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INNOVATICS OF HIGHER EDUCATION AS A TOOL OF INNOVATION MANAGEMENT IN THE SPHERE OF HIGHER EDUCATION AND SCIENCE

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ІННОВАТИКА ВИЩОЇ ОСВІТИ ЯК ІНСТРУМЕНТ УПРАВЛІННЯ ІННОВАЦІЯМИ У СФЕРІ ВИЩОЇ ОСВІТИ І НАУКИ

The purpose of the article is to develop the concept and principles of a new scientific direction – higher education innovatics, further development and improvement of higher education innovatics, the definition of directions, and management of innovations in the field of higher education and science.

Higher education innovatics studies and summarizes the theoretical issues and practice of implementing and managing innovative activities of higher education institutions, scientific institutions, organizations, and management bodies related to the higher education system.

The article analyzes innovative changes in the system of higher education caused by the environment of academic capitalism. Among them: the main questions of the theory of the organization of innovation in higher education; analysis of the orientation and impact of innovative processes in the field of higher education and science on the objects and subjects of innovative transformations; the role of the state in the management of innovative activities in the field of higher education and science; types of innovations in the higher education system that can lead to innovative changes; innovations of economic and market type in higher education, etc. Innovative activity in the field of higher education and science leads to serious innovative transformations both in the entire field of higher education and science and in its subjects - universities, research institutes, related organizations, and institutions.

In the article, academic entrepreneurship is considered as an economic category in the system of socio-economic ties and relations of an integrated economic system in the modern knowledge society. With the help of abstraction methods, system-structural and information-theoretical methods, the conditions for the formation of academic entrepreneurship, the features and essence of university entrepreneurship, and its impact on the competitiveness of the economies of countries are studied. Authors used methods of analysis in synthesis to study and form directions and ways of innovative development of higher education and science.

After studying and analyzing a significant amount of useful information about the emergence and impact of academic capitalism on the socio-economic and public-humanitarian spheres of human activity, its positive contribution to the birth and spread of innovative activities in the field of higher education and science, the authors proposed to create and introduce a new scientific and applied direction - innovatics of higher education.

In general, the article is devoted to the further development of the concept and foundations of innovatics in higher education, as a tool for managing innovative activities

in the field of higher education and science, as well as defining directions and means of innovation management in the field of higher education and science.

Метою статті є розробка концепції та засад нового наукового напрямку – інноватики вищої освіти, подальший розвиток і вдосконалення інноватики вищої освіти, визначення напрямів та управління інноваціями у сфері вищої освіти і науки.

Інноватика вищої освіти вивчає та узагальнює теоретичні питання та практику впровадження та управління інноваційною діяльністю вищих навчальних закладів, наукових установ, організацій та органів управління, пов'язаних із системою вищої освіти.

У статті аналізуються інноваційні зміни в системі вищої освіти, спричинені середовищем академічного капіталізму. Серед них: основні питання теорії організації інноватики вищої освіти; аналіз спрямованості та впливу інноваційних процесів у сфері вищої освіти і науки на об'єкти та суб'єкти інноваційних перетворень; роль держави в управлінні інноваційною діяльністю у сфері вищої освіти та науки; види інновацій у системі вищої освіти, які можуть призвести до інноваційних змін; інновації економіко-ринкового типу у вищій освіті тощо. Інноваційна діяльність у сфері вищої освіти і науки призводить до серйозних інноваційних перетворень як у всій сфері вищої освіти і науки, так і в її суб'єктах – університетах, науково-дослідних інститутах, суміжних організаціях і установах.

У статті академічне підприємництво розглядається як економічна категорія в системі соціально-економічних зв'язків і відносин інтегрованої економічної системи сучасного суспільства знань. За допомогою методів абстрагування, системно-структурних та інформаційно-теоретичних методів досліджено умови формування академічного підприємництва, особливості та сутність університетського підприємництва, його вплив на конкурентоспроможність економік країн. Методи аналізу в синтезі використано для вивчення та формування напрямів і шляхів інноваційного розвитку вищої освіти і науки.

Після вивчення та аналізу значного обсягу корисної інформації щодо виникнення та впливу академічного капіталізму на соціально-економічну та громадсько-гуманітарну сфери людської діяльності, його позитивного сприяння зародженню та поширенню інноваційної діяльності у сфері вищої освіти та науки, автори запропонували створити та запровадити новий науково-прикладний напрямок - інноватика вищої освіти.

В цілому статтю присвячено подальшій розробці концепції та основ

інноватики вищої освіти, як інструменту управління інноваційною діяльністю у сфері вищої освіти і науки, а також визначенню напрямів та засобів управління інноваціями у сфері вищої освіти та науки.

Keywords: *higher education innovatics; innovative development of higher education; academic capitalism; entrepreneurial university.*

Ключові слова: *інноватика вищої освіти; інноваційний розвиток вищої освіти; академічний капіталізм; підприємницький університет.*

I. Introduction

The environment of academic capitalism, encompassing almost the entire field of science and higher education, has greatly accelerated the commercialization of applied research and development results by universities and research institutes and has allowed these institutions to greatly benefit from their intellectual capital. This gave impetus to the development of progressive innovations and outstanding inventions. Since the adoption by the US government of the Bay-Dole Act (the Law on Patents and Amendments to the Trademark Act) on December 12, 1980, the era of rapid economic growth in the country began, which became a prerequisite for the phenomenon of “academic capitalism”. The “Bayh-Dole Act”, one of the best legislative acts in the United States law, “enables universities, nonprofit research institutions and small businesses to own, patent and commercialize inventions developed under federally funded research programs within their organizations.” [1].

Earlier higher education and science belonged to the non-commercial sphere of intellectual activity of society and were called upon to find, generate and disseminate knowledge for the benefit of all mankind. Further, in the environment of academic capitalism higher educational institutions (HEIs) and scientific institutions (SIs) have transformed from “temples of knowledge” into participants in the market of educational and scientific services with strict market economic rules.

Having studied and analyzed a significant amount of useful information about the emergence and impact of academic capitalism on the socio-economic and public-humanitarian sphere of human activity, its positive impact on the emergence and spread of

innovative activity in the field of higher education and science, the authors proposed to create and introduce a new scientific and applied direction – innovatics of higher education [2]. Higher education innovatics is designed to systematize a comprehensive study of innovative changes in the field of higher education and science with the aim of their further dissemination in the systems of higher education and science of various countries [3].

The fundamentals of the study.

The fundamental foundations of the theory of academic capitalism, the theory of innovation, innovation management, academic or university entrepreneurship, and innovation activity in higher education and science considered in the different works, which formed the basis of the theory and practice of the multidisciplinary direction of higher education innovatics. Within the framework of higher education innovatics, the authors will consider the types, varieties and direction of innovative (transformational) changes in the field of higher education and science. The main goal of all such changes is building an innovative model of the higher education and science system aimed at creating a knowledge society.

