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**THE METHOD OF FORMING INFORMATIONAL COMPETENCE SPACES  
FOR EDUCATIONAL PROJECT EXECUTIVES**

**Abstract.** *The work describes the application of competence methods in implementing educational projects. Practices and experience of other universities. It was determined that the planning and monitoring of the educational project should be carried out concerning the specifics of the development of competencies as a rational process of improvement and achievement of individual and collective goals of the executors of this project. With this in mind, understanding the process of competence development is the basis of the practical construction of an educational project aimed at the effective achievement of goals. In addition, developing project executors' competencies can occur consciously through training and indirectly in teamwork. It was established that the task of taking into account the dynamics of transformation and development of the competencies of performers and the connection of this development with the functions of a specific project still needs to be solved. To ensure effective planning and monitoring of an educational project, it is advisable to build information technology to support decision-making based on competency-based methods. The development of such a system is essential for the educational system of the People's Republic of China because universities manage many educational projects with many students, which requires an innovative monitoring system. Moreover, such a system should be able to work out both large-scale projects and small ones, such as, for example, the implementation of a distance learning system within one or several courses. To build such a system, multiple models of identification of the executor of the educational project and a model of transformation of the executor of the educational project were built. Based on them, the method of making information competence spaces is defined. This method is the basis of creating an information technology decision support system for monitoring educational projects.*

**Keywords:** *educational project; competence; information space; value*

**Introduction**

The mechanism for ensuring the stimulation of the development of education and professional training is the creation of strategic partnerships and the organization of educational projects. These projects are the basis of implementation of joint initiatives for the development of innovative methods of collegiate education, exchange of experience, introduction of new practices to improve the quality of education at all levels for the relevant target groups. Competitive programs for the formation of strategic partnerships are actively implemented in the European Union (Erasmus+ program) [1], and are created outside of this initiative by individual institutions of higher education for the development of educational activities. The creation of a single European space for research and innovation, including in the field of education, takes place within the European scientific space [2]. The strategic goals determining the creation of this space are the implementation of reforms to promote digital transformation, expanding access to research by

scientists with the possibility of exchanging knowledge with partners [3].

Formally, the creation and functioning of educational projects takes place in educational and scientific information spaces. These spaces consist of ordered objects or subjects, often with a multi-level structure, defined by their dynamically changing identifiers. Each executor of such projects develops in his own information space, which accumulates information about competencies, his productivity and, accordingly, provides material for evaluating his potential in a specific field of activity. For the high-quality organization of the implementation of educational projects, an important role is played by the development of methods of building information spaces of project executors, taking into account the competencies that are significant for the project of a specific direction in a dynamic environment. That is why it is important to formalize the constituent information spaces of performers, which should be based mostly on objective assessments of their activities.

Since the information spaces of performers include all information about their activities, an important task is its formalization, taking into account the dynamics of the development of each performer. This is due to the fact that the performer transforms and develops in his own space, acquiring new knowledge and competences over time.

The creation of a competence-based method for the formation of information spaces for executors of educational projects is an urgent direction. This will stimulate the development of innovative partnership cooperation in the educational sector, increase the productivity and quality of educational and project activities as a whole.

The analysis of literary data should be considered taking into account three dimensions of the assessment of the competence of an individual subject of educational activity or project executor: assessment of knowledge, assessment of productivity, assessment of personal qualities. Assessment of knowledge involves the allocation of necessary knowledge and experience of the appropriate amount and their quantitative expression as qualifications of an individual subject of educational activity regarding the implementation of a specific educational project. Performance evaluation involves a quantitative interpretation of the effectiveness of the project work of an individual subject of educational activity during a certain period in the direction of a specific project. Assessment of personal characteristics involves taking into account the subject's ability to effectively carry out project activities, taking into account the attitude to work, individual traits, sociability, etc.

The work [4] describes the properties of structural models of competencies in project management. The model of competencies in the field of professional project management proposed by the International Project Management Association [5] was chosen as the object of research in the work [4]. To determine the properties of the structural models of competences, the method of studying adjacency matrices of oriented graphs was used. However, the disadvantage of the proposed method is insufficient consideration of the specifics and sequence of project tasks, which may lead to an incorrect interpretation of the results, even if it is based on the current version of the international standard. Despite this, standard [6] and standard [7], which reflect the features of competence management, indicate that the qualifications of the project manager and his executors are directly correlated with the project's effectiveness. In work [6], these factors are defined, but not used. The work [7] describes the developed method of creating a project team, which takes into account the requirements of the project, the characteristics of individual candidates and the general competencies of the team as a whole, as well as the

limitations of the project in terms of budget and labor intensity. The stages of building a project team in work [7] are the maximization of the competencies of the executors directly and the maximization of competencies taking into account the time and budget constraints of the project. However, in [7], the set of performers' competencies is considered static and fixed at the time of assessment.

