innovation enabling environment;

II) in “Research and Innovation”: (1) after discussing possibilities of open science conclusions were adopted on the transition to the open system science; (2) conclusions were adopted on the results of the 7th Framework research program (FP7) and future prospects of creating a friendly regulatory environment for research and innovation.

In addition, this ministerial conference emphasized the importance of research infrastructures for the operation of ERA and development of innovative and competitive Europe and approved a total ERA Roadmap 2015-2020 (Strategy Report and Roadmap Update 2016), which was developed by the European Strategy Forum on Research infrastructures (ESFRI). Roadmap aims to simplify the steps and strengthen the efforts already made by Member States and ensure that: (1) a common understanding of the strategic goals for the forthcoming years; (2) a set of tools and best practices that can support innovative development of Member States; (3) implementing of national policies that meets their own features and priorities.

The conference also supported the statement by the Committee of ERA for a note of Member States procedure for implementing of ERA and its consequences in the development of national strategies, including (Draft Council conclusions on FP7 and the Future Outlook(2016), Draft Council conclusions on Research and Innovation friendly regulation(2016), Draft Council conclusions on the transition towards an Open Science system(2016), European Research Infrastructure Consortium (ERIC). (2016)):

- The using of international peer review during the calls for proposals;
- Approval ESFRI efforts to further prioritize infrastructure projects within research roadmap ERA;
- The need to harmonize national policies and programs of research on current research objectives developed in the Joint Programming Initiatives (JPI), to solve major social problems;
- Improving interoperability between the national programs, the removal of barriers to international cooperation and exchange of information on actions in priority areas;
- Encouraging Member States to develop and update national roadmaps for research infrastructures compatible ESFRI process mapping, and ensuring of adequate funding;
- Wider promotion of innovative training programs preparing PhD including the using of European structural and investment funds;
- Using of open, transparent involvement of researchers based on their professional qualities;
- Facilitate mobility of researchers across different sectors, particularly between academy and industry;
- Increased efforts to implement gender equality and address the gender issues in science and innovation policy and research programs;

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- Supporting of open access to scientific publications and research data, taking into account the interests of all relevant parties;
- Intensification of cooperation between the ESFRI and other stakeholders to coordinate national investment strategies in e-infrastructure and research infrastructure are becoming more interdependent;
- The need to continue to support the development of consortia-ERIC (European Research Infrastructure Consortium), the regulatory framework entered into force on 28 August 2009 to facilitate the joint establishment and operation of European research infrastructure (European Research Infrastructure Consortium (ERIC),2016);
- Ensuring the long-term sustainability of research infrastructures;
- Preparation and implementation of the Charter for Access to Research Infrastructures as an open research tool.

So, the leading countries, technological leaders, recognize that Open Science breaks down the barriers around universities and ensures that the public can obtain the maximum possible benefit from all scientific knowledge and maximize the contributions of researchers, universities, and research institutions.

Prospects for convergent technologies' networks creation in Ukraine in the framework of the National Research Area

In Ukraine, for many years the issues of creation of own national innovation system, the formation of innovation clusters, problems of technology transferring and operation of scientific and industrial parks, the possible ways of reconstruction of technoparks, special (free) economic zones and special investment regimes in order to develop own system of scientific support for innovation have been debated for many years.

At the same time, the EU-Ukraine Association Agreement (partial use of a deep and comprehensive free trade area (DCFTA) signed in 2014 came into force since 01.01.2016.) made it real for Ukraine to maximize the utilizing of expanded free trade area for economic scientific and technical development (Ugoda pro asociaciju mizh Ukrajinoju, z odnijei storoni, ta Evropejskim sojuzom, Evropejskim Spivtovaristvom z atomnoji energiji i jihnimi derzhavami-chlenami, z inshoji storoni. Oficijni pereclad (2014), Plan zahodiv z implementaciji Ugodi pro asociaciju mizh Ukrajinoju, z odnijei storoni, ta Evropejskim sojuzom, Evropejskim Spivtovaristvom z atomnoji energiji I jihnimi derzhavami-chlenami, z inshoji storoni, na 2014-2017 (2014), Zvit pro vikonannja Porjadku dennogo asociacsji ta Ugodi pro asociaciju mizh Ukrajinoju ta Evropejskim Sojuzom za 2015 (2016)).

