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Concepts, Theoretical Approaches and Models of Higher Education and Science Innovatics

The article is devoted to the consideration of concepts, theoretical approaches, and models of higher education and science innovatics. The main sections that can include the theory and practical implementation of higher education and science innovatics are shown.

Keywords: *innovatics, higher education innovatics, innovations, innovation activities, innovation models*

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Introduction

Academic capitalism, which is based on university entrepreneurship and also on the commercialization of R&D results of research institutes and laboratories, has created optimal opportunities for the development of innovative activities in the field of higher education and science (HE&S). HE&S innovatics studies the economic, scientific, technical, organizational, and educational aspects of innovative activity both in the entire sphere of higher education and science and in its structural elements — higher educational institutions, scientific institutions, and research organizations. In other words, the objects of study in HE&S innovatics are the sphere (field, industry) of higher education and science, and its components — higher educational establishments (universities, institutions, colleges) and scientific-research institutions.

The subject of study in the innovatics of higher education and science is the educational (training) process; the upbringing of students; fundamental and applied R&D; creating and implementing of new techniques and technologies; an educational or scientific service; and all items that belong to these activities.

Concepts of HE&S innovatics

The concepts of innovation and entrepreneurship are among Schumpeter's most outstanding contributions to economic theory. And, of course, one of the most important themes in Schumpeter's writings was the role of innovation or "new combinations" and entrepreneurship in economic growth. In the "Theory of economic development" [1] and further work [2–3], Schum-

peter described the development as the historical process of structural changes, substantially driven by innovation which was divided into five types [3]:

1. Launch of a new product or a new species of already known product.
2. Application of new methods of production or sales of a product (not yet proven in the industry).
3. Opening of a new market (the market for which a branch of the industry was not yet represented).
4. Acquiring new sources of supply of raw material or semi-finished goods.
5. New industry structure such as the creation or destruction of a monopoly position.

Thus, for Schumpeter, innovations are novel combinations of knowledge, resources, etc. subject to attempts at commercialization — it is essentially the process through which new ideas are generated and put into commercial practice.

The theoretical foundations of innovation proposed by J. Schumpeter are also fundamental for HE&S innovatics theory. Also, Everett M. Rogers made a great contribution to the development of the theory of diffusion of innovations [4–5].

Considering works, devoted to the theory of innovation, it would be desirable to note the following publications. The Oslo Manual [6] is one of the universally used guidelines for collecting and analyzing innovation performances. The article [7] examines innovative business models developed by entrepreneurs outside of higher education institutions (in the field of educational technologies). The main elements of innovative business models in the field of “edtech” startups in the field of higher education are analyzed and the most original teaching and learning practices are identified.

In the publication [8] it is shown that: a) the student’s vision of the landscape of higher education contributes to institutional support for management and quality assurance; b) innovation is not simply based on technology but on the use of new technologies to more fully and effectively achieve the goals of (higher) education for all.

The works [9–11] present the theoretical and practical foundations of innovatics.

The article [12] is devoted to clarifying the concept of “higher education innovatics” and

considering the examples of the use of the term “innovatics” in other areas and cases of application — in the formation of the modern theory of innovatics; in pedagogical innovatics; and also in the innovatics as a new toolbox of skills for innovative production managers.

This article briefly presents the main formalized concepts, theoretical foundations, and models of innovation in the field of HE&S. It is important to note that fundamental theoretical, methodological, applied, and practical foundations and concepts of the science of “innovation” can be used to a greater or lesser extent in the study of HE&S.

- The theory and practical implementation of HE&S innovatics can include the following main sections of innovative activity in the sphere of innovatics of higher education [12]:
- The concept of HE&S innovation activity.
- Theoretical bases of HE&S innovation activity.
- Models and modeling of innovative processes.
- Organization and management of innovation activities.
- State regulation of innovation activity.
- Commercialization of the results of scientific, technical, and creative activities and management of the innovative.
- Innovation project management.
- Investment management in innovative projects.
- Human resource management in the process of innovative development of the sphere of higher education and science as an integral part of the socio-economic system.
- Risk management in innovation.
- Technical marketing (marketing in the early stages of a product or technology life cycle).
- Logistics of innovative processes.
- Innovative methods of environmental protection, ecological and resource-saving technologies.
- Intellectual property management.

