Management of Innovative Business Development in the Zaporizhzhia Cluster EAM 4.0

Rūta Čiutienė[1][a], Andrii Karpenko[2][b], Nataliia Kholiavko[3][c] and Dmytro Plynokos[4][d]
[1]School of Economics and Business, Kaunas University of Technology, Kaunas, Lithuania
[2]Economy and Custom Department, National University "Zaporizhzhya Polytechnic", Zaporizhzhya, Ukraine
[3]Department of Finance, Banking and Insurance,Chernihiv Polytechnic National University, Chernihiv, Ukraine
[4]Economic Sciences, Entrepreneurship, Trade and Exchange Activities Department, National University "Zaporizhzhya Polytechnic", Zaporizhzhya, Ukraine

Keywords: Innovation, Quadruple Helix Model, Smart Specialization, Project Management, Cluster.

Abstract: The purpose of the study is to consider the processes of formation and development of the Zaporizhzhia cluster EAM, on the theoretical basis of smart specialization. The conducted analysis of development of the Zaporizhzhia cluster showed that the basis of its creation and functioning is in the field of innovation and the combination of education, science, business and public interests. The Quadruple Helix model gives an idea of the modern organization of innovation processes and the role of the government, local authorities, business, educational institutions and civil society for the formation of the innovation environment. The stakeholders' cooperation within the Quadruple Helix Model creates different synergetic effects. The main of them are scale, multiplier, marketing, innovation, investment, management, social capital, innovation infrastructure. The partnership of universities, business, government, local authorities, and civil society within the Model makes it possible to successfully implement the regional strategies of smart specialization. The authors came to the conclusion that the approaches of modern project management could be effectively used for the formation of a sustainable cluster management system. Under such conditions, the Project Management 2.0 Approach could make it possible to introduce innovative products and technologies, modernize production processes, and create new sustainable business models.

1 INTRODUCTION

Stable economic growth is carried out on an innovative basis with the active use of modern scientific and technological advances, the ability to produce and commercialize innovations. A high level of production and implementation of innovations is ensured in modern conditions with high productivity and interaction of various market actors, forming a coordinated innovation system for all elements. The stability of the development of national social and economic systems in the conditions of modern transformations and innovative changes is increasingly determined by the level of development of the regions. The role of regional government in the general system of state regulation in Ukraine is growing. The regional administration acts as a leader of national interests, taking into account regional specifics and has all the necessary powers in the economic, financial and legal spheres, able to solve all the problems of life support of the population in the regions. As the regions acquire real independence, a new regional sphere of interests and responsibilities is formed. The most significant regional interests include: compliance of the level and way of life of the population of the region with state and international standards; availability of budgetary and financial and other material sources; potential for the use of available real resources, places of application of labour, intelligence, etc.; availability of infrastructure

[a] https://orcid.org/0000-0003-4821-0093
[b] https://orcid.org/0000-0002-5717-4349
[c] http://orcid.org/0000-0003-2951-7233
[d] https://orcid.org/0000-0002-3004-0279

Čiutienė, R., Karpenko, A., Kholiavko, N. and Plynokos, D.
Management of Innovative Business Development in the Zaporizhzhia Cluster EAM 4.0.
DOI: 10.5220/0011346500003350
In *Proceedings of the 5th International Scientific Congress Society of Ambient Intelligence (ISC SAI 2022) - Sustainable Development and Global Climate Change*, pages 177-186
ISBN: 978-989-758-600-2

for the development of interregional relations; natural resource and ecological potential of the region; stability of the social and political, national and ethnic situation, preservation of tolerance in the religious environment. In addition to these interests, a special place also belongs to the prevention of crises in the economy of the region, which is an integral part of a market economy.