According to S.Slaughter, and L.Leslie, “the essence of *academic capitalism* is the transformation of scientific and teaching activities into a kind of entrepreneurship: the implementation of research projects is directly dependent on the receipt of cash subsidies from individual corporations: Academic capitalism deals with market and market-like behaviors on the part of universities and faculty.” [4, p. 21] (Slaughter & Leslie, 1997, p. 21). Within the framework of “academic capitalism”, the activities of research institutes and centers within the university structure are aimed at increasing the potential for public application of knowledge. The authors give the following interpretation of the definition of academic capitalism: “To maintain or expand resources, faculty increasingly had to compete for external dollars that were tied to market-related research, which was referred to variously as applied, commercial, strategic and targeted research, whether these monies were in the form of research grants and contracts, service contracts, partnerships with industry and government, technology transfer, or the recruitment of more and higher fees-

paying students. We call institutional and professorial market or market-like efforts to secure external monies academic capitalism.” [4, p. 17] (Slaughter & Leslie, 1997, p. 17). Note that the “term *academic capitalism* was first introduced by E.J.Hackett to denote important structural changes in science.” [5] (Hackett, 1990).

“*Academic capitalism* sets new directions for the development of modern higher education and manifests itself on three levels: institutional, departmental, individual. Academic capitalism at the institutional level is realized against the background of changes in the funding of higher education institutions, the reduction of public funding, and the need to find sources of additional funds. The study of academic capitalism at the departmental level is of interest because it is here that various activities are carried out, employees adapt to new values. At the individual level, within the framework of academic capitalism, there is a revision of the distribution of time between the main activities of the teaching staff: teaching, research, services.” [6] (Leslie, Oaxaca & Rhoades, 2001).

In its essence, the environment of academic capitalism, which has covered the sphere of higher education and science (as well as all other social, public, and humanitarian spheres of human activity) with market, and market-like relations, is also a new phenomenon in the general system of capitalism. It was in the environment of academic capitalism that the powerful innovative development of both the socio-humanitarian and industrial spheres of human activity began. Accelerated innovation has spawned the digital revolution and has become an objective reality for today's globalized world.

The complete description of innovation processes was done by J. Schumpeter: “he analyzed the *new combinations* of changes in the development of economic systems. He added a definition of innovation as *new combinations* of new or existing knowledge, resources, equipment and so on”. [7, p. 65] (Schumpeter, 1934, p. 65). Also, he “underlined that innovation needs to be distinguished from invention: he saw innovation as a specific social activity (function) carried out within the economic sphere and with a commercial purpose, while inventions in principle can be carried out everywhere and without any intent of commercialization. For Schumpeter innovations are novel combinations of knowledge, resources, etc. subject to attempts at commercialization (or

carried out in practice). This *combinatory* activity he labeled *the entrepreneurial function* and the social agents fulfilling this function *entrepreneurs*.” [8, p. 21] (Fagerberg, 2008, p. 21). Also, Schumpeter [9] (1976) and Mensch [10] (1979) introduced the term *innovation* into scientific circulation, which was defined as the embodiment of scientific discovery in new technology or product.

Different surveys of the literature in the sphere of innovation have found a great number of varieties of definitions. Thus, “in 2009, Baregheh et al. found around 60 definitions in different scientific papers.” [11, p. 1325] (Baregheh, Rowley & Sambrook, 2009, p. 1325), “while a 2014 survey found 41 ones.” [12, p. 1394] (Edison, Ali & Torkar, 2014, p. 1394). Based on their survey, Baregheh et al. attempted to define a multidisciplinary definition and arrived at the following definition: “Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace” [11, p. 1334] (Baregheh, Rowley & Sambrook, 2009, p. 1334).

In an industry review of how the software industry defines innovation, the following definition was found to be the most comprehensive, based on the definition of the leadership of the Organization for Economic Co-operation and Development – OECD: “Innovation is: production or implementation, assimilation and use of new products with added value in the economic and social spheres; updating and expanding products, services and markets; development of new production methods; and the creation of new control systems. This is both a process and a result.” [12, pp. 1400-1401] (Edison, Ali & Torkar, 2014, pp. 1400-1401).

“Two main dimensions of innovation were degree of [novelty] (i.e. whether an innovation is new to the firm, new to the market, new to the industry, or new to the world) and types of innovation (i.e. whether it is product, process, market or organizational innovation).” [12, pp. 1394-1395] (Edison, Ali & Torkar, 2014, pp. 1394-1395).

Well known and influential scholar Everett Rogers “offered the following description of an innovation: An innovation is an idea, practice, or project that is perceived as new by an individual or other unit of adoption.” [13, p. 12] (Rogers, 2003, p. 12).

Peter Drucker defined the essence of innovation as follows: “Innovation is the specific function of entrepreneurship, whether in an existing business, a public service institution, or a new venture started by a lone individual in the family kitchen. It is the means by which the entrepreneur either creates new wealth-producing resources or endows existing resources with enhanced potential for creating wealth.” [14] (Drucker, 2002).

Theoretical foundations of innovation, innovative development, and innovation management, include a global study of innovation management 2006-2016 given in the book [15] (The Quest For Innovation, 2006), in an articles [16] (Chen, Viardot & Brem, 2019), and [17; 18] (Bouwer, 2015; 2017).

In his comprehensive book, F. Damanpour “synthesises research from the past 50 years of innovation studies, addressing the main elements of innovation and providing a connected perspective on innovation within organizations. The author provides an overview of key concepts, terms and theory, explores the generation and adoption processes of technological and nontechnological innovations, and examines innovation activity and internal mechanisms and procedures in organizations.” [19] (Damanpour, 2020).

This research is based on the following “conceptual foundations of innovative development of higher education: a) the H.Etzkowitz's concept of innovative development of society by the *triple helix* model [20-25] (Etzkowitz, 2003; 2008; 2019; Viale & Etzkowitz, 2010; Dzisah & Etzkowitz, 2012; Cadorin et al., 2019), which is successfully used in many developed countries (USA, UK, Canada, Australia, Japan, Germany, Sweden and many other countries of the EU) and in the developing world (China, Brazil, some other South American countries, etc.); b) B. Clark's concept of transformational changes of conventional universities into innovative universities focused on in-house entrepreneurial activities (*business universities*) [26-28] (Clark, 1998; 2000; 2004), which has been validated in higher education systems in many countries of different continents (North and South America, the United States of America, Western Europe, Japan, Africa).” [3] (Romanovskyi & Romanovska, 2020).

Also, the authors paid great attention to the following problems of innovation:

“Promoting innovation in higher education.” [29] (Haddawi & Igel, 2006); “The emergence of a real opportunity for the commercialization of R&D results, which led to the rapid development of university and academic science and technology.” [30] (Slaughter & Rhodes, 2009) and others.

For more than 50 years, the sphere of higher education and science has been subject to various innovative changes, the direction of which depends on the goals set by the innovators. Since almost all areas of social, economic, and public-humanitarian activities of mankind are connected with the sphere of higher education and science, it is advisable to investigate, identify, and group innovations according to the areas of application and the tasks assigned to them.

To systematize and comprehensively study the innovation theory and practice in the field of higher education and science, the authors of this article have developed and proposed a new scientific and applied multidisciplinary direction – *higher education innovatics*. [3] (Romanovskyi & Romanovska, 2020).

Relevance of the topic.

Higher education plays a crucial role in the development of human society, both historically and in modern conditions. The integrated role of universities in the period of globalization is presented in the publication [31] (Altbach, 2008). Universities are the engines of socio-economic development of societies and their national institutions. They play a central scientific role in society, in the multiplication, preservation, and dissemination of knowledge, and are defined as intellectual centers and international organizations. It is the universities that must ensure the accessibility of higher education and the fair provision of educational services to all layers of the population. Universities should solve the problems of both general education and develop economic science and academic (university) entrepreneurship. They must realize their historical prospects for the further development and improvement of humanity. Therefore, the broad and purposeful introduction of innovations, best practices, techniques, and technologies in the field of higher education and science should ensure the implementation of the integrated role of universities in the period of globalization.

