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THE PROBLEM OF PARTNERSHIP CHOICES FOR SCIENTIFIC PROJECTS COOPERATION

Abstract. *The paper presents a formal statement of the problem of finding partners for the formation of a scientific consortium. The main features of partners (universities, research institutes, public authorities, private companies, professional associations and foundations), which influence the ways of communication and cooperation between them, are also defined. The list of factors influencing the creation of a partnership of scholars in the framework of a project or a grant is formed. The main methods of evaluating the activities of scientific institutions and universities in Ukraine and in the world are considered. It is determined that for the selection of scientific partners the criteria of known ratings do not allow to form a rational ranked list of potential partners of the project, therefore, they need to be finalized.*

Key words: scientific community; scientific project; choosing a partner

Introduction

Formation of scientific communities usually occurs in a competitive environment, while affecting not only the space of one or more countries, but generally applies to the whole world. These scientific societies consist of universities, research institutes, private companies and foundations and associations that have formed applications for joint grants. Since most of the grants are submitted and only part of them receive funding, for each two subjects of the scientific community (universities, institutes, companies) three forms of relationships can be distinguished:

1. Competitors.
2. Neutral relationships.
3. Partners.

Moreover, such relationships can consist not only between the subjects of scientific communities, but also between their separate structural units (departments, faculties, research departments, teams of projects, etc.).

Therefore, the task of establishing a partner in the framework of a grant or a strategic partner for the implementation of a series of scientific studies is relevant, especially in the context of globalization and the intensive development of the mobility of scientific communities. In this context, one can distinguish the task of computing the ratings of competitors, assessing the activities of other companies and institutions that can potentially become partners. To find estimates of the subjects of scientific communities and individual scientists, the principle of constructing metrics can be used.

It is important to take into account the fluidity and dynamism of the indicators of activity of the subjects of scientific communities and individual scientists, as well as the specifics of the partnership activity and the specifics of the already formed competitors.

Perspective directions in the development of information technology for evaluating the results of the activities of the scientific community is to construct integrated assessments that take into account different aspects of the activity, minimize the impact on the calculation of estimates of the subjective factor [1-7].

To predict and evaluate the quality of work of a higher educational institution, [8] a parametric model and structure of educational institutions' processes have been developed. In the works [9; 10] reviewed the models of interaction between projects for providing training and the problems of implementing international standards for assessing the competencies of project managers and programs.

In work [11], probabilistic transitions of the Markov chain for the project environment, which determine the characteristics of the project, are considered.

In work [12], the features of the application of the Markov chains to the formation of the life cycle of scientific publications are considered.

Work [13] describes the ways of integrating project management and decision support using a matrix model based on key portfolio events.

It is believed that the formation of coalitions in the scientific environment plays a prominent role in the following factors:

– reputation;

– restrictions related to mechanisms of cooperation between actors [14; 15].

In work [16], partner relations and principles of management were investigated. The paper [17] describes a multi-stage mathematical model of partner choice and

an efficient combination of partners. In work [18], it is suggested to use the method of analytical hierarchy to select the best partners from a small number of potential partners. The paper [19] describes a model for selecting a partner based on a genetic algorithm.

Therefore, for the information technology of searching for scientific partners, the following tasks must be performed:

1. Construction of information model of presentation of scientific projects and their performers.
2. Construction of the method of identification of research directions of individual scientists.
3. Construction of an adequate model of selection of potential partners among the base of active subjects of scientific communities.
4. Building a model of partner assessment to form a rational ranked list of potential partners that can be involved in the project.
5. Evaluating the activities of competitors.
6. Creation of an information and analytical system, which will form a list of potential partners for the purpose of grants for cooperation.

The purpose of the article

The purpose of the article is:

1. Describe the task of finding partners and identify the key features of partners (academic institutions, universities, companies) that influence the way of communication and collaboration between them.
2. Form a list of components that affect the creation of a consortium of scientists for the implementation of a project or grant. These components are important for selecting the appropriate partners for cooperation.
3. Consider the main methods of evaluating the activities of scientific institutions and universities in Ukraine and the world.

Presenting main materials

The task of finding a rational scientific partner

Suppose $G = (g_1, g_2, \dots, g_n)$ the grants or projects that are proposed for execution or which applications can be submitted, n the number of grants. Suppose $P = (p_1, p_2, \dots, p_m)$ a set of potential partners or subjects of the scientific community, m the number of grants.

The task of choosing a research partner is to build a model for evaluating the plurality of partners and building for each grant g_i, $i = \overline{1..n}$ an ordered set whose elements are ranked by the reduction of the priority of the partners:

$$E(g_i) = \left(p^i_{k_1}, p^i_{k_2}, \dots, p^i_{k_m}\right),$$

where $k_1 < k_2 < \dots < k_m$ a strictly increasing sequence of positive integers that determines the indices of the partners, $k_j \in 1,2,\dots m$.