As a result, in the Law of Ukraine "Scientific and technical activity" as of 26 November 2015 №848-VIII (Pronaukovuinaukovo-technichnudijalnist,2015), the main goals and functions of such elements Ukrainian scientific-innovative infrastructurewere determined, which are: the centers of collective using of scientific equipment; National Research Center; The state key laboratory; State register of scientific objects of national heritage; The National Academy of Sciences of Ukraine; Scientific and technical activities in higher education; National Council of Ukraine on the development of science and technology, as well as its scientific and administrative committees; Identification Committee on Science; Public research organizations; Council of young scientists; Regional research centers, and to consider the involvement of students in scientific and scientific and technological activities through specialized general and school educational institutions, including schools and scientific research schools, boarding schools, Minor Academy of Sciences of Ukraine, or other similar institutions of adult education.

Unfortunately, Ukraine has not provided to the committee ERAC its proposals for the National Action Plan for the implementation of the Roadmap 2015-2020 ERA to April 22, 2016, And it is a direct violation of the new Law of Ukraine "Scientific and technical activity" as well as the relevant provisions of the Association Agreement between Ukraine and the EU (Shevchenko A., 2016). As a result, the formation and launch of the ERA will be available without Ukraine. Although in March 2016 at ERA-Ukraine Ukrainian experts were invited to one of the structures of the project Roadmap ERA in Ukraine (Nacionalnij doslidnickij prostip, 2016) and they offer the list of priorities and possible measures to implement the Roadmap ERA in Ukraine (Dorozhnja karta Evropejskogo doslidnickogo prostoru v Ukrajini, 2016).

Also to the list of priority measures and European partner organizations for the implementation of the Roadmap 2015-2020 ERA in Ukraine should be included:

- Creation and offering the services of Identification Committee composed of reputable foreign researchers who already have experience in work similar identification committee during the election of the European Research Council and authoritative Ukrainian scientists with world recognition for the selection of members of the Scientific Committee of the National Council science, technology, and innovation Ukraine. Transparent work of this Committee is essential selection of the best scientists of Ukraine to prevent conflicts of interest in the election of the future most authoritative body;
- The implementation of European standards assessment of projects, including the using of various financial instruments of short-term (one year) Competitions for individual scientists to peer review of long-term projects of research infrastructures and centers of excellence, to create one of the essential elements of the efficiency of Ukrainian national research system. This requires close collaboration with the European Science Foundation (ESF);
- Organization of international expertise (database of experts) and expert procedures to assess the quality of research in various institutions (research organizations, higher education institutions) based on the experience of such assessments, such as the English team evaluating the quality of research in universities REF-2014 and German scientific evaluation system institutions - Leibniz Association, the Max Planck Society with the ESF, which will protect manifestations of conflict of interest;
- The implementation of European-style research universities as part of a network of European universities and research as part of ERA in Ukraine. Thus appropriate cooperation with the League of European Research Universities (LERI), with world-class best practices;
- Organization of the work of the National Research Foundation as an important tool to support national research area in Ukraine and its integration into the ERA. For this stage of the Foundation, there is need for appropriate cooperation with Science Europe and the organizations that fund research in the EU that will allow aligning the financing procedures between countries;
- To develop interdisciplinary research (primarily in the field of convergent technologies), cooperation at the international level, providing professional expertise of higher level and general integration into the ERA requires the participation of the authorities of Ukraine, fund research, and academic experts groups relevant to the ERA, namely: (1) European Strategy Forum on Research Infrastructures (ESFRI), e-Infrastructure Reflection Group (e-IRG) and committee support ERIC; (2) international expert working groups for the implementation of various organizational forms and development roadmaps of research infrastructures and centers of excellence based Strategy reasonable specialization;
- A reconciliation of statutory Ukraine priority areas of scientific and technological development, on which the state developed target scientific and technical programs, and a reconciliation of these STSTP with similar programs of other EU states will increase the effectiveness of their performance and useful effect in the sharing of results. This requires coordination of programs and vision alignment procedures of evaluation within the committee GPC;
- The barriers will be removed to attract the free market of researchers, codes of hiring professionals will be implemented, insurance pensions for mobile researchers will be possible subject if Ukraine takes a part in the Steering Group on Human Resources and Mobility (SGHRM);
- The implementation of evaluation indicators of Ukraine's participation in the ERA, cooperation with the monitoring system integration in ERA results are only possible with the participation of Ukraine in ERA Committee (ERAC).

