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## RESEARCH OF THE TRANSFER OF TECHNOLOGIES DEVELOPED IN HIGHER EDUCATIONAL INSTITUTIONS, BASED ON THE SYSTEM APPROACH

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**ДОСЛІДЖЕННЯ ТРАНСФЕРУ ТЕХНОЛОГІЙ, РОЗРОБЛЕНИХ У ВИЩИХ НАВЧАЛЬНИХ ЗАКЛАДАХ, НА ЗАСАДАХ СИСТЕМНОГО ПІДХОДУ**

*The feasibility of interpreting the phenomenon of transfer of technologies developed in higher education institutions (HEIs) into business structures from the system approach point of view, which allows increasing the technologies transfer management efficiency and HEI response to market demands have been justified in the article. The features of the HEI-developed technologies transfer system have been set, the interaction of the parts of the HEI-developed technologies transfer system have been studied. The definition of HEI-developed technologies transfer as a system has been suggested in contrast to the known broad understanding of the phenomenon, focusing on the integrity of the processes and interactions between them within the technologies transfer originating from the academic environment. The features of the proceeding with the HEI-developed technologies transfer into the business structures have been considered based on understanding it as a system.*

*У статті обгрунтовано доцільність трактування явища трансферу технологій, розроблених у вищих навчальних закладах (ВНЗ), у підприємницькі структури із позицій системного підходу, що дає змогу підвищити ефективність управління трансфером технологій та реагування ВНЗ на запити ринку. Встановлено характеристики системи трансферу технологій, розроблених у ВНЗ, досліджено взаємодію частин системи трансферу технологій, розроблених у ВНЗ. Запропоновано визначення трансферу технологій, розроблених у ВНЗ як системи, що на відміну від відомого широкого розуміння цього явища, фокусує увагу на цілісності процесів та взаємозв'язків між ними у межах трансферу технологій, що походять з академічного середовища. Розглянуто особливості провадження трансферу технологій, розроблених у ВНЗ, у підприємницькі структури на підставі розуміння його як системи.*

*Key words: technologies transfer, higher education institution, system, system approach, research and technological development.*

*Ключові слова: трансфер технологій, вищий навчальний заклад, система, системний підхід, науково-технологічний розвиток.*

### PROBLEM DEFINITION AND ITS RELATION TO IMPORTANT SCIENTIFIC AND PRACTICAL TASKS

Academic entrepreneurship is prerequisite for the functioning of the best global HEIs. In Ukraine, one of the ways of state support for the HEIs' entrepreneurship are the possibilities set forth in the Law of Ukraine "On Higher Education", namely HEI may be founders/co-founders of other legal entities, they may establish educational, scientific and educational research and production facilities, research parks and be members of a consortium [1, chapter VI, p. 27]. The idea voiced in the law aims to strengthen the competitive positions in national education and science, it determines the increase of research and development results commercialization efficiency and training of highly qualified specialists — scientists and experts, cooperation with other HEI within the various programs of basic and applied researches, etc. Taking

these and other aspects into account, the prospects of academic entrepreneurship in Ukraine grow.

One of the major drives of academic entrepreneurship development in HEIs is technologies transfer. However, given certain consensus in understanding of technologies transfer nature the scientists' approaches to its identification indicate a definitions variety for the phenomenon. The scientists in the course of exploration of the HEI-developed technologies transfer mainly focus on individual aspects of the activity (including commercialization), which makes it difficult to see the integrity and multidimensionality of the technologies transfer and, therefore, to develop efficient strategies for scientific and technological development of HEIs.

Technologies transfer is an activity subject to investigation by dint of the methodology for the concepts special knowledge, one of the pillars of which is system approach. The main goal and tasks of the system approach

are to study the objects as complex systems. A look at the HEI-developed technologies transfer from the system approach point of view invokes studying structural and functional relationships between its subsystems and components, taking into account of which will increase the efficiency of planning the technologies transfer, and performance management as well.