In the period of post-crisis recovery and intensification of competition on the world market to increase the competitiveness of regions in the EU in 2010, the development and implementation of a new tool for market economy development – smart specialization was initiated. The spread of the concept of "smart specialization" was associated with the need to "unlock" the development of regions, revive their potential and industrial modernization of Europe. The concept of smart specialization, which was developed by economists D. Foray, P. David and B. Hall1 and proposed to the European Commission in 2008, was recognized as one of the key tools for implementing the Europe 2020 strategy (Foray et al., 2011). The official EU regulation states that "smart specialization strategy means a national or regional innovation strategy that sets priorities for competitive advantage by developing and adapting its own research and innovation capacity to business needs in order to consistently respond to new opportunities and market changes, while avoiding duplication and fragmentation of efforts" (Regulation EU, 2013). In addition, it is noted that a smart specialization strategy may take the form of or be part of national or regional policy. In a study, the authors substantiated the main reasons for the large gap between economic growth in the United States and Europe: the quality of human capital; brutality of European labour markets; differences in adaptation and adoption of new management practices; differences in the organization of the investment process and the availability of venture capital. This Concept became the basis for defining nationally oriented directions of development and formation of innovative strategies at the level of regions for overcoming the problem of their uneven development in the conditions of globalization challenges and for the purpose of achievement of steady, reasonable and inclusive growth. First of all, the main idea of smart specialization was the division of regions according to the level of innovative development: if advanced innovation regions specialize in research, development and implementation of new technologies, the mission of more innovative backward regions should be to promote such technologies by local entrepreneurs. EU member states have traditionally differed in their innovative regional strategies from other countries. Their strategies have always included horizontal measures of industrial policy, which adhered to a neutral position in terms of sector and industry and was aimed at improving the general environment and creating opportunities for innovative development (development of higher education institutions, human resources, creation of intellectual property, IT infrastructure) and increasing the volume and efficiency of scientific and research activities, etc.).

2 QUADRUPLE HELIX MODEL

One of the promising concepts for the development of cooperation between stakeholders from different sectors is the Quadruple Helix model. In our opinion this concept could be used within the implementation of smart specialization strategies.

The Quadruple Helix is based on the Triple Helix Model developed by Etzkowitz H. (Etzkowitz, 2008), (Etzkowitz & Dizisah, 2008) and Leydesdorff L. (Leydesdorff, 2012). The Triple Helix Model demonstrates a set of "Academy – Industry – Governance" interrelations aimed at boosting the national economy's innovative development.

Over time, the need to expand this model to the Quadruple Helix Model has become relevant. In the joint publications, Carayannis E. G. and Campbell D.F. (Carayannis & Campbell, 2012), (Carayannis & Grigoroudis, 2016) reveal the role of civil society in the implementation of innovation processes. The merit of these scientists is that they proposed to consider civil society not only as participants in innovation processes involved at different stages of their implementation, but also as partners or subcontractors. Within the Quadruple Helix Model, civil society is considered as organizers and co-owners of the achieved innovative results. In other words, scientists are departing from the idea of considering civil society just as the end-users of innovative products. The emphasis is shifting towards the consideration of civil society as an active actor of innovation. Yawson R.M. justifies the wider involvement of public sector representatives in innovation development and proves that they are an active component of the national innovation system (Yawson, 2009). Woo Park H. holds a similar opinion (Woo Park, 2014).

An in-depth literature review shows that scientists consider the Quadruple Helix Model as the basis for the innovative development of an enterprise and of the country as a whole. A team of scientists (Oscar et

al., 2010) proposes the conceptual foundations of the growth model for the Quadruple Helix innovation theory. Grigoroudis E. highlights the aspects of the relationship between this Model and modern approaches to smart specialization (Carayannis & Grigoroudis, 2016). McAdam M., Miller K., McAdam R. study the peculiarities of establishing interaction between partners within the framework of the Quadruple Helix Model, in particular the influence of relations between them on university technology commercialization (McAdam et al., 2016). The role of Quadruple Helix Model in the development of creative industries is revealed in the article of Colapinto C. and Porlezza C. (Colapinto & Porlezza, 2012). A thorough project on exploring Quadruple Helix outlining user-oriented innovation models was conducted by Arnkil R., Järvensivu A., Koski P. and Piirainen (Arnkil et al., 2010).

Thus, the literature review confirms the presence of high scientific interest in the study of various aspects of the interaction of actors within the Quadruple Helix Model. In addition, applied principles of the impact of such interactions on the innovative development of industrial enterprises and relevant clusters require further in-depth study.

Let us take a closer look at the components of the Quadruple Helix Model and the system of their interrelations (see Fig. 1). Government is presented in the Model as a set of state institutions whose regulatory activity is focused on innovative economic development and support for innovative enterprises. The institutions of this sector are responsible for the development of a regulatory platform for cooperation between the Quadruple Helix Model actors in the field of innovation. At the national level, it is also necessary to implement a set of systemic measures for the development of innovative culture in society. For developing countries, it is important to strengthen the role of the government in the development of innovation infrastructure and modernization of its structural components.