The authors believe that “to build a knowledge society with an innovation-oriented type of economy in any country requires fundamental reform of its socio-economic and humanitarian spheres, innovative development of the system of higher education, science, and scientific and technical activities. At the same time, a reasonable combination of the best foreign experience with national traditions is necessary. The priority of the state policy of innovative development of higher education requires the early introduction of innovative entrepreneurship of various types and organizational and legal forms. At the same time, the basis of economic reform and the main lever in the new model of the economy is the activation of all types of entrepreneurship, including innovative academic or university entrepreneurship, as an integral socio-economic process. Accelerated creation, development and implementation of innovations in higher education and science, promotion of innovative methods, technologies and innovative entrepreneurship are especially important in the period of search for new economic models and strategies that will contribute to the accelerated development of the social and economic system. In this regard, it is necessary to study and develop the theory of innovation in higher education, to determine the types and directions of innovations for the early implementation in this area.” [3] (Romanovskyi & Romanovska, 2020).

Statement of the problem.

According to the authors, “innovation in higher education studies, systematizes and expands interdisciplinary scientific and applied fields in higher education and science.

Innovation in higher education studies the innovative transformations of subjects of higher education and science in the context of academic capitalism.” [3] (Romanovskyi & Romanovska, 2020).

This study is devoted to the study of the processes of innovative development of the higher education system in Ukraine and other countries during the formation of the knowledge society.

“The spread of market mechanisms in all spheres of social, economic and humanitarian activities of mankind, the emergence of the phenomenon of academic entrepreneurship, the commercialization of knowledge and R&D requires the development

and scientific substantiation of the theory and practice of innovative development of higher education and science.” [3] (Romanovskiy & Romanovska, 2020)..

The novelty of the research lies in identifying areas of practical implementation of innovative changes, searching, studying, and choosing relevant ways, indicating methods and mechanisms for innovative transformation of the higher education sector as a whole, as well as its constituent parts – HEIs, SIs, organizations, and institutions related to higher education and science sphere.

2. Analysis of recent studies and publications.

Among the latest publications on innovations in higher education, the following works seem to be interesting. In the work [32] of Eddie Blass and Peter Hayward (2014) “Innovation in higher education; will there be a role for “the academe/university” in 2025?” the authors “presents five scenarios for the future of higher education underpinned by drivers of funding, the ownership and exploitation of *research*, the provision of good *teaching*, and the potential missing link of social innovation development. The authors emphasize that by refocusing on facilitating social innovation, the university can find a new means of adding value to society that will sustain its existence beyond 2025.” [32] (Blass & Hayward, 2014).

In his paper [33], Dustin Swanger (2016) “explores the current state of higher education and the pressures facing colleges. He also explores innovation and some of the challenges to innovation in higher education, as well as some of the successes. This paper will recommend some changes that can be implemented on any campus to improve outcomes and efficiencies.” [33] (Swanger, 2016). The full report reference, specially prepared for the 2nd Summit of the Global Education Industry, held on September, 26-27, 2016 in Jerusalem, “covers the available evidence on innovation in education, the impact of digital technologies on teaching and learning, and the role of digital skills and the education industries in the process of innovation, using data from OECD surveys.” [34, p. 9] (OECD, 2016, p. 9). “Understanding the education industries better, including their market structures and innovation processes, would help to create a more mature relationship with the education sector. Innovation in the industry – which develops the

products and services that could drive innovation in schools – does not happen in isolation from what is happening in the education sector. Only when there is an innovation-friendly culture in education systems, supported by an innovation-friendly business environment and policies, will industries start to engage in risk-intensive research and development. Governments can support this by fostering a climate of entrepreneurship and innovation in education.” [34, p. 10]. Also, the report underlines that: “Innovation in the public sector in general, and in education in particular, could be a major driver for significant welfare gains. Governments provide a large number of services in OECD countries and these services account for a considerable share of national income.” [34, p. 13].

The article [35] of P. Serdyukov (2017) is devoted to the problem of innovation in American higher education. Analyzing publications of American experts in the field of higher education and innovation, studying the existing situation with regards to innovations in higher education institutions, he made several valuable conclusions and recommendations. The paper is based on a literature survey and author research. The author emphasizes that “Actually US education badly needs effective innovations of scale that can help produce the needed high-quality learning outcomes across the system. The primary focus of educational innovations should be on teaching and learning theory and practice, as well as on the learner, In the parents, community, society, and its culture. Technology applications need a solid theoretical foundation based on purposeful, systemic research, and sound pedagogy. One of the critical areas of research and innovation can be cost and time efficiency of the learning.” [35, p.4]. Some practical recommendations are given in this paper: “how to create a base for large-scale innovations and their implementation; how to increase the effectiveness of technology innovations in education, particularly online learning; how to raise time and cost efficiency of education.” [35, p. 4].

Unbundling is the process by which products previously sold together are separated into their component parts. In his work [36] T. McCowan (2017) notes that “unbundling is the process by which products previously sold together are separated into their component parts.” The author states that in “higher education there is a dynamic separation of teaching and research. This dynamic was driven primarily by financial motivation and was driven by the commercial sector, but also had pedagogical motivation through an emphasis

on personalization and employability. The article presents a theoretical analysis of the trend and proposes new conceptual tools with which to map regulatory implications.” [36] (McCowan, 2017).

The article [37] of M. Jakovljevic (2018) devoted to the “institutional innovation and some models of innovation in higher education. The author concludes that contemporary innovation research informs us of models and the nature of innovation and its basic facets: a) TAR model; b) A stakeholder model; c) The structural model; d) Governance structured models and e) Triple helix and quadruple helix innovation models.” [37] (Jakovljevic, 2018).

In their book [38], J. Branch et al. (2018) are presenting “primary examples of innovative teaching and learning practices in higher education. The book is truly international, containing contributions from Australia, Denmark, England, Hong Kong, Italy, Qatar, Scotland, South Africa, Tasmania, Vietnam, and USA. Although the educational contexts are very different across these countries, there appears to be a striking similarity in the approach to innovative teaching and learning.” [38] (Branch et al., 2018).

The following works are devoted to a critical study of the problems of academic capitalism.

In the article “On academic capitalism” [39] B. Jessop (2018) is considering “the increasing trend toward academic capitalism and profit-oriented entrepreneurial practices in the fields of education and research discusses in the work. This occurs as universities, in different ways and subject to greater or lesser financial, administrative, and ideological pressures, act less like centers of disinterested education and research and more like economic enterprises that aim to maximize their revenues and/or advance the economic competitiveness of the spaces in which they operate.” [39] (Jessop, 2018).

The article [40] of P. Somers et al. (2018) “provides a definition of academic capitalism and overview of the research literature, presents the prospects for academic capitalism in the Americas, and discusses the implications of academic capitalism for Latin America. Estimates are given of what is useful in academic capitalism for Brazil.” [40] (Somers et al., 2018).

