ПРОБЛЕМИ ПРИЙНЯТТЯ РІШЕНЬ ТА УПРАВЛІННЯ В ЕКОНОМІЧНИХ, ТЕХНІЧНИХ, ЕКОЛОГІЧНИХ І СОЦІАЛЬНИХ СИСТЕМАХ

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THE MANAGEMENT OF INNOVATIVE PROCESSES IN ORGANIZATIONS. SYSTEM-TRANSDISCIPLINARY APPROACH

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Abstract. The article justifies the application of a system-interdisciplinary approach to solving problems of managing innovative processes, especially in the field of planning, organizing and controlling innovative events. Such problems are the justification of innovative events and the selection of their dates. The article describes the principles of innovation classification based on the interdisciplinary model of the information unit of order. The development of the system can be represented as a multiplex of waves or as a set of *M*-waves. It is shown that the system at each stage of its development is predisposed to changes in a certain trait. The article describes the methodological principles for justifying the dates for planning, conducting and monitoring the implementation of measures in the innovation process.

Keywords: innovation management, system-interdisciplinary approach, innovation planning, multiplex waves (*M*-waves), normative parameters of the innovation process.

INTRODUCTION

The problem of innovative development of the economy is one of the most discussed in the last quarter century. A large number of works are devoted to this issue. An international community of scientists has been formed to work on innovations and the formation of competencies in the context of the economic development of GLOBELICS [13], where problems and solutions to innovative processes are discussed at annual international conferences. The problem of innovative development is of such importance that the issues of managing the innovation process are reflected in international and national regulatory documents. So, the European Organization for Economic Co-operation and Development, OECD adopted guidelines for managing the innovation process in 2005 [15]. In Russia, in April 2014, the State Program "Economic Development and Innovation Economy" was adopted [2]. Nevertheless, to date, a number of problems that reduce the effectiveness of innovative management remain unresolved. We completely agree with the opinion of Economist magazine: "... innovation has come out of the shadow to become a new industrial religion worshiped by public figures, investors and businessmen ... But despite being the cause of about 50% of the total economic growth and the subject of countless government research, innovation remains, in essence, a form of black magic" [14].

The implementation of any innovation requires the attraction of financial resources, specialists and time. According to a PDMA (Product Development and Management Association) study, "only one in nine concepts becomes commercially successful. Approximately 40% of all innovations fail at launch, or even at distant approaches to the market – at the stage of testing or creating prototypes. Almost half of the company resources allocated to development of new products are spent on unsuccessful projects" [9]. Given that the volume of investment in innovative development of only 1000 of the most developed companies in the world is annually about $425 billion, the losses from failed innovations are very substantial.

Undoubtedly, the effectiveness of the innovation process depends, on the essence, the quality of the innovation itself (ideas, designs, schemes, etc.), which are to be implemented. However, one cannot fail to admit that there are situations when excellent innovations (ideas, designs, schemes, etc.) are poorly implemented or not implemented at all in business practice. There are many explanations for this, but the efficiency of managing any process depends on how justified are the action plans and the calendar dates of their implementation. Most often, if the essence, the direction of the changes necessary for the development of the organization is obvious, then there are problems with the determination of the calendar dates for conducting innovative activities.

For most natural objects or technological processes, the temporal patterns of development in the form of stages, periods and cycles are obvious. The nature and timing of the changes are predetermined by natural laws. For example, an experienced gardener knows at what stage of tree development and at what time of year the trees can be pruned, a mechanical engineer knows when to make changes to the machine, etc.

In socio-economic objects, such as organizations, these patterns are often less conspicuous. Many works indicate the presence of stages, periods, cycles in the development of enterprises and organizations [3], [6], [12]. In works devoted to the study of the temporal characteristics of development, various temporal characteristics of the development of organizations such as "youth", "maturity", "old age" [1], etc. are distinguished. However, at present, there is no unified theory or concept capable of linking steps (stages, phasing, periodicity) and polycyclicity in the development of economic and business systems and the nature of innovation. And the biggest problem is that no objective criteria are proposed for determining the calendar dates for innovative events. In other words, no criteria are proposed for when the "adolescence" or "maturity" of an organization ends. This leads to the fact that, in practice, management decisions in the field of the innovation process are made based on the experience and intuition of managers, and in small and medium-sized businesses, according to the National Federation of Independent Business and Wells Fargo (USA), "family consulting" prevails [5]. The consequence of the above facts is that a 50% success rate of innovation is considered a very good result.