In the current context of the digitalization of national economies, there is a certain transformation in the roles of the main actors of the Quadruple Helix Model. In particular, the role of the government should be changed from the regulator and controller to an equal partner of economic entities in innovation processes. In the context of the study, the government's efforts should be focused on harmonizing current legislation with the provisions of the European Union, as well as on creating effective economic incentives to intensify innovation (including minimizing bureaucracy, optimizing reporting, accelerating transfer and commercializing innovation in the real economy, simplifying the procedures for patenting innovative research results).

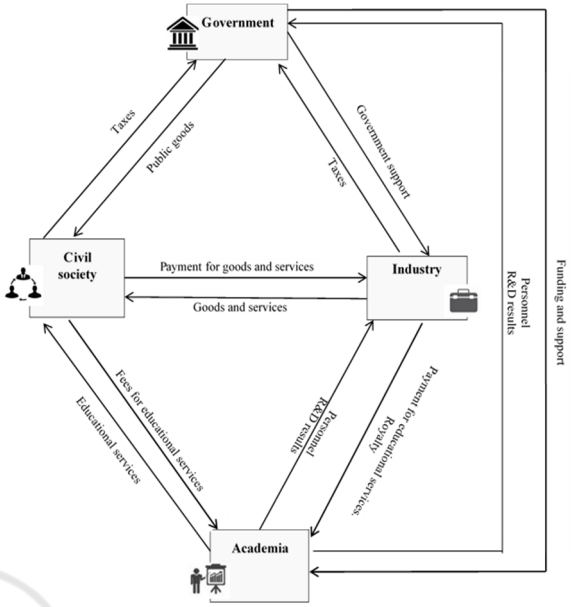

Figure 1: Scheme of relationship within the Quadruple Helix Model

Thus, the government should now become a kind of link between universities (academia), enterprises (industry) and the public (civil society), creating favorable conditions for the development of their innovative cooperation on a long-term basis. The public sector is obliged to support knowledge-intensive industries and develop innovation-oriented public policies.

Industry within the Quadruple Helix Model covers a set of enterprises that are innovatively active or are capable of implementing innovative activities. Within this Model, the role of enterprises is not limited to the manufacture and sale of innovative products. They are considered as initiators, investors and direct participants in innovation processes. If before the enterprises placed orders and financed R&D, today they are increasingly involved in R&D implementation as partners, idea generators and subcontractors. It is considered promising to expand cooperation between businesses with universities and research institutes, rather than focusing on the development of enterprises' own (corporate) research units. Such cooperation will expand the partners' access to modern research and their results, the latest industrial equipment, research laboratories, elements of innovation infrastructure, etc. Thus, today in the Quadruple Helix Model, business is transforming from a consumer and the investor of innovative ideas to strategic partner of educational and research

institutions in the initiation and implementation of innovative projects.

Civil society within the Quadruple Helix Model occupies a central place, as it represents the population of the country as the main customers and end-users of goods, services, and public goods. Enterprises focus their activities on the interests and preferences of representatives of this sector; the profitability of enterprises is directly correlated with the ability to meet the needs and expectations of the public. It is in view of the growing role of civil society that the business sector is launching social responsibility programs widely. For the higher education sector (academia), representatives of the public are the main consumers of their educational services, and for the public sector (government) they are consumers of public goods. As mentioned above, in today's growing role of innovation, knowledge, and information, civil society is transforming from only a consumer to a generator of innovative ideas and co-contractor of innovative projects.

An important agent of the Quadruple Helix model is the higher education sector - Academia. Its role is primarily manifested in the training of personnel for the business and public sectors, who have the skills of innovative thinking, are able to generate ideas and implement innovative projects. The development of Industry 4.0 growths the role of higher education significantly, but in the same time there is a trend in transformation of universities and reorientation of the vectors of their activities. In particular, along with education, universities intensify research, invention, innovation activities. It is these activities that contribute to the generation of innovations necessary for the development of regional and national innovation systems. Innovations generated by the universities scientists are commercialized in the real sector of the economy. The introduction of innovations in the activities of enterprises increases the level of their competitiveness in the market, causes the increasing of demand for its products and, consequently, increase profit. This, in turn, can lead to an increase in tax revenues to the local or state budget. Increasing tax revenues expands the ability of governments to improve the quality of public goods and social protection. Activation of innovation activity at the microeconomic, mesoeconomic and macroeconomic levels has a positive effect on the living standards of the population.