First, let us consider the **definition of key concepts** of the HE&S innovation activity. We will carry out our consideration using as a base definitions and concepts from the Eurostat Dictionary of Science and Technology [13].

It should be noted that the HE&S innovation framework is a fundamental set of theories, practices, and tools that help higher education and research institutions generate ideas, evaluate them, and turn the best ideas into added value in the sphere of academic business (in the field of educational and research activities).

1. HE&S innovation activity.

HE&S innovation activities are all scientific, technological, pedagogical, psychological, organizational, environmental, life-protection and resource-saving, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations in the field of higher education and science. Some HE&S innovation activities are themselves innovative; others are not novel activities but are necessary for the implementation of innovations. HE&S innovation also includes research and development (R&D) innovations that are directly related to the development of a specific innovation.

A common feature of a HE&S innovation is that its results must have been implemented. A new product or improved HE&S innovative product is executed when it is introduced to the educational and scientific market. New (innovative) product, processes, marketing methods or organizational methods in HE&S are implemented when they are brought into actual use in the universities, colleges, institutions, and educational and R&D firm's operations.

HE&S innovation activities vary greatly in their nature from one educational or scientific establishment to another. Some establishments engage in well-defined innovation projects, such as the development and introduction of a new innovative product, whereas others primarily make continuous improvements to their products, processes, and operations. Both types of establishments can be innovative: an innovation can consist of the implementation of a single significant change, or of a series of smaller incremental changes that together constitute a significant change.

2. HE&S product.

HE&S product consists of the result of scientific research or university studying/education, and/or educational or scientific service. It also includes scientific and applied research, technical and educational pedagogical characteristics, necessary components and materials, embed-

ded software, user-friendliness, methodological issues, and other functional characteristics.

The product may use knowledge or technology or may be based on applications or combinations of existing knowledge or technology.

The term "HE&S product" is used to cover both the results of research and scientific and pedagogical services and include the introduction and use of R&D results and scientific and pedagogical services on the educational and scientific market.

3. HE&S new (innovative) product.

A new (innovative) HE&S product is an R&D result or an educational or scientific service that differs significantly in terms of its characteristics or purpose from products previously produced by the educational, or scientific establishment.

Developing a new use for a HE&S product with only minor changes in its technical characteristics is a product innovation.

A HE&S novel product is a new or improved product not, only new for the establishment, but also for the educational and scientific market.

4. HE&S innovation.

HE&S innovation is the use of new educational or scientific ideas, products, or methods that have not been used before. For the Community Innovation Survey (CIS), an innovation is defined as a new or significantly improved product (good or service) introduced to the market or the introduction of a new or significantly improved process in an enterprise [14].

HE&S innovations are based on the results of new educational, scientific, or technological developments, new combinations of technologies, or the use of other knowledge obtained by the institution. Innovations can be developed by an innovative educational or scientific institution or another establishment. However, the pure sale of innovations entirely produced and developed by other institutions is not considered an innovative activity of the establishment, nor is the introduction of products with purely aesthetic changes.

The innovation must be new to the institution concerned: for product innovation it need not be new to the market, and for process innovation the institution need not necessarily be the first to introduce the process.

Establishments that carry out innovative activities cover all types of innovators, including educational or scientific product and process innovators, as well as those establishments that

carry out only ongoing and/or discontinued innovation activities. The share of institutions that carry out innovative activities is also called the propensity (tendency) to innovate.

HE&S product innovation is the introduction to the market of a new or significantly improved educational or scientific product or service.

A HE&S process innovation is the introduction of a new or significantly improved educational or scientific process, distribution method, or support activity for R&D results or services.