**ANALYSIS OF THE LAST RESEARCHES AND PUBLICATIONS**

In recent years, the issues of HEI-developed technologies transfer into business structures is becoming increasingly topical. The works [4; 5; 7; 11; 12; 13] are dedicated to the technologies transfer research. The study of scientific and technological approaches to universities' development where one of the major roles is given to technologies transfer, is covered in works [2; 6; 9; 14]. One of the important approaches to the study of technologies transfer is its research in the "HEI — government — business" system, the results of which are shown in works [3; 8; 15].

However, the existing points of view only fragmentarily describe the HEI-developed technologies transfer into business structures. This makes it impossible to shape such a concept of technologies transfer originating from the academic environment that would, on the one hand, contribute to a flexible and efficient management of the process and help to quickly respond to market demands on the other. In our view, it is possible to shape such a concept subject to study the phenomenon of HEI-developed technologies transfer as a system.

**RESEARCH GOAL**

The research goal is the feasibility justification for interpretation of the phenomenon of HEI-developed technologies transfer into the business structures based on a system approach; analysis of the features of the HEI-developed technologies transfer system.

To achieve the designated goal we have set and solved a number of issues, namely: 1) feasibility of studying the phenomenon of HEI-developed technologies transfer by dint of system approach has been justified; 2) the features of the HEI-developed technologies transfer as a system that allow reaching a consensus in the interpretation of this phenomenon within the science and practice have been singled out; 3) the definition of HEI-developed technologies transfer as a system that, unlike the others, is focused on the integrity of the processes and relations between them within the technologies transfer originating from the academic environment have been suggested; 4) features of the proceeding with the HEI-developed technologies transfer into the business structures have been considered based on understanding it as a system.

This study is outlined by the economic theory framework, i.e. the concept of technologies transfer system has been covered.

**MAJOR RESEARCH RESULTS**

At present there is no universal systems methodology since there is a limited set of features inherent to systems of different nature (social, technical, etc.). In the perspective of economics, the term "system" is used in different contexts reflecting a wide range of conventional

ideas. However, the science methodology shows that the condition of a complex phenomenon can be detected and assessed and its development predicted only from the systematicity standpoint.

Any system has its own relation of order and randomness states that may transform into each other. The essence of these transformations is in finding the stability. Then, under specific conditions, the systems are being characterized by trends — the desire for chaos in closed systems and to order in the open ones.

Based on the results of our research and descriptive approach to the study of phenomena we believe that the HEI-developed technologies transfer is a complex system — an ordered set of elements related by specific structure, characterized by direct and reversed links, separation into sections, commitment, preserving stability within the prescribed limits, multidimensionality, etc., which meets all the requirements for the study of phenomena based on system approach.

The HEI-developed technologies transfer system is characterized by strong relation to the environment and uniting therewith it reveals its integrity. The HEI-developed technologies transfer is an open socio-economic system, subsystem of the hierarchically higher level — management.

HEI-developed technologies transfer is a probabilistic extremely complicated and dynamic system. The same action in such a system will cause different results, each of which comes with a certain level of probability and is not subject to complete description. The main objective of the HEI-developed technologies transfer system is ordering of inbound and outbound information according to the managerial needs.

Development of the HEI-developed technologies transfer system into business structures is characterized by the evolution type. Based on expert estimates, the effect of individual factors (such as the development and dissemination of information technologies, rising of the country coverage by the internet, socio-economic and political changes, etc.) causes abrupt stages of processes development within the technologies transfer.

The following features have been singled out (Table 1) to study the HEI-developed technologies transfer system, which will help to unify it understanding within the science and practice.

Generally, understanding the HEI-developed technologies transfer system is popularized as a set of operations to transfer technology from HEIs to business structures. In our way of thinking, such understanding should be expanded by adding research methodology of scientific arrangement of its entities to the HEI-developed technologies transfer system (technologies producers, customers, consumers, etc.) that drives the technologies transfer. In turn, developing such a methodology will facilitate better arrangement of all the processes that make up the transfer of technologies originating from the academic environment.