Nowadays the Quadruple Helix Model is widely used by modern scientists in various fields of research: development of innovations ecosystem, business practices (Mineiro et al., 2021), creation of hybrid organizations (Champenois & Etzkowitz, 2018), synergy in innovation systems (Leydesdorff et al., 2019), university–industry project collaboration (Rantala et al., 2021), digital entrepreneurship services (Kitsios et al., 2021), regional competitive entrepreneurial ecosystems (Carayannis et al., 2018), and also future prospects of the Model's implication.

The cooperation of partners within the Quadruple Helix Model allows to achieve a set of positive synergetic effects, namely: synergy of scale; synergy of multiplier; marketing synergy; innovation synergy; investment synergy; management synergy; synergy of social capital; synergy of innovation infrastructure. However, the achievement of these effects is possible only if the transformation of all agents of the Model (see Table 1).

The main principles of the Model should be adaptability, flexibility, digitalization, dynamism, and innovation perception.

The Quadruple Helix Model is useful in implement of the regional strategies of smart specialization because it implies the deepening of cooperation between various stakeholders.

Smart specialization is used in developed countries as a conceptual model for the formation of not only innovation (identifying and stimulating the development of unique industries or economic activities), but also social and economic policy in general, as it promotes long-term structural changes in the region's economy with a focus on the prospect of occupying important niches in foreign markets. Smart specialization is an integrated, local transformation program based on four general principles:

– selection and critical mass (limited number of priorities identified taking into account regional capacity and international cooperation);

– competitive advantage (the process of entrepreneurial discovery);

– relationship and clusters (synchronize what you have with what the rest of the world has) – joint management (public and private partnership; cooperation between universities, local authorities, business, and representatives of civil society (within the Quadruple Helix Model)). In the framework of our research we formulated the hypothesis that the project management (project or project portfolio management) is a strategy and process through which organizations realize their goals and success.

Table 1: Transformation of stakeholders' roles within the Quadruple Helix Model

Stakeholder	Obsolete principles of operation	Predominant current role in economy	Promising principles of operation	Promising role in national economy
Government	Principle of centralized management; directive planning	Manage-rial, control-ling role	Principle of management decentralization; principle of synchronization of interests of subjects of national economy	Stimulating, organizational-providing, information-advisory role
Academia	Principle of conservatism; dependence on public funding; predominance of the financial model of consumption	Social role (understanding of educational services as a public good)	Principle of efficiency, optimization, profitability of educational, research and innovation activity; principle of self-sufficiency; principle of adequacy to economic realities	Economic role (understanding of educational services as a specific commodity)
Business (Industry)	Principles of competitiveness, self-financing	Active - in the areas of production and sales of goods; passive-consumer role - in the fields of education and science	Principles of innovation and intersectional interaction	Affiliate investment role
Civil society	Principles of social justice, equality, transparency	Mostly inertial role	Principle of balancing the interests of society and economy; principle of feedback between stakeholders	Activation role

Source: developed by the authors

3 PROJECT MANAGEMENT APPROACHES

According to Guide to the Project Management Body of Knowledge PMBOK 7 (2021) projects are key drivers for organizational changes. The projects are as a tool that allows an organization to move from current to desired situation in order to achieve a specific objective. Organizations recognize projects as extremely important mechanisms for changes and renewal. Through projects, organizations seek to innovate by developing new or improving existing products and services, entering new markets, developing new business models or building more effective business processes (Te Wu, 2021). Modern organizations are increasingly aware of the importance of strategy and take into account in the formulation of strategic goals that they can only be implemented through appropriate and carefully selected projects (Hadjinicolaou & Dumrak, 2017). The business results of an organization are implemented through successfully completed projects, so it can be said that project or project portfolio management is a strategy and process through which organizations realize their goals and success. (Salameh, 2014). Projects are instrumental to the sustainable development of organisations and society. According to Project Management 2.0 approach project management is a strategic competence required to ensure the success of an organization performance; project managers need to master not only project management, but also business processes; project managers has to be involved in such processes as project initiation, selection and resource planning; projects have to be in line with organizational strategy (Kerzner, 2015).

Project Management 2.0 approach, is based on rapid development of information technologies and increased opportunities of communication. Robotization, digitalization and other transformations based on Industry 4.0 requirements lead to projects complexity and speed of implementation of activities.