The network approach to building a project team is considered in [8]. For this, the analysis of social networks is used, reflecting the connections between performers. In work [9], a social network is used for this, taking into account the reputation of performers. The work [10] describes an individually-oriented method of selecting subjects of scientific activity as executors of scientific and educational projects, taking into account the productivity of their scientific activity in the past and taking into account the structure of projects. However, the approaches described in works [8–10] do not take into account the competence of potential executors, but are based only on some components that determine the competence of the executor of an educational project. It should be understood that competencies tend to change over time. Accordingly, the mechanisms of competence development and erosion in an innovative project are described in [11].

In work [12], the concept of building information spaces of subjects of scientific activity, which is based on the assessment of scientific productivity, is described. That is, only the productivity component is taken into account, which, as already indicated, is one of the parts that form the competence of the project executor. In work [13], a set of competencies of potential performers is already used to form a project team, but personal characteristics of performers and their performance are not taken into account. The method of expert evaluation for forming teams is considered in the work [14], however, the project management staff is not considered in the work. Consideration of management personnel to increase the effectiveness of project team management based on the use of educational environment-oriented project-vector management methodology is described in [15]. The construction of an information communication system for the implementation of this methodology for evaluating the productivity of subjects of scientific activity is described in [16]. However, works [15, 16] refer to a comprehensive evaluation of the activity of higher education institutions, which also takes into account the educational component.

Therefore, the task of taking into account the dynamics of transformation and development of the competences of performers and the connection of this development with the tasks of a specific project remains unresolved. To ensure effective planning of an

educational project, it is advisable to build information technology to support decision-making. To ensure the flexibility of this system, it is proposed to apply the competence method of evaluating the benefits of project executors.

Since the task of assessing project executors' competencies is complex, the assessment process can be formally automated by building information spaces of executors with the competencies they have developed. Competencies in this context will be considered as a set of three components: assessment of knowledge, assessment of productivity and assessment of personal characteristics of the executors of educational projects. The formation of this information space should take place dynamically, taking into account the acquisition of new knowledge by the performers or the improvement of existing ones. The space should change taking into account changes in performance indicators of performers: their publication of scientific publications, speeches at specialized conferences. The introduction of research elements into the project can significantly strengthen the sustainability of the project, because the results of the project, if they are published, can later be used by other universities or project working groups. This, in turn, has a positive effect on the development of this direction in the region. The evaluation of the personal characteristics of the performers, which is also included in the information space of the performers, is an important indicator of the comfort of working with one or another performer in the team. This indicator is important, because effective teamwork is the basis for ensuring the effectiveness of the project. It is important to track any communication breakdowns within the project team. This has an impact on the adjustment of the composition of project executors, in the event that communication violations are critical and do not allow to achieve an effective project result within the specified period.

### Goal

The purpose of the research is to study the possibilities of forming the informational competence spaces of the executors of educational projects.

To achieve the goal, the following tasks were set:

1. Build a multiple model of identification of the executor of the educational project
2. To build a model of transformation of the executors of educational projects and a method of building information competence spaces.

### Multiple model of identification of the executor of the educational project

Let's consider three dimensions of evaluating project performers' competencies: evaluating knowledge, evaluating performance, and personal characteristics of performers. This is explained by the

fact that for the evaluation of potential performers of an educational project, these characteristics are sufficient for ranking the performers and they are measurable. When evaluating knowledge, we highlight the list of levels of knowledge and experience regarding specific project tasks that relate to the corresponding work package. For example, the availability of project management certificates, participation in seminars, conferences. The specified list of criteria is formed by the project manager when selecting executors. Evaluation of the performer's productivity involves a quantitative interpretation of the effectiveness of the project work during a certain period of time in the direction of the educational project. For example, the number of projects in which the performer participated and the role in them, the presence of scientific articles within the scope of the project in the relevant journals. The assessment of personal characteristics involves taking into account the subject's ability to perform activities qualitatively: attitude towards the performance and timeliness of specific tasks of the work package, individual traits of the performer, sociability, etc. The selection of educational project executors is a process aimed at forming an effective project implementation team of specialists in educational activities. For this, it is necessary to form information spaces of potential performers. This can be done based on the competence method.