5. Research and development (R&D).

Research and experimental development is carried out in the HE&S field by universities, colleges, and scientific institutions using the newest research methods, techniques, and technologies. R&D is innovative because it leads to new discoveries and advances in basic and applied research. R&D carries out new design developments and improves existing outcomes. According to Commission Implementing Regulation (EU) "Research and experimental development (R&D) includes creative and systematic work carried out with the aim of increasing the stock of knowledge — including knowledge about humanity, culture, and society — and developing new applications of existing knowledge [15]."

6. HE&S product innovation.

HE&S product innovation is the implementation of the results of scientific research or educational or scientific services that are new or significantly improved in terms of their characteristics or intended use. This includes significant improvements in technical characteristics, components and materials, embedded software, user-friendliness, methodological or pedagogical issues, and other functional characteristics.

Product innovations may use new knowledge or technology or may be based on new applications or combinations of existing knowledge or technology. The term "HE&S product" is used to cover both the results of research and scientific and pedagogical services. HE&S product innovations include both the introduction of new R&D results and scientific and pedagogical services, as well as significant improvements in the functional or user characteristics of existing R&D results and educational services on the educational and scientific market.

7. HE&S process innovation.

HE&S process innovation is the implementation of new or significantly improved R&D re-

sults or delivery of novel methods in educational and scientific activity. This includes significant changes in R&D, techniques and technologies, education and research methods, equipment, software, etc.

Process innovations can be intended to decrease unit costs of production or delivery of R&D results and education activity, to increase quality, or to produce or deliver new or significantly improved products.

Process innovations include new or significantly improved methods for the creation and provision of services in the sphere of HE&S. They can involve significant changes in the techniques and technologies, education and research methods, equipment, and software, used in services-oriented institutions or in the procedures or techniques that are employed to deliver services.

Process innovations also cover new or significantly improved techniques, equipment, and software in ancillary support activities, such as management, marketing, accounting, computing, advertising, students and personal recruiting, purchasing, and maintenance. The implementation of new or significantly improved information and communication technology (ICT) is a process innovation if it is intended to improve the efficiency and/or quality of ancillary support of establishment activity and scientific and educational process organization.

8. HE&S marketing innovation.

HE&S marketing innovation is the introduction of a new method of marketing, which involves significant changes in the institution's organization of scientific research, design and development, and educational and upbringing activities in order to obtain competitive and high-quality results that can interest users. It is important to highlight and disseminate the innovative achievements of a scientific institution or educational establishment; design materials regarding the achievements and advantages of the institution's activity in the market of educational and scientific services, high level of employment of graduates; innovative advertising and positive feedback from employers; informing potential users about further development of the institution, etc.

It is necessary to apply the latest approach HE&S to the further promotion of the establishment to the international educational and scien-

tific markets and innovative methods of pricing in the institution.

Marketing innovations are aimed at better meeting customer needs, opening or capturing new markets, and repositioning HE&S of the institution's product on the markets with the aim of increasing student recruitment and strengthening the material and financial condition of the establishment.

A distinctive feature of a marketing innovation compared to other changes in an institution's marketing tools is the introduction of a marketing method that the institution has not used before. It should be part of a new marketing concept or strategy that represents a significant departure from the establishment's existing marketing methods. A new marketing method may be developed by the innovator institution or adopted by other institutions or establishments. New marketing techniques can be applied to both new and existing HE&S products.

9. HE&S organizational innovation.

An organizational innovation is the implementation of a new organizational method in the educational establishment or scientific institution business practices, workplace organization, or external relations.

Organizational innovations can be intended to increase the establishment or an institution's performance by reducing administrative costs or transaction costs, improving working and study conditions, expanding professors' scientific potential and professional internships, flexible system of bonuses for high-performance, and improving workplace satisfaction (and thus labor productivity), gaining access to non-tradable assets (such as non-codified external knowledge) or reducing costs of supplies.