The benefits of projects have led to an increase in projects importance in business processes. Project integration enables organizations to overcome digital business. Based on Wellington research even 85 % respondents practice methods of project management in order to create a value-based business. Successful projects are precondition to implement organisation's strategy and create strategic value (Marnewick, 2018). There are several conceptions of project added value. The concept of project added value derives from M. Porter's value chain theory. Project added value is understood as project success criteria (Mir &Pinnington, 2014); a strategic approach of building successful brands or achieving a high level of quality (Kalafatis et al., 2016); promotes change that helps realize the benefits and values of stakeholders (Laursen & Svejving, 2016). There are several types of project value: financial value, internal value, future value, customer-related value. Financial value includes such indicators as cost savings, increased returns, profits. Internal value is based on internal organization improvements and covers such aspects as organizational culture, increased productivity and employees satisfaction and competence development, processes improvements. Future value focuses on strategic development of organization, based on achieved outputs and increased organization value in the future. The business value is accrued through the realization of benefits that result from project-work. Benefits are part of ensuring that investments are made to deliver value to the organization (APM Body Knowledge, 2019)

The Project Management Institute's 2021 Pulse of the Profession report "Beyond Agility" noted that 72% of the projects completed within organization in the past 12 months met original goals, 59% completed, within original budget, 52 % completed on time, 37% experienced scope creep, 37 % failed project, budget lost, 13 % deemed failures, 10,5 % wasted investment due to poor project performance (Profession report, 2021).

The results of the study show that value creation through projects face with challenges. Therefore, organizations have to apply an effective project management method in order to achieve desirable outputs and value of the projects.

4 CLUSTER "ENGINEERING-AUTOMATION-MACHINERY"

In Ukraine, a significant experience in development of cooperation "business-university-public-government" has the Zaporizhzhia Cluster "Engineering-Automation-Machinery". Besides, the Cluster is actively using the project management approaches, both from the moment of its foundation, official registration, and in the course of carrying out of its current activities.

In September 2020, at the initiative of a number of enterprises and organizations of Zaporizhzhia in accordance with the signed Memorandum of Cooperation between the Association of Industrial Automation Enterprises of Ukraine (AIAEU) and Zaporizhzhia Chamber of Commerce and Industry (ZCCI) with the participation of National University "Zaporizhzhya Polytechnic" creation of a professional association of entrepreneurs, scientists and business associations was launched. In November, with the support of AIAEU and the German federal company Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, "Zaporizhzhia Cluster "Engineering-Automation-Machinery" was registered at the request of the German Government for the development of industrial high-tech clusters.

In the framework of cooperation with the European Commission in the Zaporizhzhia region (together with two other regions, Kharkiv and Odessa), smart specialization was identified for the first time. The practice of discussing and approving smart specialization, which was joined by representatives of the educational and scientific sphere, showed certain shortcomings. In general, smart specialization of the regions is aimed at concentrating efforts and ensuring consolidation within the existing infrastructure and resource base to attract investment and finance for the development of innovative products and services.

Significant attention within this concept is focused on small and medium-sized businesses, which should be maximally involved in cooperation within the areas of smart specialization. It is believed that big business is self-sufficient and it's not ready to disclose its own research and involve third-party structures in innovation activities (formation of high value-added chains), which is a strategic goal of smart specialization. This practice is aimed at demonstrating the priorities of regional production and high competitiveness not only in local but also global markets. At the same time, the development of these priorities in the region was complicated by methodological reasons for identifying the innovation potential of the region and the inability to attract a wide range of innovative enterprises of small and medium-sized businesses. Broad discussions and maximum involvement of regional stakeholders in

this process should be an important step in building a constructive dialogue on smart priorities. That's why clusters, as voluntary associations on a regional and sectoral basis of the structure, which include representatives of almost all local stakeholders, could act as intermediaries in the reasonable choice of smart priorities and further ensure their implementation.

Today Zaporizhzhia cluster "EAM" has united and continues to attract to its ranks the leading players of Zaporizhzhia region to increase the economic potential of Zaporizhzhia region through the competitiveness of cluster participants and development of regional innovative technologies (Fig. 2).

Figure 2: Zaporizhzhia Cluster members (EAM, 2021).