So, in order to implement Ukrainian National Research Area (UNRA), it will be expedient if the Cabinet of Ministers, Ministry of Education and the National Academy of Sciences of Ukraine (NAS of Ukraine) make an appropriate actions: (1) to form a plan of UNRA which may be integrated in ERA generally and by parts; (2) coordinate NAS of Ukraine with the National Academy of Medical Sciences (NAMS) and the National Academy of Agricultural Sciences (NAAS) and public research organizations on joint activities to develop rational strategies specialization of regions of Ukraine and integration into the ERA through implementation roadmap ERA 2015-2020; (3) develop a mechanism

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for implementing the National Action Plan for the realization of the Roadmap 2015-2020 ERA for innovative development through: (a) Open Science; (B) open innovation; (C) a reasonable strategy of specialization; (D) support from the EU through technical assistance for the implementation of the ERA agreed national priorities; (4) create the Council of the EU - Ukraine on the reform of science and innovation system of Ukraine involving the main actors ERA and UNRA to support the phased implementation of the Roadmap 2015-2020 ERA; (5) to hold a forum with a presentation of the National Action Plan for the implementation of the Roadmap 2015-2020 ERA involving the main actors and the UNRA, including ESFRI, ERIC-consortia and the European Institute of Innovation and Technology(Shevchenko A., 2016).

Figure 1 demonstrates the authors' view on reconciliation of ERA Roadmap 2020 and the Roadmap on the UNRA realization on the assumption of ERA's implementation in Ukraine by 2020.