Let  $E = \{ e^1, e^2, \dots, e^m \}$  is the set of executors of some educational project  $A$ ,  $m$  is the number of executors. Executors are mostly individual subjects of educational and scientific activity: employees of institutions of higher and professional education. Each element of the set  $E$  corresponds to a trio of competencies [17]:

$$K(t), P(t), I(t),$$

the value of which varies discretely over time. If  $t_0, t_1, \dots, t_{w-1}$  are the moments of time at which the values of the indicated indicators are fixed,  $t_0$  is the initial moment of time. Then you can write down the time series of evaluations of the competences of the performer  $e_j$ :

$$K^j = (K_0^j, K_1^j, \dots, K_{w-1}^j) = (K^j(t_0), K^j(t_1), \dots, K^j(t_{w-1})),$$

$$P^j = (P_0^j, P_1^j, \dots, P_{w-1}^j) = (P^j(t_0), P^j(t_1), \dots, P^j(t_{w-1})),$$

$$I^j = (I_0^j, I_1^j, \dots, I_{w-1}^j) = (I^j(t_0), I^j(t_1), \dots, I^j(t_{w-1})),$$

where  $K^j$  is a discrete time series of evaluation of the performer's knowledge  $e_j$  educational project  $A$  in the field of education, according to the tasks of project  $A$ , which this performer must perform;  $P^j$  is a discrete time series of performance evaluation of performer  $e_j$  educational project  $A$ ;  $I^j$  is a discrete time series of evaluation of the personal characteristics of the performer  $e_j$ ,  $j = \overline{1, m}$ .

Thus, the executor of the educational project A at the  $i$ -th moment of time  $i = \overline{0, w-1}$  is represented by a set of identifiers that define it:

$$e_i^j = (K_i^j, P_i^j, I_i^j), \quad j = \overline{1, m}.$$

These identifiers are not limited to the assignment of the information space of the executor of the educational project. However, after calculating the specified parameters, it is possible to solve problems that will increase the efficiency of project implementation. Assessments of performers or competencies obtained in educational projects, in the process of their implementation, form a system of values that performers acquire in the process of their own activities.

If  $F: E \rightarrow \mathbb{R}^n$ , it is possible to form a discrete time series of values for the educational project A, which is obtained due to the activities of performers  $e^j$ . That is, the value chain for project A, provided by the executor  $e^j$ , looks like this:

$$\{F(e^1), F(e^2), \dots, F(e^m)\}.$$

Accordingly, the total value that educational project A will receive consists of the sum of values for each performer, i.e.:

$$F_A = \sum_{j=1}^m F(e^j).$$

If we consider the change of identifiers over time, it can be determined that the value chain for project A, provided by the performer  $e^j$  at the  $i$ -th moment of time, looks like this:

$$\{F(e_i^1), F(e_i^2), \dots, F(e_i^m)\}.$$

Or for the  $q$ -th executor of the educational project, it is possible to highlight the values that he gives to project A at the  $i$ -th moment of time:

$$\{F(e_0^q), F(e_1^q), \dots, F(e_{w-1}^q)\}.$$

Moreover, the accumulated value that educational project A will receive is determined as:

$$F_A(t_i) = \sum_{j=1}^m F(e_i^j), \quad i = \overline{0, w-1}.$$

It can be assumed that  $F_A(t_i)$  the evaluation of the results of the educational project will depend on the value. Also, the dynamics of changes in values  $F_A(t_i)$  may indicate a potential evaluation of the project by the evaluator.

Therefore, the executor of the educational project is determined by a trio of identifiers at the moment of time  $t_i, i = \overline{0, w-1}$ . This is shown in Figure 1.

Each executor accumulates his competences to create values for a certain project A in which he participates. In turn, the performer's participation in this project will allow to receive an increase in identifiers

(Fig. 2.): at the moment of time  $t_i: e_i^q = (K_i^q, P_i^q, I_i^q)$ , and at the moment of time  $t_{i+1}: e_{i+1}^q = (K_{i+1}^q, P_{i+1}^q, I_{i+1}^q)$ ,

$$K_{i+1}^q = K_i^q + \Delta K_{i+1}^q,$$

$$P_{i+1}^q = P_i^q + \Delta P_{i+1}^q,$$

$$I_{i+1}^q = I_i^q + \Delta I_{i+1}^q,$$

$\Delta K_{i+1}^q$  is the assessment of the increase in the identifier of knowledge,  $\Delta P_{i+1}^q$  is the assessment of the increase in the identifier of productivity,  $\Delta I_{i+1}^q \in \mathbb{R}$  is the assessment of the increase in the identifier of characteristics of the executor.