In his work [41], R. Münch (2020) describes the most important “features of

academic capitalism and their impact on science, as well as on the evolution of scientific knowledge; notes that academic capitalism is located in the intersection of scientific research, economic profit maximization and innovation policy; examines the institutional conflicts of interest associated with corporate research funding. He argues that academic capitalism is a unique hybrid that combines the scientific search for truth and the economic maximization of profit and turns universities into enterprises competing for capital accumulation, and enterprises into knowledge producers looking for new discoveries that can be turned into patents and profitable goods.” [41] (Münch, 2020). The book “The International Encyclopedia of Higher Education Systems and Institutions” [42] edited by editors-in-chief P. N. Teixeira and J. C. Shin (2020) includes most topics from higher education and is available for comparison with other sources. The book examines the problems of higher education in the twenty-first century, analyzes the changes that have taken place and new challenges that may face future scientists and possible research directions.

In their article [43], M. Muftahu and H. Jamil (2021) considered that “one of the most difficult tasks in HEIs is to implement effective and constructive changes in the already functioning system.” They point out, that the “resistance and unwillingness of the members of the institution are the main obstacles for the institution to implement the necessary changes.” The authors suggest “how to facilitate the flow of knowledge and adopt an innovative way of thinking in the context of higher education or higher education institutions.” The paper also analyzes “three areas of a comprehensive implementation plan or change management: structure, culture, and strategies.” The authors propose their program to manage changes. They explain “how a change initiative can be undertaken in a higher education institution in the context of the flow of knowledge and the adoption of innovative thinking. The main message of this publication is that, according to the authors, the institutional mission, vision, and priorities must be clearly understood by every employee in order to support and promote change and innovative thinking.” [43] (Muftahu & Jamil, 2021). In the paper [44], which contributes to the discourse on the future of learning in higher education the author D. W. Stoten (2021) “focuses on the utility of the MBA as a management qualification to those that adopt a more holistic

perspective of the development of managerial capability in an uncertain and volatile world.” [44, p. 53].

In their research [45] S. Mazzioni et al. (2021) analyze the degree of interconnectedness of processes with organizational innovations, with efficiency in the field of products, market, technical and other innovations, and with social and environmental sustainability. The authors “proposed a theory that allowed us to understand the mechanisms of this relationship by analyzing the impact between innovation and sustainability mediated by efficiency.” [45, p. 527].

The study [46] of M. J. Mayhew et al. (2021) has the purpose “to test the effectiveness of a theoretically developed pedagogical exercise designed to help students develop their innovation capacities during a single-semester course.” [46, p. 3]. Researchers “organized the theoretical perspectives and empirical literature base through the use of two broad categories: innovation capacity theory and pedagogical frameworks, respectively.” [46, p. 3]. Authors stress that "good teaching is the crucial link between the aspirations of undergraduate education and their subsequent realizations; between collegiate environments and desired outcomes". [46, p. 17].

The author of the next study [47] S.Y. Tan (2021) suggests that “thinking can be perceived as an ambiguous task that allows for different interpretations. From the students' point of view, reflection was often characterized as a product that was one-layer (not repetitive) and monologic, rather than iterative and dialogical.” [47] (Tan, 2021). Also, he points out “the need for a deeper understanding of the student's point of view and its consideration in context in order to develop a teaching methodology that would better support and strengthen the reflective approach to learning.” [47] (Tan, 2021).

3. Purpose of the article.

The main purpose of this article the authors consider further development of the theory and practice of interdisciplinary scientific and practical direction of innovations in higher education and science, as well as the definition of objectives, directions, and features of innovative transformations in this sphere. An important research problem is the effective organization of management in the field of innovative transformations in the

main components of the higher education and science sphere – universities, SI, and related organizations.

Authors stress that university innovations are the result of the development of academic capitalism and studies mainly both its market innovation processes spreading to the sphere of higher education and their impact on the socio-economic sphere of society.

4. Methodology and the research methods.

The study was conducted as follows: a) a comprehensive and purposeful literary and documentary search was carried out; b) the main areas of search are identified: academic capitalism; academic (university) entrepreneurship; innovative development of society according to the “triple helix” model; a variety of innovative models, directions and ways of implementing innovative transformations in the field of higher education and science. The authors used a dialectical approach to the analysis and comprehension of the content and features of the innovative development of higher education based on the phenomenon of academic (university) entrepreneurship. In the article, academic entrepreneurship is considered as an economic category in the system of socio-economic ties and relations of an integrated economic system in the modern knowledge society. With the help of abstraction methods, system-structural and information-theoretical methods, the conditions for the formation of academic entrepreneurship, the features and essence of university entrepreneurship, and its impact on the competitiveness of the economies of countries are studied. Methods of analysis in synthesis were used to study and form directions and ways of innovative development of higher education and science.

All drawings presented in the article (Fig. 1 – Fig. 6) were developed by the authors.

5. Presentation of the main research material.

As higher education innovatics is a branch of knowledge aimed at studying, creating explaining, and effectively implementing innovations in the sphere of higher education and science, authors will consider the main results of their research of types of innovations in higher education and science and direction of their implementation as the practical use of innovatics theory and practice.

The core of higher education innovatics as a science is the general organizational theory of innovation with a focus on application in the sphere of higher education and science including academic or university entrepreneurial activities. [26-28] (Clark, 1998; 2000; 2004).

The object of research in the higher education innovatics is the process of conducting innovations in the sphere of higher education and science; the subject is the theoretical, methodological, and organizational bases for implementing this process; the product is a system of scientific and practical provisions that ensure the development, implementation, and support of innovations in the sphere of higher education and science, as well as their explanation and foresight.

The basic issues of the organizational theory of higher education innovatics include (Fig. 1): classification of innovations in the sphere of higher education and science by their focus on the types of activity; classification of innovations in the sphere of higher education and science by their focus on the types of activity; classification of innovations by their type and model used; stating their goals; identification of conditions and methods of innovation; forecasting and planning; risk assessment; error prevention.

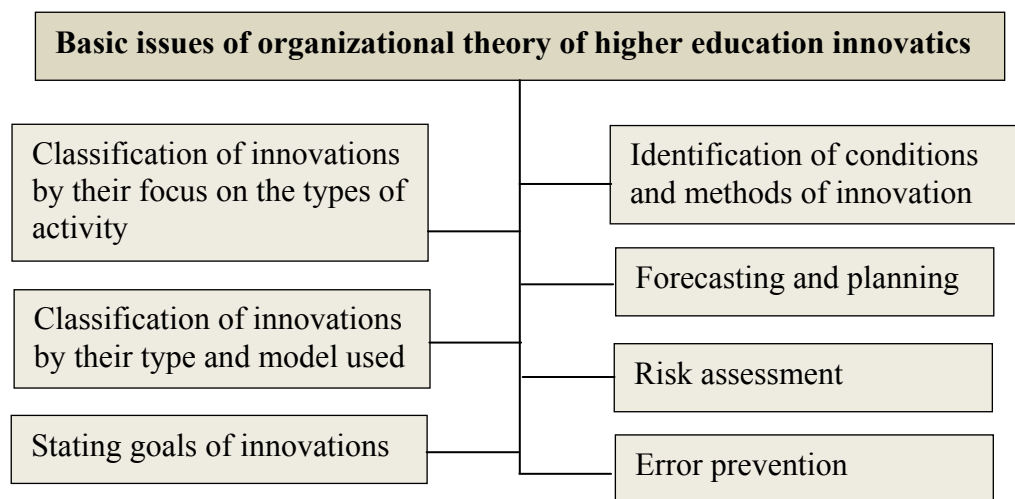


Fig. 1. The basic issues of the organizational theory of higher education innovatics

There are two general types of innovation: sustaining innovation or disruptive innovation. [48] (Bower & Christensen, 1995).