The distinguishing feature of an organizational innovation compared to other organizational changes in an educational establishment or scientific institution is the implementation of an organizational method (in business practices, workplace organization, or external relations) that has not been used before in the firm and is the result of strategic decisions taken by management.

10. Innovatively active educational organization or scientific institution.

An innovatively active educational organization or scientific institution is one that conducted innovative activities during the period under

review, including those that continued or ceased such activities.

Educational organizations or scientific institutions that carried out innovative activities during the period under review, regardless of whether this activity led to the introduction of innovation, are innovatively active.

11. Innovating educational organization or scientific institution.

An innovating educational organization or scientific institution is one that has introduced new or improved products or services on the educational and scientific market or new or improved processes. An educational organization or a scientific institution can have innovation activity without introducing an innovation on the market (it may either have unsuccessful or not yet completed innovation projects).

Theoretical approaches and models of HE&S innovatics

Second, let us look at the main **theoretical bases** of HE&S innovation activity. It is necessary to note that sometimes we will carry out our consideration using as a base some definitions and concepts from the "Innovation glossary: O" [16].

The theoretical approach HE&S to the study of HE&S innovation activities are quantitative and qualitative in nature using elements of economic and engineering analysis, such as the design and creation of educational and scientific products or services and patents, humanistic aspects of psychology, such as leadership, organizational culture, as well as theory and practice pedagogical activities. The innovative ideas and practices of academic capitalism, university entrepreneurship, environmental approach HE&S in higher education and scientific activity, resource-saving technologies, etc. are widely studied.

The theories of innovation are important because developing successful innovations may never become an entirely predictable exercise, but by applying innovation theories to help demystify complex problems, innovators can surely increase their odds of success.

Joseph A. Schumpeter proposed the "Innovation Theory of Profit", in which he believed that an entrepreneur could earn economic profit by introducing successful innovations.

1. The importance of the Joseph A. Schumpeter's **theory of innovation** for HE&S innovatics, and the function of this innovation theory.

Schumpeter believed that it was necessary to introduce successful, well innovations. The innovation theory of profit claims that the main function of an entrepreneur is to introduce, well, innovations — which Schumpeter defined as any new policy that reduces the overall cost of production or increases the demand for products. In other words, Schumpeter deemed Profit as the reward to enterprise and innovation. In his opinion, the entrepreneur initiates innovation in the business and when he succeeds, he earns profit as his reward.

As Joseph Schumpeter states, the effective function of an entrepreneur is to start innovation in venture. This theory is also called innovation theory or dynamic theory. According to this theory, entrepreneurs emerge because of individuals having certain psychological elements i.e., will power, self-intuitions, tolerance capacity. Also, J. Schumpeter stressed, that the process of technological change in a free market consists of three parts: invention (conceiving a new idea or process), innovation (arranging the economic requirements for implementing an invention), and diffusion (whereby people observing the new discovery adopt or imitate it) [17].

2. The main contributions of the Everett M. Rogers' **theory of innovation diffusion** [4–5].

Diffusion of Innovation Theory, developed by Rogers in 1962, is one of the oldest social science theories. It originated in communication to explain how, over time, an idea or product gains momentum and diffuses (or spreads) through a specific population or social system.

Theory of HE&S innovation is propagated and diffused in certain channels within a university or scientific institution to deliver information and discover factors that impact an innovation's rate of acceptance into society. According to the theory, the three primary factors that enable the diffusion of innovation are communication, ties, and social systems.

The diffusion of innovations theory describes the pattern and speed at which new ideas, practices, or products spread through a population. The main players in the theory are innovators, early adopters, early majority, late majority, and laggards.

The stages, by which an educator or scientist person adopts an innovation, and whereby diffusion is accomplished, include awareness of the need for an innovation, decision to adopt (or reject) the innovation, initial use of the innovation to test it, and continued use of the innovation.