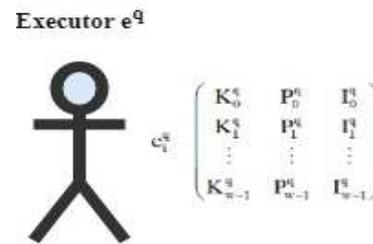


Figure 1 – Model of identification of the executor of the educational project

The model of interaction of the educational project executor with project A is shown schematically in Figure 2.

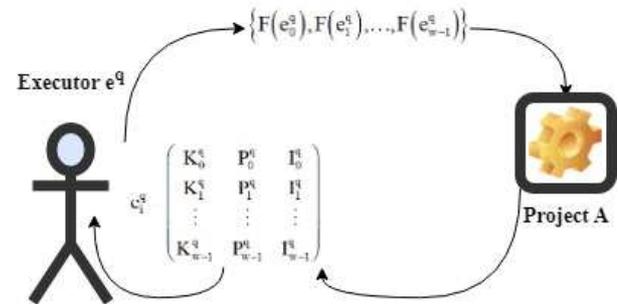


Figure 2 – Model of the interaction of the executor of the educational project with project A

Based on the model of identification of the executor of the educational project and his interaction with the project, we will get that the process of changing the identifiers of the executor occurs constantly in the process of interaction with the project. The contractor provides his experience and the results of his work, making his contribution to the results of the project. In turn, participation in the project improves knowledge and increases the performer's productivity, as well as influences the performer's personal qualities.

Since all projects are implemented in a team, interaction takes place at the level between performers. Moreover, the value for project A, in which both performers participate, is formed by each performer separately (Fig. 3.).

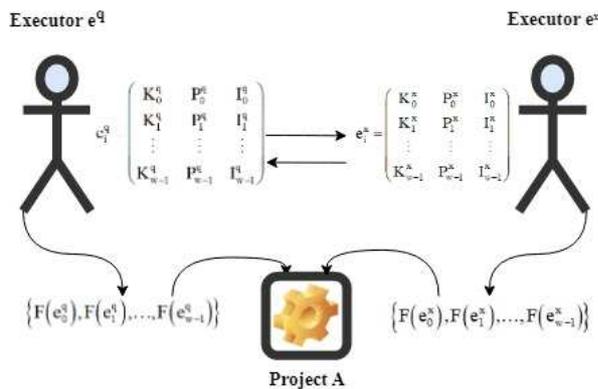


Figure 3 – Model of the interaction of the team members of the educational project A

The described structure and composition of identifiers of educational project executors is the basis for the formation of information competence spaces. Ensuring the effective implementation of educational projects depends on understanding the principles of formation and change of the components of the information spaces of the executors of these projects. The theory of sets was used to create multiple models of identification of information spaces of educational project executors.

**The model of transformation of the executors of educational projects and the method of formation of information competence spaces**

The model of interaction with the information competence space is shown in Figure 4. Within this space there are performers who interact with each other within the framework of educational projects.

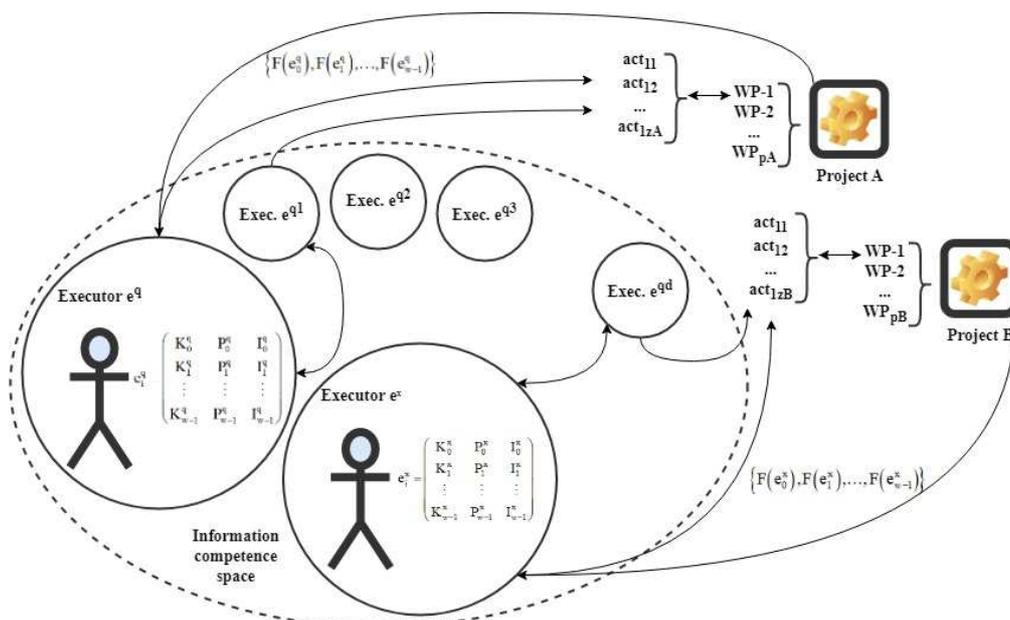


Figure 4 – The model of the transformation of the executors of the educational project A