Such models of innovations can be used: radical, incremental, architectural, or modular. [49] (Henderson & Clark, 1990).

Also, innovation can be used for profit generation (commercial), or non-for-profit purpose: social,

sustainable, or green innovation and responsible innovation. [50; 51] (Schiederig, Tietze & Herstatt, 2012; Blok & Lemmens, 2015).

The organizational theory of higher education innovatics covers such groups of problems as scientific (basic and applied); educational and pedagogical; managerial; technological; informational; legal; organizational; financial and economic; socio-psychological and cultural; personnel (HR).

The latter group is of particular importance and results in the basic principle of innovation. Innovations are formed and implemented by people (personnel). Therefore, the main actor in any innovation process is a person and the basic principle of higher education innovation can be formulated as follows: the effectiveness of the innovation process in the field of higher education is ensured by managers and participants in this process, their creative potential, energy, and talent. Since the innovation process in the field of higher education takes place at different levels, accordingly, managers and participants in this process should be persons who are endowed with appropriate official powers, as well as have the desire and internal strength to experiment, a vision of the problem and prospects, creativity, the courage to take responsibility for the development and implementation of changes, and other properties and character traits necessary for innovation. The ability to work in an ever-changing world is a necessary quality for both senior management personnel, as well as for specialists of all other management levels.

A very important reflection of the crucial importance of innovation in the field of higher education and science is the innovation policy, innovation relations, and innovation culture of the subjects of this field. This sphere is including all higher educational institutions, scientific institutes, organizations, and legal entities involved in the educational and scientific sphere. The problems of innovation policy, innovation relations, and innovation culture of the subjects of higher education and science-universities, scientific (research) institutions, and other organizations related to these areas, which find

themselves in the conditions of academic capitalism, require further research. Also, in our opinion, a very important issue for further research is the formation of a corporate innovation culture of employees at all levels of higher education and science in the conditions of academic capitalism. In future publications authors will consider the main provisions concerning innovation policy, innovation relations, and innovation culture of HEIs on the example of innovation-oriented entrepreneurial universities.

The unique characteristics of higher education as an integral part of the anthroposphere (technosphere) can be formulated as follows (Fig. 2).

Innovations in higher education and science, as an open educational, scientific and cultural system,

should be classified according to their complexity, significance, and functional purpose. For example, large-scale innovations are aimed at improving the efficiency of higher education as an industry that is part of the socio-economic and public-humanitarian complex of the entire country.

Innovations implemented at the regional level are medium-sized. Individual innovations are carried out at the level of HEIs, SIs, and their individual divisions.

Taking into account the level of significance, it is advisable to distinguish international and national educational, scientific and cultural innovations that are aimed at services in the field of education, science, and culture by their scope of application (Fig. 3).

The problem of innovation management in the field of higher education is not to optimally implement individual innovative projects, but to build structural-transformational innovative techniques and qualitative structures of new mechanisms, methods, and forms of activity. At the same time, the primary principle of the process of organizing innovation activities in the higher education system is the purposefulness and specificity of innovations. The goal system should have a well-built hierarchical structure. Also, it is very important for the country's population to understand and support the goals and directions of innovation in the field of higher education and science.

Analysis of the direction and impact of innovation processes in the field of higher education and science on the objects and subjects of innovative transformations certifies

the necessity and importance of intensifying the processes of search and formation of new knowledge and identification their scientific, technical, and applied significance for the further socio-economic development of society, science, and technology.

That is, the development of mechanisms for effective search and further accelerated use of new knowledge is the core of innovative transformations both in society as a whole and in its individual branch – the system of higher education and science.

In the field of higher education, new socio-economic mechanisms of innovation activity should certainly include university or academic entrepreneurship, the latest methods of accelerated transfer of technologies, the formation of start-up and spin-off business structures, and so on.

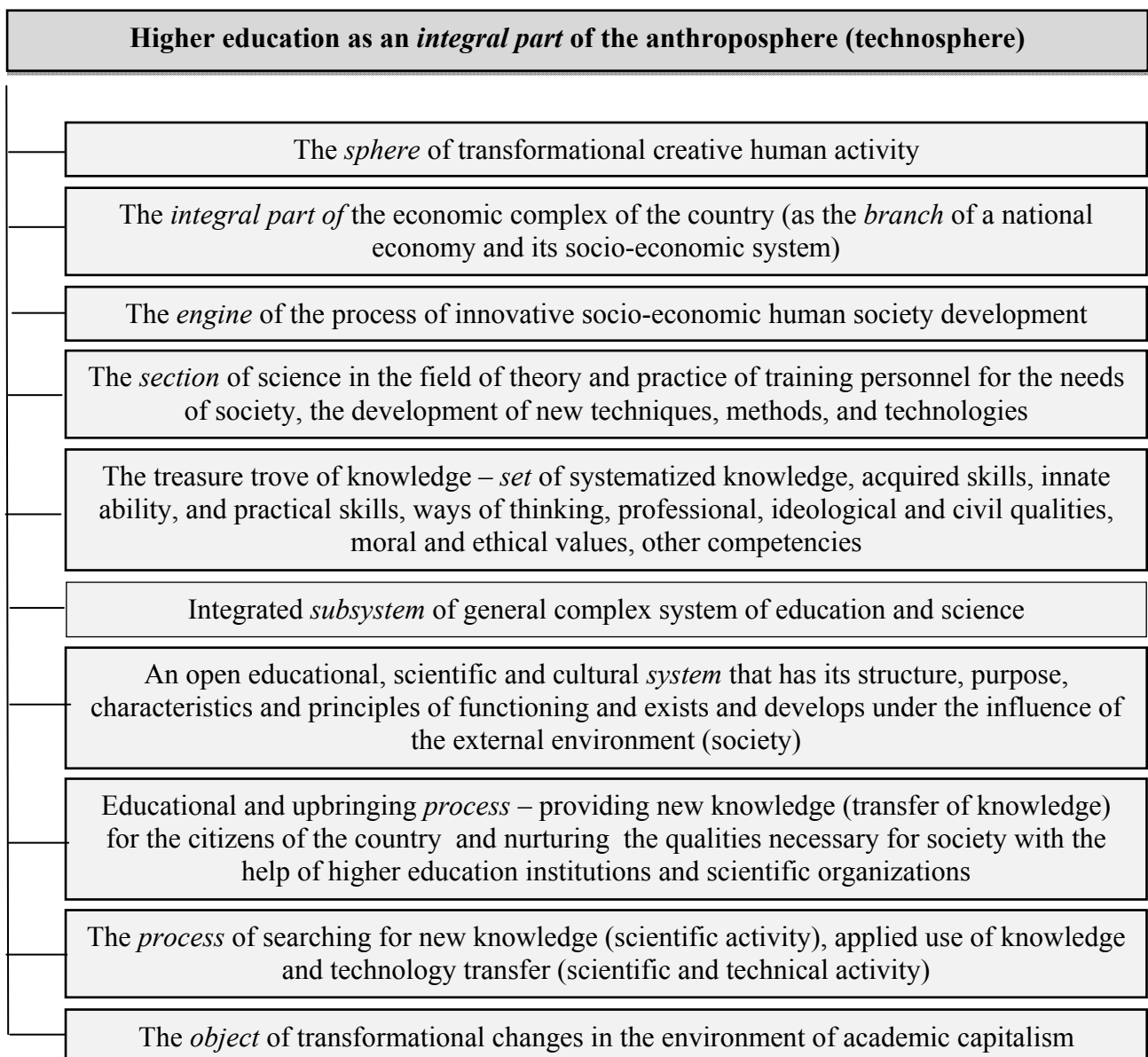


Fig.2. The unique characteristics of higher education

The authors identified the general “orientation of processes of innovative activity in the field of higher education and science on objects and subjects of innovative transformations. Innovative activities in the field of higher education and science are aimed at:

1. Search, formation, accumulation, and analysis of new knowledge.
2. Use and commercialization of basic R&D results, applied research, design, development, and implementation of new equipment and technologies.
3. Transformation of scientific research and development, other scientific and technological achievements into new or improved products, technologies, services introduced to the market, into a new or improved technological process used in practice, or a new approach to social services.
4. Academic (university) entrepreneurship, technology transfer, formation of start-up and spin-off structures.
5. Formation of entrepreneurial mentality and corporate entrepreneurial culture in subjects of innovative activity in the system of higher education.
6. The use of new tools, methods, and technologies to accelerate the economic growth of society
7. Formation of intellectual and formation of human capital.
8. The formation of an innovative climate in the system of higher education and science, the development of higher education innovatics as a scientific-applied and practical direction of transformation and improvement of the sphere higher education and science.” (Romanovskyi & Romanovska, 2020)..

Also, the authors determined the “influence of processes of innovative activity in the field of higher education and science on objects and subjects of innovative transformations. Thus, the “innovative activity in the field of higher education and science affects the objects and subjects of innovative activity for the formation of:

1. Innovative programs and projects.
2. New knowledge and intellectual products, educational and scientific services.

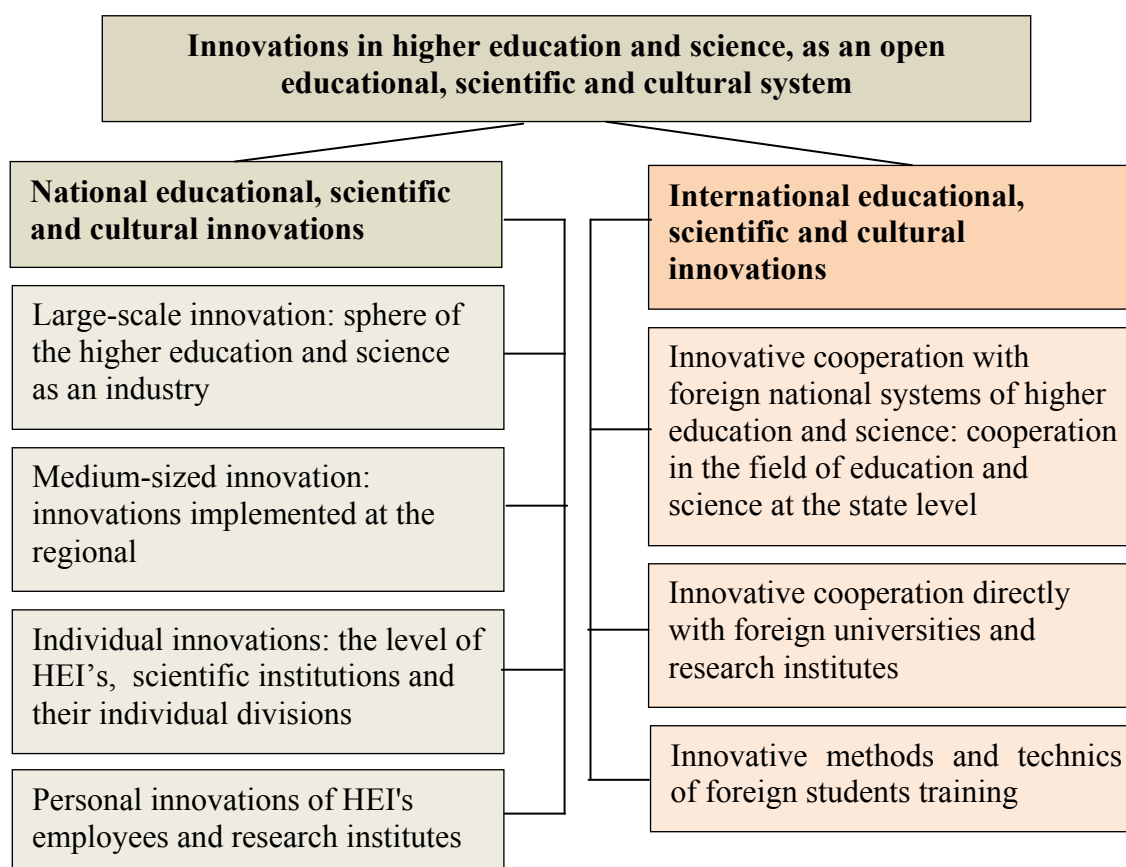


Fig. 3. National and international components of the innovations in the sphere of higher education and science, as an open educational, scientific and cultural system

3. Innovative infrastructure in the field of higher education and science in the national system of the socio-economic and public development, security of human life, support of academic (university) and intellectual entrepreneurship.

4. New organizational and technical solutions of economic, administrative, commercial, or other (non-production) nature, which significantly improve the structure and quality of the national system of the socio-economic and public development as well as the security of human life (non-productive and social spheres).

5. New experimental samples and innovative solutions of engineering and technical nature, innovative technologies for the production of new products (services).

6. Academic (university) entrepreneurship, technology transfer, formation of start-up and spin-off structures.

7. Innovative mechanisms: a) formation (formation) of markets for educational

and scientific services; b) training of labor resources of the necessary qualification; c) education of employees' entrepreneurial mentality and integrated corporate entrepreneurial culture.” [3].

Innovative changes in the field of higher education and science occur at the state, industry, regional, and domestic (at the level of subjects of the higher education and science system) levels. State administration of scientific, technical, and innovative activities in the sphere of higher education and science is an integral part of the country's socio-economic strategy. So, it should be carried out by means of:

- a) monitoring and analysis of the state of achievements of the world and national systems of higher education, science, and technology, technologies and innovations;
- b) development of an image of the future (expected) state of the higher education system, its provision with the necessary scientific, technical, and human resources;
- c) justification of key areas of development of the higher education system in the short, medium, and long term;
- d) creation and support of innovation infrastructure, including its environmental component;
- e) legal support of state support for innovation activities;
- f) financial support for priority areas of innovative development of the sphere of higher education and science;
- g) targeted funding for education and basic research.

State measures should also ensure that:

- a) capital inflows to innovative development of higher education;
- b) a high level of innovation is required;
- c) training a sufficient number of engineers, scientists and management personnel;
- d) facilitating access of national higher education and science to foreign markets.