In the diffusion of innovations theory, Rogers identified five attributes that impact the rate of adoption: high relative advantage, compatibility, low complexity, trialability, and observability. These characteristics are likely to succeed over innovations that do not.

3. The **five stages of diffusion of innovation theory**.

According to Rogers [5], the innovation-decision process involves five steps: knowledge, persuasion, decision, implementation, and confirmation. These stages in the sphere of HE&S typically follow each other in a time-ordered manner.

4. The **three important theories of innovation** [18].

The three theories of innovation useful for HE&S sphere are the following:

- Product-process concept. When creating and introducing something new to the market, the innovative process must have the essential parts or stages.
- Meta-learning concept.
- Concept of technological interdependence.

5. The **innovation process**.

An innovation process in the sphere of HE&S is a set of steps between an idea's conception and its implementation. It is a streamlined process that is managed in a way that reflects a company's structure and innovation goals.

A process innovation is the implementation of a new or significantly improved educational or scientific production or delivery method. This includes significant changes in techniques, equipment and/or software.

The innovation process begins with a felt need for change and culminates in its successful implementation. Key process stages include the generation of ideas, the development of the most promising, and their acceptance by relevant parties.

That is why an innovative process is the translocation of an idea into educational or scientific product or services that create value. In HE&S business, innovative processes can help prod-

ucts or services seem more appealing to customers and may increase an institution's competitive advantage.

As a rule, there are six stages in the HE&S process of innovation: generating ideas, capturing ideas, beginning innovation, developing a business-effectiveness strategy, applying business improvement, and decline.

A successful innovation process runs in the following ten steps [19]:

- Step 1: Define innovation.
- Step 2: Define the goals.
- Step 3: Assemble your team.
- Step 4: Secure the budget.
- Step 5: Create diverse teams.
- Step 6: Select collaboration tools.
- Step 7: Don't be afraid to take risks.
- Step 8: Implement incrementally.
- Step 9: Evaluate and improve.
- Step 10: Work on your culture of innovation.

6. The **three open models of innovation process**.

Open innovation theory refers to three different models, depending on the direction of the knowledge flows that a higher educational establishment or a scientific-research organization wish to leverage [20]:

- Outside-in open innovation (or inbound knowledge flow).
- Inside-out (or outbound knowledge flow).
- Coupled open innovation (combining knowledge inflows and outflows).

7. The **six key elements of innovation**.

In his research at Harvard Business School and Babson College, Professor Daniel Isenberg delineates a framework of the six key elements of an innovation ecosystem: people, markets, policy, culture, finance, and infrastructure support. He identifies six domains within the entrepreneurial system: a conducive culture, enabling policies and leadership, availability of appropriate finance, quality human capital, venture friendly markets for products, and a range of institutional supports [21–22]. All of these domains may be effectively used in the HE&S theory.

8. The **four main types of innovation**.

The four main types of innovation [23] are:

- Sustaining, or incremental innovation.
- Breakthrough innovation.
- Disruptive innovation.
- Basic research.

These four types of innovation are included in the HE&S theory.

9. The **seven elements of innovation**.

The elements, or success factors, to innovate effectively are structured in seven key areas [24]: context, leadership, planning, support, operations, evaluation, and improvement.

Recommendations to higher educational establishments and research organizations are provided in each area.

10. The **seven steps of the innovation process**.

The starting point is a solid understanding of the innovation process itself. John Campbell breaks down the innovation process into a sequence of seven steps: preparation, exploration, incubation, insight, prototype and trial, planning and execution, and reflection and evaluation [25]. All of them are useful for HE&S field.

11. The **six types of innovation models**.

The research [26] revealed six distinct innovation models which may be used in the HE&S sphere: creator, solution builder, leverager, expander, defender, and fast follower.

12. The **seven sources of innovation** [27]. It is necessary to go out looking for innovation opportunities in seven key areas of HE&S:

- Unexpected occurrences.
- Incongruities.
- Process needs.
- Industry and market changes.
- Demographic changes.
- Changes in perception.
- New knowledge.