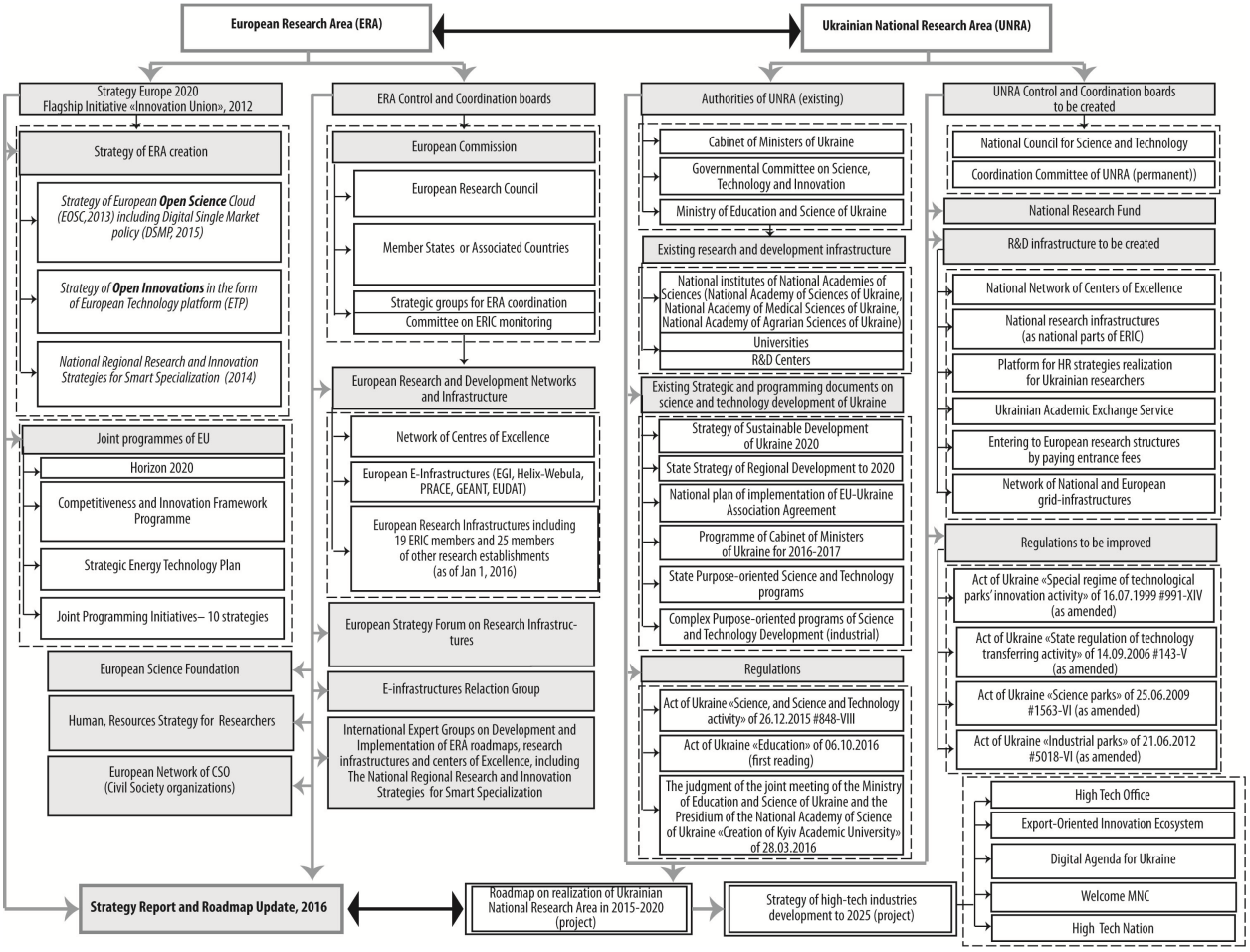

Figure 1. Reconciliation of ERA Roadmap 2020 and the Roadmap on the UNRA realization on the assumption of ERA's implementation in Ukraine by 2020

Fig. 1 shows those governments and the UNRA research infrastructure, that are necessary to be created within the implementation of the Ukrainian roadmap, namely: (1) National Council for Science and Technology (NCST); (2) Scientific Committee as the basis NCST Coordinating Committee of UNRA; (3) National Fund for Research; (4) Basic elements of research infrastructure, including: a national network of centers of excellence; national research infrastructure as part of a consortium of Ukrainian ERIC, as well as joining other European research institutions in the payment of membership fees; the interaction network of national and European grid infrastructure; platform to implement HR Strategy for researchers in Ukraine; Ukrainian Academic Exchange Service, and others.

In addition, since 2006 under the existing European Technology Platforms (ETP) and by a group of scientists and supported by a National Information Point (NIP) framework programs of scientific and technical research of the EU in Ukraine the proposals for National Technology Platforms (NTP) were started to develop. At the same time, as the experience of leading countries, the base of networked structures dealing with large-scale interdisciplinary research (including in the field of convergent technologies) and subsequent commercialization of the results according to the selected community and agreed areas of science and technology is scientific-educational centers and research universities.

Conclusions

It has been established that the commercialization of interdisciplinary research, development and using of convergent technologies in most countries - technological leaders faced an urgent need for the formation of infrastructure that will engage the support of scientific and technological development, accelerated transfer of leading (primarily convergent) technologies production, create transparent conditions for competition and public-private cooperation.

It has been revealed that in the period 2004 - 2015 the rapid growth of interdisciplinary research in most major industries and wide spreading of convergent technologies and NBIC-formation on the basis of leading manufacturing technologies which have the greatest commercial prospects for 2020, caused the need to use a more common management tool in research and innovation than technology platforms or clusters. This global technology leaders began to build their science and innovation policy based on the model of four helices “power - science - civil society – business”, which has many players that prevents the absorption of one structure (even powerful TNCs), in which the main element is no cluster or technology platform and innovative ecosystem.