The role of the state in the management of innovation activities in the field of higher

education and science is an important task of the state. For the state, it is necessary to solve the following most important tasks (Fig. 4):

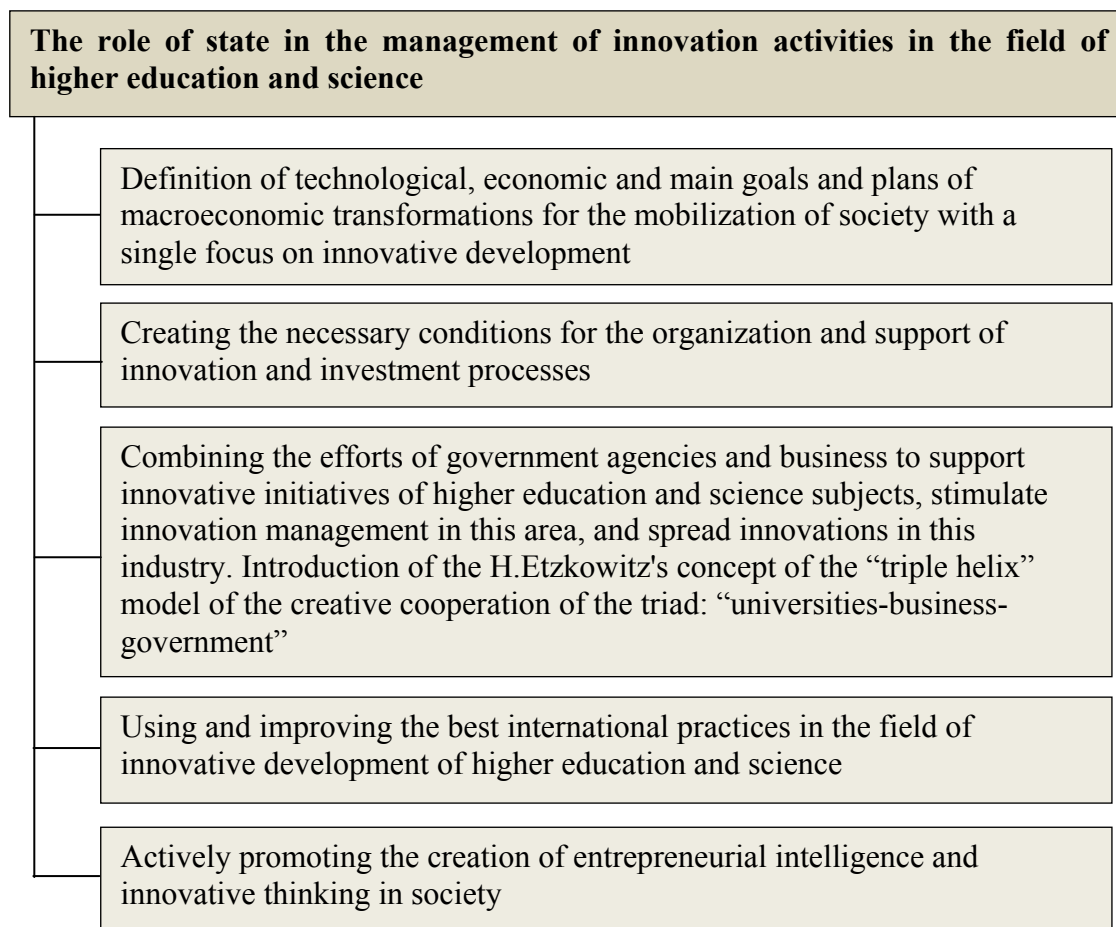


Fig. 4. The most important tasks of the state in the management of innovation activities in the field of higher education and science

1. To determine the technological and economic main goals, and develop a plan for macroeconomic transformations that will mobilize society with a single focus on innovative development.

2. Creating the necessary conditions that best contribute to the innovation and investment process.

3. Combining the efforts of government agencies with business to support innovative initiatives of higher education and science subjects, stimulating innovation management in this area, and spreading innovations in this industry. Support and practical implementation of H.Etzkowitz's concept of innovative development of society by the

“triple helix” model [20-25] (Etzkowitz, 2003; 2008; 2019; Viale & Etzkowitz, 2010; Dzisah & Etzkowitz, 2012; Cadorin et al., 2019).

4. To use and improve the advanced world experience in the field of innovative development of the sphere of higher education and science.

5. Actively promoting the creation of entrepreneurial intelligence and innovative thinking in society

Innovation management should turn into a consolidated interaction of government and business mechanisms. Creating conditions for achieving agreement between the interests of the state and the employee in the field of higher education and scientific and technical activities is the main task of the state level of management. This level becomes strategic, giving tactical and operational control to new innovative individual firms and specialized structures in the field of higher education and science.

At the same time, academic or university entrepreneurship was noted as one of the main motivators and engines of innovation in the sphere of higher education and science.

Summarizing the results of a comprehensive study of the phenomenon of academic (university) entrepreneurship authors noted that entrepreneurial institutions of higher education implement their activities in higher education in the current market laws of the economic system, interacting with internal forces of society (with response to its challenges and inquiries) under the influence of globalization pressure of the world community. The authors argue that innovations in the field of higher education and science must link to lead to innovative changes. It is reasonable to consider HEI's innovative activity in the higher education system as an economic category related to the capitalization and commercialization of intellectual products – knowledge, technology, educational and scientific services, etc.

Innovations in higher education and science can lead to innovative change. These can be innovations of the following types (Fig. 5): economic and market; technological; organizational; structural and pedagogical; educational and pedagogical. Most of them are either directly or indirectly initiated by academic capitalism.

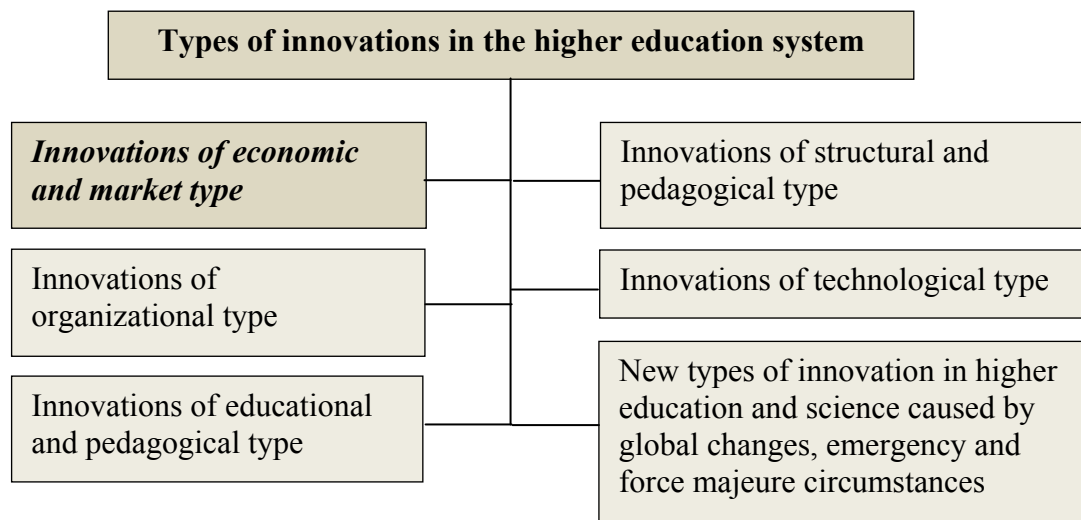


Fig. 5. Types of innovations in the higher education system that can lead to innovative changes

The authors determined that “*Innovations of economic and market type* (Fig. 6) united novations caused by the scientific, technical, industrial, and economic development of society and the spread of market economic relations in all areas of socio-economic activity of mankind, the commercialization of educational and scientific and technical activities of HEI and all higher education (*innovations of economic and industrial development, depending on market requirements*).” [3] (Romanovskii, 2012).

Economic and market innovations include such innovations that allow to reduce the budget funding for higher education and science to obtain the necessary resources not only for survival but also for the prosperity of HEI. They are:

1. New forms and types of financing of education and crediting of educational services, educational institutions of various types, statutory (including – educational, R&D, technological and cultural) activity of educational institutions; diversification of funding sources; formation of various funds, grants, endowment institute, etc.