13. The **four key areas of innovation** [28].

The four key elements of innovation in the field of HE&S are:

- Collaboration.
- Ideation.
- Implementation.
- Value creation.

Innovation requires collaboration, ideation, implementation and value creation. Community developers actively engaged in innovation illustrated each of elements during breakout sessions.

14. The **five methods of innovation** [29].

To use five methods to inspire innovation within the university or scientific institute it is necessary:

- To embrace failure.
- To dedicate the right resources.

- To expose employees to open innovation.
- To consider offering incentives.
- To train employees in design thinking.

15. The four Ps of innovation.

It is useful for business leaders in all spheres of human activity to understand the four Ps of innovation: paradigm, process, position, and product [30]. The four Ps of innovation is a framework developed to help the university or scientific institute business create more efficient, effective, and innovative educational and/or scientific products, services, and processes.

16. The seven Cs of innovation.

The seven Cs of innovation [31], acceptable for the sphere of HE&S, are:

- Consistency — in the approach/support/provision of educational and scientific products or services, a university or scientific institute is required to achieve the results that it would like to receive both from itself and from its partners.
- Constraint — drives innovation.
- Continuous improvement.
- Collaboration.
- Challenge.
- Celebrate.
- Culture.

17. The nine types of innovation models.

If we put every major innovation model side by side a pattern emerges — they are all doing roughly the same thing with only a change to the first step [32].

- Ancient Greeks Creativity Model:
 - › Inspiration.
 - › Ideate.
 - › Plan.
 - › Make.
- Design Thinking's Innovation Model:
 - › Empathize.
 - › Ideate.
 - › Prototype.
 - › Make.
- Jeremy Gutsche (trends hunter) Model for Innovation:
 - › Trends Analysis.
 - › Ideate.
 - › Plan.
 - › Make.
- Equity Centered Community Design Creativity Models:
 - › Power Context / Informed Empathy.
 - › Ideate.

- › Prototype.
- › Make.
- Frame Innovation's Model:
 - › Archeology & Reframing.
 - › Ideate.
 - › Transformation.
 - › Integration.
- The Innovator's Dictionary Model for Creativity:
 - › Deep Analysis.
 - › Ideate.
 - › Plan / Prototype.
 - › Make.
- Radical Innovation Playbook's Model for Creativity:
 - › Inspiration.
 - › Ideate.
 - › Plan.
 - › Make.
- Disciplined Entrepreneurship's Model for Innovation:
 - › Inspiration.
 - › Ideate.
 - › Plan.
 - › Make.
- Lateral Thinking — A Model for Innovation:
 - › Mind Loosening / Creativity Exercises.
 - › Ideate.
 - › Plan.
 - › Make.

These provisions, possibly, are also valid for the field of HE&S.

18. The ten types of business model innovation [33].

Doblin's Ten Types of Innovation is a model that can be used to revisit existing strategies to develop viable innovations across all levels of higher educational and scientific-research organization:

- Profit Model provides insight into how best to structure the internal operations of a company to maximize profits.
- Network focuses on creating multiple channels through which a company interacts with its customers.
- Structure concentrates on how best to design organizational structures that are suited to delivering efficient results.
- Process examines both internal processes within an organization, such as manufacture or delivery, as well as customer processes, such as registration or purchase.

- Product Performance looks at ways to make products more useful or appealing.
- Product System covers both interrelated elements within one product (e.g., hardware & software) as well as combined components within different products (e.g., integration between two separate systems).
- Service works towards improving customer service efficiencies by streamlining processes like setting up accounts or ordering items online.
- Channel entails finding better ways to communicate with potential customers through digital channels such as online advertising campaigns.
- Brand deals with enhancing brand loyalty among existing customers while also working towards increasing visibility among prospective clients; and
- Customer Engagement pays special attention to creating a connection with customers through activities such as loyalty programs or VIP access. attention to creating a connection with customers through activities such as loyalty programs or VIP access.