The basis of the cluster formation is the harmonization, coordination and synchronization of cooperation of participants around: definition of common goals and needs; building trust through networking and regular communications; launching a specific action plan.

The main tasks of the Zaporizhzhia Cluster "Engineering-Automation-Machinery" are: establishing broad cooperation between all categories of cluster participants and creating a common innovation ecosystem in the region to develop innovation and R&D, development of new generation products (Industry 4.0), as well as joint implementation of engineering projects; increasing competitiveness and export potential through better and joint implementation of existing export support instruments, creation of new opportunities and integration into international chains of high added value; better cooperation and synergy with regional authorities and local governments, expert communities and the public, integration into regional development programs (Fig. 3).

The experience of collaboration of four participants of the local system of Zaporizhzhia region (business, education, government and public)

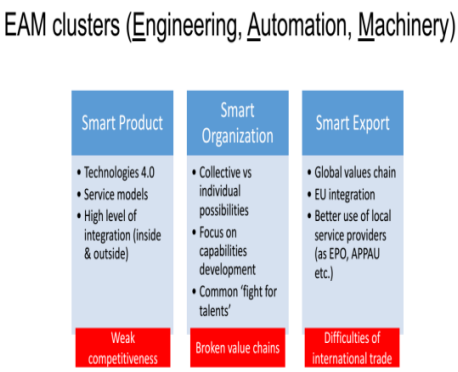

Figure 3: Smart specialization of Zaporizhzhia cluster "Engineering-Automation-Machinery" (Yurchak, 2021)

through the creation of the Zaporizhzhia cluster "EAM" demonstrates the positive results of development of each of the participants. The cluster allows to unite all regional stakeholders around local problems and to provide faster and more efficient solution of current problems, use of available potential for economic development.

The main advantages of participation in the Zaporizhzhia cluster "Engineering-Automation-Machinery": the use of joint assets of the cluster (site, joint funds, joint promotion, joint stands at exhibitions, etc.); obtaining important information about market opportunities within or outside the region; image and reputation growth, joint and individual PR; obtaining a synergistic effect of cooperation in the development of joint products or projects; better access to innovation and export resources and opportunities, including finding partners and clients abroad; obtaining preferential terms for training and development programs organized by partners; priority inclusion in grant and other structural programs of export, innovation, regional, industrial and digital development, etc.

Thus, the basis for the formation and effective functioning of the cluster is trust and responsibility between its members, tolerance and solidarity in society, which in the monopolization of many markets low level of business ethics and low legal culture for a long time does not allow to fully using the potential of the national economy.

Territorial integration of scientific and educational institutions with a network of specialized suppliers, major producers and consumers connected by a technological chain, for faster and more efficient dissemination of innovations (new knowledge, discoveries and inventions) in a certain economic subsystem supported by public administration and the public to ensure the progressive development of the region. Conscious creation of clusters by all

participants in economic relations will allow to make full use of all available potential and to provide realization of their competitive advantages (Fig. 4).

The practical implementation of the cooperation between the EAM cluster, science, education and business is implemented in the projects WORK4CE: Cross-domain competencies for healthy and safe work in the 21st century (Erasmus + KA2). The grantholder of this project is National University "Zaporizhzhya Polytechnic" together with the universities of Ukraine, Azerbaijan, Germany, Belgium and Spain. The project develops standards and learning materials for the new topic of cross-domain competences for healthy and safe work by setting up industry-university communities for the development, delivery and dissemination for the relevant topics (WORK4CE, 2021).

Figure 4: Zaporizhzhia cluster EAM in innovation system of the region (EAM, 2021)

Zaporizhzhia EAM cluster is a relatively new structure that has been operating for only 2 years. Its creation was also associated with the implementation of sustainable development goals, including the development of innovation and innovation infrastructure, renewable energy, quality education and more. The current activities of the Zaporizhzhia cluster are aimed at achieving the goals of sustainable development, which is manifested in organized activities, the formation of interaction between participants of the regional ecosystem (Quadruple Helix), improving production processes among cluster members and more.

According to the social component of the concept of sustainable development, people should have such competencies that allow them to navigate freely in today's world, have a job, and be ready for any changes. The formation of new competencies in project WORK4CE in collaboration with business and the EAM cluster will allow to implement such approach.

This approach will overcome the gap between universities and industry and equip graduates with competences to cope with the transformation of working environments, to assess where they are and where they want to go (analysis, strategy); to transform to a sustainable working environment, to consider occupational safety and health.