Before selecting scientific partners, it is necessary to identify the directions of their research. In paper [20], the task of clustering scientific publications in scientific areas was initially solved. Then, a method for identifying the directions of research by scientists based on the results of clustering of publications is described. It is important that after applying these methods we will already have a general list of scientists working in the areas of interest to us. The next stage will be their thorough evaluation and the formation of a ranked list in accordance with the statement of the task.

Suppose $P = (p_1, p_2, \dots, p_m)$ a number of scholars, m the number of scientists, and $A = (a_1, a_2, \dots, a_h)$ a set of publications published by these scientists, h the number of publications. Let's $C = (c_1, c_2, \dots, c_d)$ a plurality of scientific research areas, d the number of directions of scientific research. The identification of scientific research areas is the process of establishing a correspondence between a specific scientist and the scientific directions in which this scientist works and publishes scientific publications within the framework of these directions. That is, you need to find a reflection $F : P \to C.$

In order to identify the directions of research of scientists, one way is to use information about the publication activity of scientists, taking into account the constructed set of clusters of scientific areas to which these publications belong. It should also be borne in mind that scientific publications in the overwhelming majority are published with co-authors.

Consider the scenario of cooperation in scientific communities, in which partners (universities, research institutes, companies) cooperate in the framework of some scientific projects. Every project $G=(g_1, g_2, \dots, g_n)$ related to a specific topic. Each organization that participates in the project has a role. This role may include functions that relate to the project implementer or project coordinator. In order to reflect the information model of cooperation, it is necessary to consider the degree of involvement of the partner in the project. For example, in one project g_u, a specific partner p_r is attracted by 20%, in another project g_y the partner p_r is involved in 50% (for example, plays a coordinating role). The weight of partner involvement in a project can be determined by the amount of funding received by the partner within the project. For the most part, more funding means more work, as it is possible to attract more human resources.

Such a scheme of cooperation can be displayed in the form of an unoriented graph with vertices of projects and partners and arcs as weight coefficients.

It is possible to highlight such key features of partners (scientific institutions, universities, companies) that influence both the way of communication and cooperation between them:

1. Partners can be located in different countries and even on different continents. Therefore, a significant part of communications takes place through the Internet.
2. Each partner may have unique competencies that are necessary for the successful implementation of

the project and which should be taken into account when assigning tasks to the project.

3. Partners operate in their own legal system. Partner decision-making is regulated not only by project needs, but also by the legislation of the country or region in which they are located. This should be taken into account when signing joint agreements and conducting tender procedures.

4. Each company may occupy an appropriate place in the organizational structure, which contributes to increasing trust and ensuring common interests in the project. The organizational structure of the project can vary dynamically, depending on the objectives of the project.

Conceptually, a partner's choice can consist of four components that must be taken into account when creating a consortium (Figure 1):

1. Partner type.
2. Objectives of the project.
3. Use of knowledge.
4. Factors that affect the choice of partner.

Types of partners for the implementation of scientific projects are:

– universities
– research institutes;
– private companies (including hubs, start-up financing incubators), foundations, professional associations;
– government organizations (ministries, employment centers, etc.).

Often, a public-private partnership is organized in the scientific consortium to ensure a lasting effect from the results.

Project objectives are divided into:

– strategic, which involves long-term cooperation within the project;
– situational, which is necessary to reduce risks;
– the goals, which involve creating new competencies in the consortium of projects;
– goals that involve obtaining financial results (increase of profits of participants in the consortium of projects).

The use of knowledge involves two components:

– obtaining knowledge in the course of project implementation;
– obtaining knowledge after project implementation.

Partner choice can take place under the following criteria:

1. Integrated assessment of scientific activity for a certain period on a certain topic.
2. Previous experience in project implementation and their role.
3. Degree of innovation in activity.
4. Financial capacity.
5. Reputation evaluation.

Consider the question of evaluating the scientific activity of universities and research institutes. In Ukraine for the first time a thorough calculation of the rating of higher educational establishments in 2009 began the Kiev Polytechnic Institute named after Igor Sikorsky. According to this rating system, the rating of a scientist is defined as the sum of coefficients of performance of certain works: methodical, educational, scientific, organizational and educational. These coefficients are defined as the ratio of the sum of values of the time norm for performing certain types of work to the basic value of the work direction. In determining the ranking of the heads of departments additionally the average value of the ratings of scientific and pedagogical staff of the department with a coefficient of 0,3.