19. The **nine most common forms of innovation** [34].

- Product innovation. This type of innovation generally consists of a more recent (improved) version of an existing higher educational or scientific-research product (results of the mentioned above institutional activity). As where noted before the HE&S product innovations can be disruptive or incremental. Disruptive innovation refers to a totally new HE&S product. Incremental innovation consists in improving existing HE&S products.
- Innovation in services. This type of innovation provides a way to improve the interaction of HE&S institutions with customers who are increasingly accountable and well-informed. HE&S customers are changing and are likely to see many alternatives and possibilities. That is why, it is crucial to optimize your own services and innovate on a regular basis by providing chat-bots and online services for their independent distance learning, helping customers learn by themselves, by launching new internet technologies, or by using artificial intelligence to predict customer behavior. Business model innovation. Sometimes, you also have to take a chance and question your business model. Does your current approach enable you to meet your objectives or have more effective options appeared in the meantime? This is obviously an important decision which cannot be taken lightly. What business models are your competitors using; can you take your cue from successful international models, or is a slight adjustment to your current economic model enough? Our advice: the Business Model Canvas will help you find the answers.
- Organizational structure innovation. This type of innovation can be useful if you have employees. Remote work, flexible work schedules, redistribution of responsibilities, new internal communication channels, the Agile Method, etc. are examples of the options available to you. It is necessary to stress that the Agile methodology is a project management approach that involves breaking the project into phases and emphasizes continuous collaboration and improvement. Teams follow a cycle of planning, executing, and evaluating. There are many useful innovation tips for higher educational and research institution organizational structure.
- Market innovation. This type of innovation consists of introducing HE&R institution's products or services to new markets, for example, by exporting. With good preparation and a clearly defined export strategy, some foreign markets can be more accessible than in own country. Market innovation can, however, also involve other sectors and new users in your own country.
- Technological innovation. The fourth industrial revolution is ramping up. New technologies like the Internet of Things (IoT), 5G, artificial intelligence (IA), virtual reality (VR), blockchain, and machine learning are more accessible than ever. As a result, these technology skills are no longer reserved for the few. These are very important and attractive activities in the field of HE&S.
- Sustainable innovation. In major cities, sustainability is an omnipresent source of opportunity. Successfully ensuring the

sustainable development of a university or scientific institute, educational and scientific products or services helps to attract more and more consumers. The development of innovative methods and techniques of higher education, as well as new results of scientific research, will increase the efficiency of the organization and improve control of costs and expenses.

- **Process innovation.** Process innovation is intended to make a university's or scientific institute's processes faster, more efficient, more customer-oriented, or more profitable to optimize operations. In other words, it is necessary to innovate the process behind educational and scientific products or services. Many HE&S institutions can still become more efficient by opting for digital transformation.
- **Trademark innovation.** When consumers think of a university or research institute, they automatically associate certain values and characteristics with its brand. For sustainable growth and continuous success, it is necessary to strengthen, improve, and maintain at a high level the brand of an educational or scientific institution. The main goal is to avoid scaring off existing customers and attract new ones.

Now let us consider some additional definitions from innovation terminology [16].

Opportunity Solution Tree. The Opportunity Solution Tree (OST) is a tool innovation consultants use to identify and explore potential opportunities for innovation in a HE&S industry or market. The tree provides a visual representation of the opportunities available and their potential solutions, allowing consultants to identify the most promising areas for development.

Output Metrics. Output metrics are measures of performance that indicate the success of a particular process or activity. They are used to assess the effectiveness of the higher educational or research organization's operations and can be used to identify areas for improvement. Output metrics measure the results of a higher educational or scientific-research activity or process, such as sales revenue, customer satisfaction, cost savings, or productivity.

Operational Expenditure Savings. Operational Expenditure (OPEX) savings refer to the

cost-saving measures a higher educational establishment or scientific-research organization takes to reduce operating costs. It is an integral part of any business strategy as it helps to improve profitability and efficiency. OPEX savings can be achieved through various methods, including reducing overhead costs, streamlining processes, and improving productivity.