Zaporizhzhia EAM cluster provides practical implementation of the project goals, in particular the dissemination of educational and research developments of universities among the enterprises of the Zaporizhzhia region.

The cooperation between the WORK4CE project management and the EAM cluster practically implements the Quadruple Helix Model principles in Ukraine. In our opinion, such efficient use of available resources, human potential, synergy of universities, science and business will give the best result.

5 CONCLUSIONS

Summarizing the above, it should be noted that smart specialization is a new model of regional and interregional development, which provides a close link between science, education, business (mostly small and medium), public and local authorities on the optimal use of available resources and creation innovative products, services or technologies competitive in the scale of the national or world economy with the use of cluster cooperation of innovation ecosystems. Further development of national economies and regional economic systems based on the model of smart specialization requires deepening cooperation between stakeholders within the framework of the Quadruple Helix Concept. One of the promising areas of ensuring the long-term nature of partnerships between business, universities, government and civil society is the implementation of project management approaches. The expediency of using such approaches in management of innovative business development was studied on the basis of experience of the Ukrainian Zaporizhzhia cluster "Engineering-Automation-Machinery".

REFERENCES

Foray, D., David, P. A., Hall, B. H. (2011) Smart specialization: from academic idea to political instrument, the surprising career of a concept and the difficulties involved in its implementation. MTEI Working Paper. Lausanne, Switzerland, 2011. 16 p.

Regulation (EU) No 1303/2013 of the European Parliament and of the Council. https://eurlex.europa.eu/legal-content/en/ALL/?uri= CELEX%3A32013R1303

Etzkowitz, H. (2008) The Bi-Evolution of the University in the Triple Helix Ere. Science Policy Institute, State University of New York. 2008. 12 p. URL: http:/www.ie.ufrj.br/eventos/seminarios/pesquisa/a_universidade_e_o_desenvolvimento_regional.pdf. (Last accessed: 15.07.2018).

Etzkowitz, H. (2008) Triple Helix Innovation: Industry, University, and Government in Action, London and New York: Routledge, 2008.

Etzkowitz, H., Dizisah, J. (2008) Triple Helix Circulation: the heart of innovation and development. International Journal of Tecnology Management and Sustainable Development. 2008. № 7(3). P. 101- 115.

Leydesdorff, L. (2012) The Triple Helix, Quadruple Helix,…, and an N-tuple of helices: Explanatory models for analysing the knowledge-based economy? Journal of the Knowledge Economy. 2012. № 3(1). P. 25-35.

Carayannis, E. G., Campbell, D.F.J. (2012) Mode 3 Knowledge Production 1 in Quadruple Helix Innovation Systems. Springer Briefs in Business. 2012. № 7. 63 p.

Carayannis, E., Grigoroudis, E. (2016) Quadruple Innovation Helix and Smart Specialization: Knowledge Production and National Competitiveness. Foresight and STI Governance. 2016. Vol. 10, no 1. P. 31–42.

Yawson, R. M. (2009) The Ecological System of Innovation: A New Architectural Framework for a Functional Evidence-Based Platform for Science and Innovation Policy. The Future of Innovation Proceedings of the XXIV ISPIM 2009 Conference. Vienna, Austria. June 21-24, 2009.

Woo Park H. (2014) Transition from the Triple Helix to N-Tuple Helices? An interview with Elias G. Carayannis and David F. J. Campbell. Scientometrics. 2014. № 99. P. 203-207.

Oscar, A., Monterino, S., Thomshon, M. (2010) A Growth Model for the Quadruple Helix Innovation Theory. Journal of Business Economics and Management. 2010. № 13(4). P. 1-31.

Carayannis, E., Grigoroudis, E. Quadruple Innovation Helix and Smart Specialization: Knowledge Production and National Competitiveness. Foresight and STI Governance. 2016. Vol. 10, no 1. P. 31–42.

McAdam, M., Miller, K., McAdam, R. (2016) Understanding Quadruple Helix Relationships of University Technology Commercialisation: A Micro Level Approach. Studies in Higher Education. 2016. № 43(6). P. 1058-1073. URL: https://www.tandfonline.com/action/showCitFormats?doi=10.1080%2F03075079.2016.1212328

Colapinto, C., Porlezza, C. (2012) Innovation in creative industries: from the quadruple helix model to the systems theory. Journal of the Knowledge Economy. 2012. № 3(4). P. 343-353.