Thus, if the innovation process is understood as the whole cycle of transformation of scientific knowledge (scientific ideas, discoveries and inventions) into a material result, then the main problems of the implementation of the planning function in the management of the innovation process are the substantiation of the type of innovations and the determination of the calendar dates for their implementation.

METHODS

To solve these problems, it is proposed to use the methodological apparatus of the system-transdisciplinary approach. According to the concept of the system-transdisciplinary approach, an idealized image called "system" is an order that determines the unity of elements and the integrity of the object. That is, an essential property of the system is order, a certain form of organization. The existence and development of the "system" object is a manifestation of its potential in space and time. Such a manifestation requires the implementation of the main function of the system – the transformation of matter and energy. The implementation of functions is possible only if there is a device in the system, a mechanism consisting of the corresponding elements and connections between them. This mechanism is called *system structure*. The task of the structure of the system is to ensure the transformation of matter and energy. For this, the system structure must have mechanisms for evaluating parameters:

- incoming matter and energy;
- the process of their transformation;
- the result of this process.

The discrepancy between the actual parameters and the given ones is assessed as dysfunction. Therefore, the system must have a mechanism for neutralizing dysfunctions.

The development of a system in time is a consistent change in its state. Changes in the operation of any objects can be caused either by the internal laws of the development of the object, or caused by a change in external conditions. Naturally, at each stage of development, changes in the structure and functions of the system are assumed. If such changes do not occur, then the system collapses. But in any case, these changes must correspond to the signs of the development period, otherwise these changes will not bring success.

The change in the state of the system in time is a strict sequence of time intervals (stages, periods and cycles), each of which characterizes the system's predisposition only to certain changes. These patterns are objective, have a transdisciplinary (universal) character and are described by a time (temporal) unit of order [8] and it can be represented as a multiplex wave (fig. 1), the model of which was proposed by Vladimir Mokiy [7].

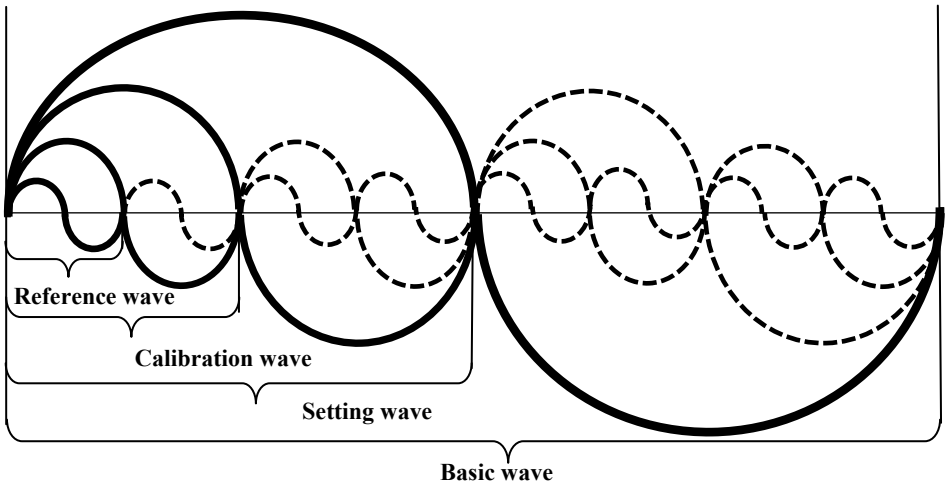

Fig. 1. Model of the development wave multiplex

"Multiplex (from lat. Multiplex – complex, multiple) is a natural complex of waves, logically fragmenting the development process, plays the role of a harmonious structure of the development of the object [7]. Waves of a multiplex (*M*-wave) indicate not the amplitude of the oscillation, but the calendar duration of the periods. For real objects, the temporal features are formed by duration.

Each wave is characterized by a certain set of quantitative and qualitative changes. In accordance with the multiplex model, the duration of each wave can be calculated by the formula:

$$M_n = 2^n a ,$$

where a is the duration of the reference wave; n — takes the value 1,2,3.

RESULTS

Innovation as a feature of development of objects considered as systems

Thus, from the standpoint of the system-transdisciplinary approach, the concept of "innovative management" can be interpreted as purposeful (control) influences aimed at changing the structural and functional properties of an object.