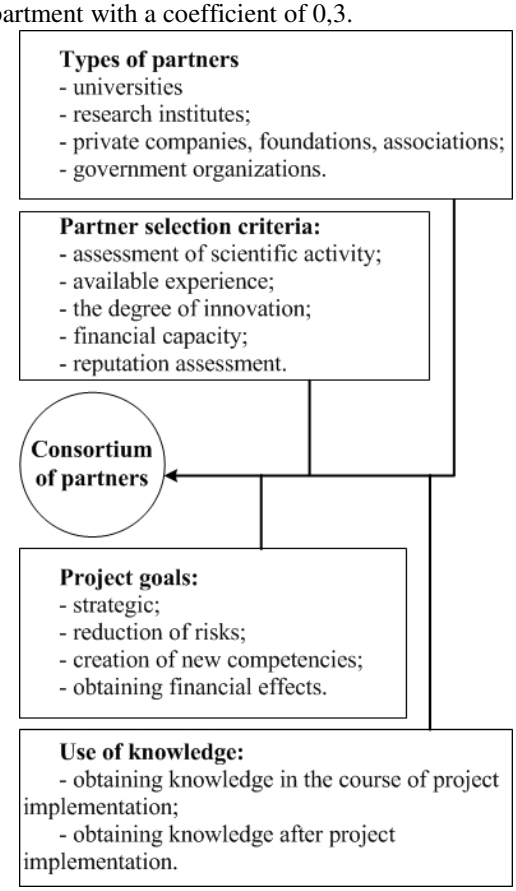

Figure – Components that are taken into account when selecting partners for a scientific consortium

The result of the introduction of such a system for determining the rating of scholars is to: increase the efficiency and effectiveness of research and training activities, ensure competition, and increase the motivation of employees [21].

The most popular international methods of assessing the activities of universities and research institutes are:

– Methodology of the British consulting company Quacquarelli Symonds (QS);
– Academic Ranking of Universities of the World, compiled by the Shanghai Institute of Higher Education, Jiaotong University (Shanghai Rating) [22].

When calculating QS ranking, the following indicators are taken into account:

1. Academic Reputation Index.
2. The reputation index among employers.
3. The ratio of the number of teachers and students.

4. Index of citation of scientific articles of teaching staff in science-based bases (Scopus) in relation to the number of teaching staff.

5. Part of foreign teachers with regard to the teaching staff (equivalent to the full rate).

6. Part of foreign students relative to the number of students (full-cycle study programs).

The Shanghai rating is calculated on the basis of the following indicators:

1. Number of articles published in Nature or Science.

2. Number of quoted publications (SCIE citation index – Science Citation Index – Expanded and SSCI – Social Science Citation Index).

3. The number of teachers who received the Nobel Prize or Fields Award.

4. Number of publications cited in scientific journals.

5. The number of university graduates who received the Nobel Prize or the Fields Prize.

6. The ratio of the above indicators to the number of staff at universities.

It should be borne in mind that the criteria that are suitable for the evaluation of scientific institutions and universities do not fully reflect the criteria that potential partners of the consortium of scientific projects should have.

Conclusions and perspectives of further research

Describes the task of finding partners and identifies the key features of partners (academic institutions, universities, companies) that influence the way of communication and cooperation between them. Also, in the article to form a list of components that affect the creation of a consortium of scientists for the implementation of a project or a grant. These components are important for selecting the appropriate partners for cooperation.

Also, the article deals with methods of evaluating the activities of scientific institutions and universities that are used in Ukraine and for the international community. It has been found that the criteria on which these ratings are based do not fully reflect the criteria that potential partners of the consortium of scientific projects must have. Therefore, further research should be the formation of a list of criteria that directly affect the choice of partner.

Also, an important task is to create an information and conceptual model for presenting projects and project implementers in the scientific community. Then, based on certain criteria, it is necessary to formulate models for choosing partners and determine the directions of research of individual scientists, which may be useful in planning the tasks in the project. As the scientific community operates in a competitive environment, potential competitors can be identified in addition to the potential partners. Competitions also require a separate evaluation.

Finally, an information and analytical system should be created which, for the purpose of grants or projects, will form a list of potential partners (universities, research institutes, individual scientists, private companies, foundations and associations, public authorities) for cooperation.

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ЗАДАЧА ВИБОРУ ПАРТНЕРІВ ДЛЯ СПІВПРАЦІ В РАМКАХ НАУКОВИХ ПРОЕКТІВ

Анотація. *В роботі наведено формальну постановку задачі пошуку партнерів для формування наукового консорціуму. Також визначено основні особливості партнерів (університетів, науково-дослідних інститутів, органів державної влади, приватних компаній, професійних асоціацій та фундацій), які впливають на способи комунікації та співпраці між ними. Сформовано перелік факторів, які впливають на створення партнерства науковців в рамках виконання проекту або гранту. Розглянуто основні методи оцінювання діяльності наукових установ та університетів в Україні та світі. Визначено, що для підбору наукових партнерів критерії відомих рейтингів не дають змогу сформувати раціональний ранжований перелік потенційних партнерів проекту, тому потребують доопрацювання.*

Ключові слова: наукове співтовариство; науковий проект; вибір партнера

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