Based on treating the HEI-developed technologies transfer as a system, the following definition of the concept has been suggested: HEI-developed technologies transfer is a branch of management theory the subject of which is the research of forms and means of organizational

**Table 1. Features of the system of HEI-developed technologies transfer system**

Classifications	Features
Abstraction level	Abstract system (conceptual) being a concept in its essence contains ideas, hypotheses, principles, etc.
Structure complexity	Complex (comprised of many interacting and interrelated parts).
Number of elements	Multi-element.
Lifetime	Permanent (acting on a permanent basis for a long period of time).
Construction structure	Decentralized – elements are interconnected sequentially or in parallel.
Relation to the environment	Open (exchange of information with the environment).
The degree of action definability	Determined (objects in the system and their relations operate in accordance with the defined plan).
The response to the environment impact	Adaptive (system adapts to the environment changes).
Changes of the properties and functions	Stable, cyclic.
Type of the system development	Evolutionary.

Own design.

and economic, structural and functional, and institutional impact on technologies transfer from the environment they were developed in (HEI) to other entities, executed by an agreement between two or more individuals and/or legal entities (one of which a HEI is) in order to develop (and/or apply) and implement the target function of technologies transfer system, aimed at commercialization and/or other effects from technology transfer.

Any system can be determined by singling it out of its environment based on the cybernetics principles. The HEI-developed technologies transfer system is doubly associated with the external environment: external environment influences the system through the input and the system influences the external environment through the output; it is characterized by feedback coming from market players both to the environment of the technology invention — HEIs — and its customers (consumers) — business structures.

From the theoretical points of view, the HEI-developed technologies transfer system is a model of retrospective and prospective reflection of technology traffic between the subjects of technologies transfer predetermined by mutual influence of these entities. Such a system is characterized not only by the links between the subsystems but also by the integrity with the external environment.

Some levels of the HEI-developed technologies transfer system determine its behavior, and the integrated system operation is the result of the inter-level interaction. This has led to the need for a detailed review of the concepts components in the HEI-developed technologies transfer system (the concepts set forth by us in [9]), the results of which have been summarized in Table 2.

Determining the effect of the HEI-developed technologies transfer (commercial, social, environmental, etc.) as a function is set for the technologies transfer system from outside. It shows the system importance with regard to the higher level system (macroeconomic level) the first one

is hierarchically included into. Substantiation of system functioning parameters and establishing interrelations between them and the type of their interaction will lead to synergistic effect.

As noted by K.M. Oganjan, after the system has crossed the bifurcation point its further evolution is unpredictable and the behavior of the system can be influenced by random events [10, p. 10]. This situation is due to the fact that the voltage in the system rapidly increases, and the existing administrative mechanisms become inoperable. The system shifts from one equilibrium position into another. Thus, the issue of establishing such bifurcation points leading to efficient management becomes topical for the HEI-developed technologies transfer system.

**CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH**

The systems approach is a fundamental component of the dialectical and materialist methodology of scientific knowledge. Applying a system approach facilitates adequate understanding of the nature of the HEI-developed technologies transfer not only in specific scientific framework but also as a phenomenon in general.

The feasibility justification for interpretation of the HEI-developed technologies transfer phenomenon on the basis of the system approach enables to:

- encounter all subsystems of HEI-developed technologies transfer and the relations between them as well as the force of the impact and the nature of such relations. This will facilitate more thorough process planning within the technologies transfer originating from the academic environment and enhancing the efficiency of implementation of the strategy of HEIs scientific and technological development;

- offer a definition for HEI-developed technologies transfer as a system, establish its characteristics and

**Table 2. Concepts components in the system of HEI-developed technologies transfer system**

Concepts components	Components essence
Organizational	Distinguishing elements of the HEI-developed technologies transfer system (technologies transfer entities) and developing the organizational structure of their interaction.
Functional	Separation of HEI-developed technologies transfer system into objects and specific functions for technologies transfer.
Technological	Tools for carrying out the HEI-developed technologies transfer.
Documental	Classification, forms, content and use of documents for recording economic activities from the HEI-developed technologies transfer, and control over the existing deviations from the norms and legislation.
Informational	Information support of all entities involved in the HEI-developed technologies transfer; converting input data into relevant information for implementing HEI-developed technologies transfer.

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features of the technologies transfer proceedings, which allows reaching a consensus in the interpretation of this phenomenon within the scientific and practical framework.

Based on the above and having analyzed the HEI-developed technologies transfer system, it is appropriate to form the concept for HEI-developed technologies transfer, and with that in mind, management strategies for HEI scientific and technological development.

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