In this case, we do not consider the characteristics of the innovation itself, ideas, etc. In other words, it doesn't matter "good" or "bad" innovation. It is important for us to emphasize that the nature of structural and functional changes depends on the degree of radicalism of innovation. Therefore, at the first stage of classification of innovations, we distinguish:

- modifying innovations — as a rule, they require changes in the functions of system elements;
- radical innovations – cause qualitative changes in the main function of the economic system, and hence fundamental changes in the structure of the enterprise.

Applying the consistent differentiation of innovations, their system-transdisciplinary classification was developed. The basis of such a classification is Vladimir Mokiy's order information unit model [8], on the basis of which the division of innovations into quantitative and qualitative and the classification of the Slovak researcher F. Valent [16] is assumed.

According to the developed classification, the radicalism of changes as a result of innovation gradually increases from the first to the eighth order (see table).

It should be noted here that if the implementation of innovations of lower orders (quantitative changes) can be relatively easy to ensure within the framework of the usual management system, then innovations of higher orders require either changes or the creation of a system of strategic and tactical management. The use and adaptation of this classification for the needs of a particular organization makes it possible to correctly determine the level (order) of required innovations.

However, determining the level of innovation (such as the radical nature of change) is a necessary, but not sufficient condition for managing innovation. For its successful implementation, it is imperative to determine the timing of the events.

System-transdisciplinary temporal features of the innovation process

To determine the timing of innovations, it is proposed to use the regularities that determine the temporal development of the system. Of course, for real objects,

these features are determined by the laws of development of this object. Obviously, it is different for organizations of different industries and its definition requires specific research.

In each of the time intervals of the corresponding attribute, the object is predisposed to innovations of a certain order.

Transdisciplinary classification of innovations

Innovation order	**Innovation attribute**	**Innovation characteristic**
1order	**Quantitative attribute** Functional properties of the object remain	Change of the structural elements of the system, preserving existing functions
2 order		Simple target adaptation to quantitative requirements while maintaining the functions of the system or its part
3 order		Simple organizational changes to secure a better
4 order		Changes caused by the adaptation of the system's elements, which do not affect the quality of particular elements, but in complex lead to increase in efficiency of the system as a whole Partial functional changes within the system or its parts
5 order	**Qualitative attribute** the functional properties of an object are partially or completely changed	Partial functional changes within the system or part of it
6 order		Changes altering the initial concept but partially or entirely altered preserving the functional principle
7 order		Changes that change the original concept, but retain the functional principle
8 order		Changes altering the base functional principle of the system's

Then, the management of the innovation process looks like the preparation and implementation of a consistent transformation of the organization, based on its "internal readiness" to accept these transformations. Sign, the level of innovation must coincide with the sign of the period, otherwise the innovation process is doomed to failure. For example, the growing season for potatoes is 60 days. However, if one wanted to eat young potatoes at the end of November, then planting potatoes at the end of August will not be crowned with success.

The hypothesis about a similar structure of temporal development of organizations was put forward by the authors and verified back in the 1990's. Based on a retrospective analysis of development of IBM, confirmation of the existence of such a pattern was obtained [9]. Studies of the full set of *M*-waves (the entire multiplex) were carried out on the basis of data from Pfizer, Takeda Pharmaceutical Company Limited, Stada CIS, Novo Nordisk, Gedeon Richter [10] and five electronics companies – LG, Philips, Sony, Panasonic and Aiwa [4]. These studies made it possible to formulate guidelines for the temporal planning of innovative development and to determine the normative temporal parameters for the development of business systems. Regulatory temporal parameters for constructing an innovative map-graph of an object's development are:

- the calendar duration of the *M*-waves (the entire multiplex);
- calendar dates of development control points (calendar dates of beginning and end of the period).

Knowing the calendar dates for the beginning and end of individual development periods allows one to determine the direction of work on the development of innovations of the appropriate type, to determine the objective terms for the development of plans and terms for their implementation in advance. This will help to avoid financial losses that occur when innovation changes are delayed or if they are prematurely implemented.

With the classification of innovations and the determination of the timing of the onset and duration of the corresponding periods in the development of the enterprise, it becomes possible to increase the objectivity and effectiveness of innovation management.