Performers perform certain actions (act) to obtain results for each of the work packages of the project (WP). As a result, the performers enrich these projects with values determined by their competencies, and the projects, in turn, give the performers experience, which leads to an increase in the competencies of these performers.

For each executor of project A, it is possible to standardize competency assessments [17]:

$$\bar{K}_i^j = \frac{K_i^j - \min_{j=1,m} K_i^j}{\max_{j=1,m} K_i^j - \min_{j=1,m} K_i^j}, \quad \bar{P}_i^j = \frac{P_i^j - \min_{j=1,m} P_i^j}{\max_{j=1,m} P_i^j - \min_{j=1,m} P_i^j},$$

$$\bar{I}_i^j = \frac{I_i^j - \min_{j=1,m} I_i^j}{\max_{j=1,m} I_i^j - \min_{j=1,m} I_i^j},$$

and find the average value of the scores of project A performers at each time point  $i = 0, w - 1$ :

$$\tilde{K}_i = \frac{1}{m} \sum_{j=1}^m \bar{K}_i^j, \quad \tilde{P}_i = \frac{1}{m} \sum_{j=1}^m \bar{P}_i^j, \quad \tilde{I}_i = \frac{1}{m} \sum_{j=1}^m \bar{I}_i^j.$$

Average assessment of competencies  $\tilde{A}_i$  by all performers and criteria at every moment of time  $i = 0, w - 1$  determined by the formula:

$$\tilde{A}_i = \frac{1}{3} (\tilde{K}_i + \tilde{P}_i + \tilde{I}_i). \tag{3}$$

The method of forming information competence spaces consists of the following steps:

1. Selection for unification of a group of educational project executors.
2. Calculation of competency assessments by level of knowledge, productivity and individual characteristics.
3. Dynamic updating of competency assessments during implementation of educational projects by executors.

## Conclusion

An overview of the task of building information competence spaces and the use of competence methods in education was carried out. It was determined that the planning and monitoring of the educational project should be carried out with reference to the specifics of the development of competences as a rational process of improvement and achievement of individual and collective goals of the executors of this project. With this in mind, understanding the process of competence development is the basis of effective construction of an educational project aimed at effective achievement of goals. In addition, the development of project executors' competencies can occur both consciously through training and indirectly in teamwork.

It was established that the task of taking into account the dynamics of transformation and development of the competences of performers and the connection of this development with the tasks of a specific project is unresolved. To ensure effective planning and monitoring of an educational project, it is advisable to build information technology to support decision-making based on competency-based methods. The first stage of the construction of such technology is the construction of the model of the executor of the educational project, the model of the transformation of the executors of educational projects, the method of formation of information competence spaces. These methods and models were described in this paper.

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### МЕТОД ФОРМУВАННЯ ІНФОРМАЦІЙНИХ КОМПЕТЕНТІСНИХ ПРОСТОРІВ ВИКОНАВЦІВ ОСВІТНІХ ПРОЄКТІВ

**Анотація.** Для забезпечення ефективного планування та моніторингу освітнього проєкту доцільно побудувати інформаційну технологію підтримки прийняття рішень на основі компетентнісних методів. Розроблення такої системи є важливою для освітньої системи Китайської народної республіки, оскільки університети здійснюють управління великою кількістю освітніх проєктів з великою кількістю студентів, для чого потрібна розробка інноваційної системи моніторингу. Причому така система має мати можливість опрацьовувати як великі за масштабом проєкти, так і малі, такі як, наприклад, впровадження системи дистанційного навчання в межах одного чи кількох курсів. Для такої системи побудовано множинну модель ідентифікації виконавця освітнього проєкту та модель трансформації виконавців освітніх проєктів. На їх основі визначено метод побудови інформаційних компетентнісних просторів. Цей метод є в основі побудови інформаційної технології системи підтримки прийняття рішень для моніторингу освітніх проєктів.

**Ключові слова:** освітній проєкт; компетенція; інформаційний простір; цінність

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