Arnkil, R., Järvensivu, A., Koski, P. and Piirainen, T. (2010) Exploring Quadruple Helix Outlining user-oriented innovation models, Final Report on Quadruple Helix Research for the CLIQ project, under the Interreg IVC Programme. 2010.

Mineiro, A.A.d.C., Arantes, R.d.C., Vieira, K.C., Castro, C.C., Carvalho, E.G. and Amaral, M.G.d. (2021). Business practices for strengthening the quadruple and quintuple helix: a study using structural equation modeling", International Journal of Innovation Science, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/IJIS-02-2021-0049

Champenois, C., & Etzkowitz, H. (2018). From boundary line to boundary space: The creation of hybrid organizations as a Triple Helix micro-foundation. Technovation, 76–77(November 2018), 28–39. https://doi.org/10.1016/j.technovation.2017.11.002

Leydesdorff, L., Ivanova, I. A., & Meyer, M. (2019). Synergy in Innovation Systems Measured as Redundancy in Triple Helix Relations. In W. Glänzel, H. F. Moed, U. Schmoch, & M. Thelwall (Eds.), Springer Handbook of Science and Technology Indicators.

Rantala, T., Ukko, J., & Saunila, M. (2021). The Role of Performance Measurement in University–Industry Collaboration Projects as a Part of Managing Triple Helix Operations. Triple Helix, 1(aop), 1-40.

Kitsios, F., Kamariotou, M., Grigoroudis, E. (2021) Digital Entrepreneurship Services Evolution: Analysis of Quadruple and Quintuple Helix Innovation Models for Open Data Ecosystems. Sustainability 2021, 13, 12183. https://doi.org/10.3390/su132112183

Carayannis, E.G., Grigoroudis, E., Campbell, D.F., Meissner, D., Stamati, D. (2018) The ecosystem as helix: An exploratory theorybuilding study of regional co-opetitive entrepreneurial ecosystems as Quadruple/Quintuple Helix Innovation Models. R.D.Manag. 2018, 48, 148–162.

A Guide to the Project Management Body of Knowledge PMBOK Guide (2021) – Seventh Edition and The Standard for Project Management.

Te Wu, 2021, Digital project management: rapid changes define new working environments, Journal of Business Strategy, DOI: https://doi.org/10.1108/JBS-03-2021-0047

Hadjinicolaou N., Dumrak J. (2017). Investigating Association of Benefits and Barriers in Project Portfolio Management to Project Success. Procedia Engineering. 182. 274-281.

Salameh, H. (2014). What, When, Why, and How? A Comparison between Agile Project Management and Traditional Project Management Methods. International Journal of Management Reviews. Vol. 2. No. 5. 52-74.

Kerzner, H. (2015), Project management 2.0: leveraging tools, distributed collaboration, and metrics for project success. John Wiley & Sons, New York

C. Marnewick (2018), Realizing Strategy through Projects: the Executive's Guide, Auerbach Publications, New York (2018)

Mir, F.A. and Pinnington, A.H. (2014) Exploring the Value of Project Management: Linking Project Management

Performance and Project Success. International Journal of Project Management, 32, 202-217.
Kalafatis, Stavros & Ledden, Lesley & Riley, Debra & Singh, Jaywant, (2016) The Added Value of Brand Alliances in Higher Education. Journal of Business Research. 69. 10.1016/j.jbusres.2016.01.028.
Markus Laursen, Per Svejvig, (2016) Taking stock of project value creation: A structured literature review with future directions for research and practice, International Journal of Project Management, Volume 34, Issue 4, 2016,
APM Body Knowledge 7th edition, (2019) https://www.apm.org.uk/media/35296/ampbok7-sample.pdf
Pulse of the Profession report "Beyond Agility" (2021) https://f.hubspotusercontent40.net/hubfs/2535991/Pinnacle%20Approved%20Docs/Blog%20Attachments/PMI_Pulse_2021.pdf
Zaporizhzhia EAM Cluster. Members (2021) official web-site//https://www.iamcluster.zp.ua
Yurchak O. A (2021) New project for the development of clusters "Engineering-Automation-Machinery" in the regions of Zaporizhzhia and Kharkiv. https://appau.org.ua/clusterise
WORK4CE: Cross-domain competences for healthy and safe work in the 21st century (2021) official web-site//https://work4ce.eu