DISCUSSION

From the standpoint of the above approach, the increase in the efficiency of management of the innovative development of an organization is due to the need to determine the order of innovation or to determine their sign. The problem is that these innovations can be both quantitative and qualitative. However, the scale of structural and functional changes depends on which waves we are considering. So, for example, first-order innovations can be produced in the calendar duration of the reference wave. However, the sign of innovation is given by the sign of the reference wave. In this sense, the methodology for determining the sign of innovation for each wave of the multiplex needs further research.

Another problem for drawing up an innovative development chart is to determine the duration of the reference wave for a specific object. There are eight such periods in the base wave. In addition, as can be seen from the multiplex figure, the object is predisposed to quantitative changes during the first two calibration waves. During the next two calibration waves, the object is prone to qualitative changes. However, the determination of the calendar duration of the reference wave makes it possible to determine with high accuracy the calendar dates of changes in the object's predisposition to innovations of a certain order.

CONCLUSION

Thus, the use of a system-transdisciplinary approach can improve the efficiency of managing the innovation process.

The interpretation of the innovation process as a change in the structural and functional properties of an object studied as a system, as well as transdisciplinarity, universality of the order of its development allows:

- to develop a transdisciplinary classification of the orders of innovation;
- to represent the development of an object as a set of *M*-waves – a multiplex of development.

The objective predisposition of an object at each stage of its development to innovations of a strictly defined type and the ability to determine the calendar dates for the onset of these stages makes it possible to build an innovative map-schedule of the object's development.

The presence of such a schedule allows us to more objectively and in advance set the nature of innovative events and the time parameters of their implementation. The presence of control points allows for more efficient implementa-

tion of control functions. An opportunity is provided to more effectively conduct analysis, planning activities, organizing their implementation, motivating and stimulating employees.

A retrospective analysis of the innovative development of organizations on the basis of the described methods-techniques of the system-transdisciplinary approach allows us to conclude about their representativeness. Consequently, the practice of their application in drawing up charts of the innovative development of organizations with a high degree of probability will reduce the losses from the incorrectly assessed nature of innovations and the delay in their implementation.

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УПРАВЛІННЯ ІННОВАЦІЙНИМИ ПРОЦЕСАМИ В ОРГАНІЗАЦІЯХ. СИСТЕМНО-МІЖДИСЦИПЛІНАРНИЙ ПІДХІД / М.С. Мокій, П.М. Гуреєв

Анотація. Обґрунтовано застосування системно-міждисциплінарного підходу до вирішення проблем управління інноваційними процесами, особливо у галузі планування, організації та контролю інноваційних подій. Такими проблемами є виправдання інноваційних подій та визначення календарних дат. Описано принципи класифікації інновацій на основі трансдисциплінарної моделі інформаційної одиниці порядку. Розвиток системи можна подати як мультиплекс хвиль або як сукупність *M*-хвиль. Показано, що система на кожному етапі свого розвитку схильна до змін певної ознаки. Описано методологічні принципи обґрунтування календарних дат планування, проведення та моніторингу реалізації заходів в інноваційному процесі.

Ключевие слова: управління інноваціями, системно-міждисциплінарний підхід, інноваційне планування, мультиплексні хвилі (*M*-хвилі), нормативні параметри інноваційного процесу.

УПРАВЛЕНИЕ ИННОВАЦИОННЫМИ ПРОЦЕССАМИ В ОРГАНИЗАЦИЯХ. СИСТЕМНО-ТРАНСДИСЦИПЛИНАРНЫЙ ПОДХОД / М.С. Мокий, П.М. Гуреев

Аннотация. Обосновано применение системно-трансдисциплинарного подхода к решению задач управления инновационными процессами, особенно в области планирования, организации и контроля инновационных мероприятий. Такими проблемами являются обоснование новаторских мероприятий и определение календарных дат. Описаны принципы классификации инноваций на основе трансдисциплинарной модели информационной единицы порядка. Развитие системы можно представить как мультиплекс волн или как набор *M*-волн. Показано, что система на каждом этапе своего развития предрасположена к изменению определенного признака. Описаны методологические принципы обоснования календарных сроков планирования, проведения и мониторинга реализации мероприятий в инновационном процессе.

Ключевые слова: управление инновациями, системно-междисциплинарный подход, инновационное планирование, мультиплексные волны (*M*-волны), нормативные параметры инновационного процесса.