It has been shown that in order to realize benefits provided by the convergence of knowledge, technology and society through the using of convergent technologies by World Technology Assessment Center (WTEC), primarily for the US, has been proposed as a mechanism for National CKTS initiatives that could be organized as centers of educational and research institutions, technology platforms, applications and organizations, and relevant communication and coordination with state authorities.It is necessary to direct the government program of convergence on those areas that are of national interest, namely: (1) convergent revolutionary technologies for personal services; (2) cognitive society and lifelong well-being; (3) the production of branched-based NBIC; (4) the convergence in the field of biomedicine; (5) improving human potential; (6) sustainable earth system; (7) promoting creativity, innovation and decision analysis in the field of value added; (8) a central body of the convergence of knowledge and technology which will focus on the approaches to convergence, as well as plan for priority convergence platforms (for example, government programs on science, technology, and investment planning).

It has been established that from 2012 the EU and associated countries have become parties to build the European Research Area, which is based on three priorities - open science, open innovation, openness to the world. Implementation of the concept of open innovation involves the creation and support of European technology platforms (YETP) in priority areas of innovation, namely the bioeconomy (7 platforms); Energy (8); the environment (1); ICT (9); production and processes (8); Shipping (5). Thus for the realization and implementation of converged (“cross”) technologies singled out three “initiative”, namely: NANOfutures - connect and establish cooperation and presentation technology platforms that need to nanotechnology for its production and products; ConXEPT - takes into account the needs and desires of consumers, promoting the development of innovative products and services arising from new materials and technologies, production systems and of supply chains, business models and work; ETPIS - security equipment and systems manufacturing industries. The priorities of Horizon 2020 Programme also provides for a separate cross-cutting measures or areas of focus, which has the following priorities: (i) Industry in 2020 based on the recirculation of the economy; (II) Internet of Things; (III) Smart city, which established the developing world.

It has been established that on the April 22, 2016 Ukraine has not provided to the committee ERA their proposals for the National Action Plan for the implementation of the Roadmap 2015-2020 ERA, which is a direct violation of the new Law of Ukraine “Scientific and technical activity” and the relevant provisions of the Association Agreement between Ukraine and the EU.It has been substantiated that the implementation of Ukrainian National Research Area, Cabinet of Ministers, Ministry of Education and the National Academy of Sciences of Ukraine will be appropriate: (1) forming a plan UNRA, which may parts and generally integrate into ERA; (2) coordinate NAS of

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Ukraine with the National Academy of Medical Sciences and the National Academy of Agricultural Sciences and public research organizations on joint activities to develop rational strategies specialization of regions of Ukraine and integration into the ERA through implementation roadmap ERA 2015- in 2020; (3) developing a mechanism for implementing the National Action Plan for the implementation of the Roadmap 2015-2020 ERA for innovative development through: (a) Open Science; (B) open innovation; (C) a reasonable strategy of specialization; (D) support from the EU through technical assistance for the implementation of the ERA agreed national priorities; (4) create the Council of the EU - Ukraine on the reform of science and innovation system of Ukraine involving the main actors ERA and UNRA to support the phased implementation of the Roadmap 2015-2020 ERA; (5) to hold a forum with a presentation of the National Action Plan for the implementation of the Roadmap 2015-2020 ERA involving the main actors and the UNRA, including ESFRI, ERIC-consortia and the European Institute of Innovation and Technology.

It has been shown that in the implementation of the Ukrainian roadmap, above all, need to be established: (1) National Council for Science and Technology; (2) Scientific Committee as the basis NCST Coordinating Committee of UNRA; (3) National Fund for Research; (4) Basic elements of research infrastructure, including: (a) a national network of centers of excellence; (B) national research infrastructure as part of a consortium of Ukrainian ERIC, as well as joining other European research institutions in the payment of membership fees; (C) the interaction network of national and European grid infrastructure; (D) platform to implement HR Strategy for researchers in Ukraine; (D) Ukrainian Academic Exchange Service, etc.

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The author's warrant that their contribution is an original work not published elsewhere, that they have the full power to make this grant and that the article contains no matter unlawful or which invades the right to privacy or infringes any proprietary right.

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