Oligopoly. An oligopoly in the sphere of higher education and science is a market structure characterized by a small number of higher educational and/or research organizations that dominate the HE&S industry and have significant control over pricing. Oligopolies are formed when for new higher educational and/or research organizations there is a high barrier to entry into the existing mature market, such as high start-up costs or government regulations. This allows the existing higher educational and/or scientific institutions to maintain their market share and keep out potential competitors.

Oligopsony. Oligopsony in economics is a market situation characterized by a limited number of consumers and a large number of sellers (producers). In such a market, sellers are very sensitive to each other's pricing policies and marketing strategies. Thus, oligopsony in the sphere of HE&S is a market structure in which only a small part of potential users — buyers of services of higher educational institutions and research organizations have the opportunity to influence prices and other market conditions. This type of market structure is characterized by a high degree of concentration of users/buyers of such services, which gives them the opportunity to dictate terms to universities and research institutes (sellers of such services).

Open Collaboration. An Open Collaboration at HE&S is an approach to how universities and research institutions work together that encourages everyone to openly share their ideas and join forces to achieve the common goal of building a knowledge society. In this type of collaboration, many people from different higher education and research organizations with different skills and perspectives come together to jointly/collectively create the best HE&S products and services.

Open Innovation. Open Innovation in higher education and science is a business practice that encourages using external and internal ideas, resources, and knowledge of the HE&S sphere to drive innovation.

It involves collaboration between universities, research institutions, and individuals to create new products, services, and technologies. Open Innovation encourages all of them to share their ideas with other partners to develop better solutions faster.

Open Innovation 2.0. Innovation 2.0 (OI2) is an open version of open innovation that seeks to create new knowledge, technology, and business models by leveraging the combined capabilities of multiple universities, research institutions, and individuals across various sectors. Instead of relying solely on internal resources for innovation and problem-solving, Open Innovation 2.0 expands the range of potential solutions by embracing external networks and collaboration opportunities among participants from different educational and scientific institutions and backgrounds.

OECD Oslo Manual. The OECD Oslo Manual is an internationally recognized methodology for collecting and using innovation statistics. It was developed jointly by the OECD and Eurostat and is part of a continuously evolving family of manuals devoted to measuring and analyzing innovation activities in the industry. This Manual is very important and absolutely necessary for using in the sphere of HE&S.

Owner-driven innovation. In the field of HE&S owner-driven innovation is a type of innovation in which the owners or board of directors manage the innovation process. This type of innovation is typically seen in private higher educational or research institutions where the owners or members of the board of directors may also be its leaders: president, rector, chief executive officer, chief technology officer, the lead faculty members, scientists, researchers, inventors, constructors, designers, engineers, and technologists. The innovation value pyramid shows that the higher the scientific and organizational level of the owners and the more researchers, inventors, constructors, and designers there are in an institution, the higher its value.

Conclusion

The concepts, theoretical and practical foundations discussed in the article, as well as models of innovation in the field of higher education and science, are based on the fundamental and applied provisions of innovation and innovative

activity. Now there is a large number of studies, and scientific and applied publications devoted to the theory and practice of innovation. Therefore, innovation as the science of innovation and innovative activity, uses the results of such research and is open to new results.

Innovation in higher education and science refracts the results of fundamental and applied scientific research in the field of innovation and innovative activity into the sphere of higher education and scientific research.

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Концепції, теоретичні підходи та моделі інноватики вищої освіти і науки

Стаття присвячена розгляду концепцій, теоретичних підходів та моделей інноватики вищої освіти та науки. Показано основні розділи, до яких можна віднести теорію та практичну реалізацію інноватики вищої освіти та науки.

Ключові слова: інноватика, інноватика вищої освіти, інновації, інноваційна діяльність, інноваційні моделі