2. Commercialization of educational results (contract forms of education, educational, consulting, expert, and other services), scientific and scientific-technical activities (R&D, transfer of technology) HEI, obtaining additional financial income from extracurricular activities (lease of property, organization of mass activities for local and regional communities, etc.).

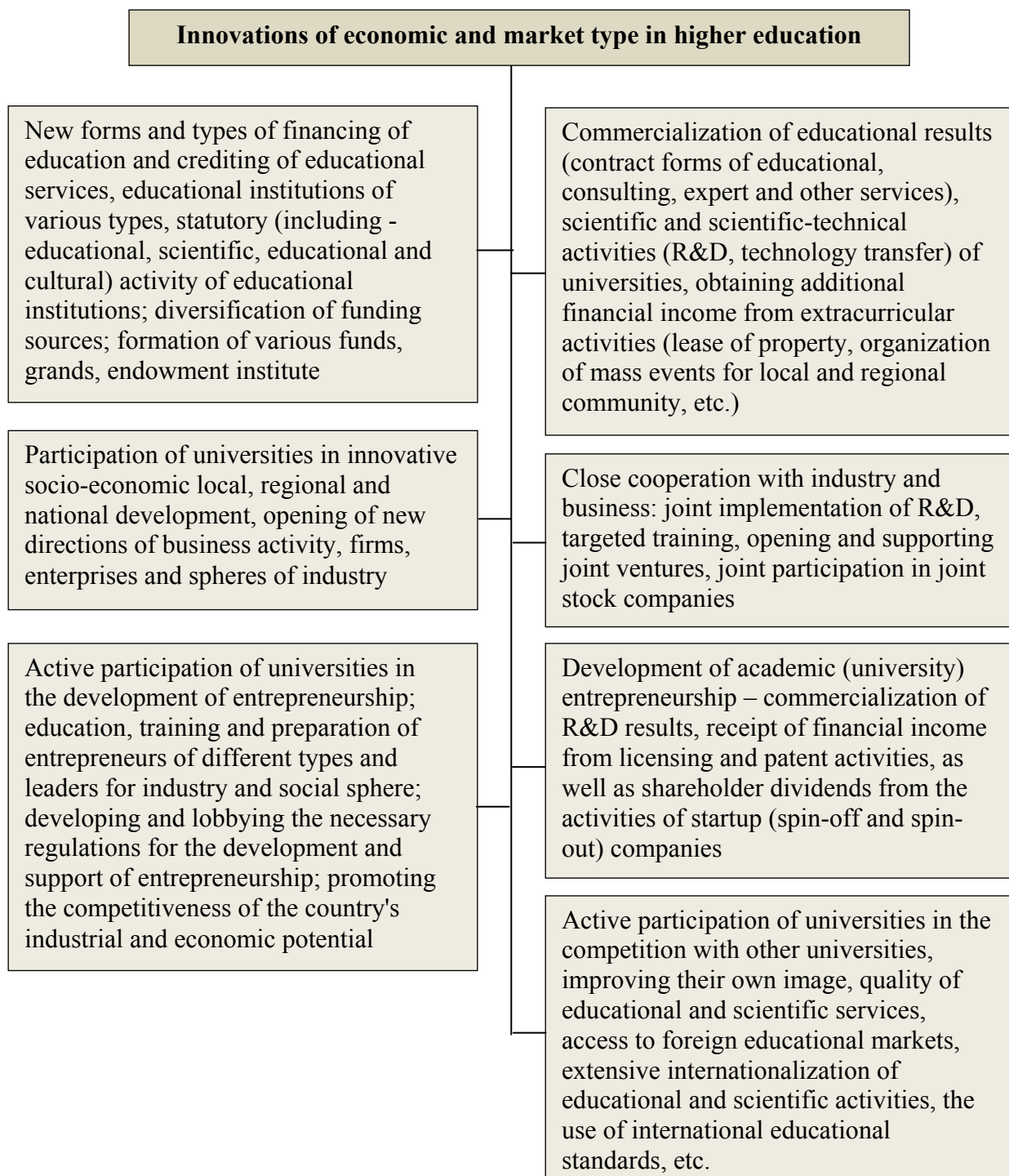


Fig. 6. Innovations of economic and market type in higher education

3. Participation of HEI in innovative socio-economic local, regional and national development, opening of new directions of business activity, enterprises, and spheres of industry.

4. Close cooperation with industry and business: joint implementation of R&D, targeted training, opening and supporting joint ventures, joint participation in joint-

stock companies.

5. Active participation of HEI in business development; education, training and preparation of entrepreneurs of different types and leaders for industry and social sphere; developing and lobbying the necessary regulations for the development and support of entrepreneurship; promoting the competitiveness of the country's industrial and economic potential.

6. Development of academic (university) entrepreneurship - commercialization of R&D results, receipt of financial income from licensing and patent activities, as well as shareholder dividends from the activities of startup (spin-off and spin-out) companies.

7. Active participation of HEI in competition with other HEIs, improvement of own image, quality of educational and scientific services, access to foreign educational markets, wide internationalization of educational and scientific activity, use of international educational standards, etc.

Note that *innovations in economic and industrial development, dependent on market requirements*, are the most painful, debatable, and unacceptable for a significant number of educators and scientists. The intrusion of market mechanisms into the academic sphere contradicts in many respects the notion of “pure science and education”, which are independent of financial interventions and financial pressure. However, it is also clear that in the context of total commercialization of all spheres of human life, global financial crises, and the constant reduction of funding for science and education (and especially higher education), the question of “to be or not to be” really faces a significant number of HEIs and research institutions, and also a large number of educators and scientists in all countries of the world. In those countries where education and science are supported, the necessary conditions have already been created for their civilized alternative financial support.

It is necessary to stress that university innovations are the result of the development of academic capitalism and studies mainly both its market innovation processes spreading to the sphere of higher education and their impact on the socio-economic sphere of society.

6. Conclusions and recommendations

Higher education is associated with all spheres of human life because literate and trained people are needed for life. Thus, the innovation of higher education is one of the most interdisciplinary scientific and applied areas in the system of the diverse knowledge of mankind.

Innovative activity in the field of higher education and science leads to serious innovative transformations both in the entire field of higher education and science and in its subjects – universities, research institutes, and related organizations and institutions. Innovation activities, initiated and directed by academic capitalism in the field of higher education and science, are primarily aimed at commercializing the results and expanding the economic activity of universities and research institutes, and only with a focus on social and socio-humanitarian problems of society. The state initiatives in the field of innovative management of higher education and science in each country are designed to strengthen the social, non-profit component of innovation in this area.

Further expedient research in the field of innovation in higher education is the study of the “human factor” during the period of innovation, namely: innovation policy, innovation relations, and innovation culture of subjects of higher education and science. The study of innovation in this area can be interesting and useful for a wide range of researchers since this area includes all higher educational institutions, scientific institutions, and organizations, as well as legal entities involved in the educational and scientific sphere. It should be noted that the problems of innovation policy, innovation relations, and innovation culture of universities and research organizations that find themselves in the conditions of academic capitalism require careful further research. And the formation of a corporate innovative culture of employees of all levels of higher education and science in the conditions of academic capitalism can be decisive in the implementation of the necessary innovative changes.

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