Відомості про авторів / Сведения об авторах / Information about authors

Першина Юлія Ігорівна (Першина Юлия Игоревна, Pershyna Iuliia Igorivna) – доктор фізико-математичних наук, доцент, Українська інженерно-педагогічна академія, м. Харків; тел.: (050) 222-69-79; e-mail: yuliapershina78@gmail.com.

Токмакова Ірина Анатоліївна (Токмакова Ирина Анатольевна, Tokmakova Iryna Anatoliyivna) – старший викладач, Національний технічний університет «Харківський політехнічний інститут», м. Харків; тел.: (099) 630-07-43; e-mail: irina777111@ukr.net.

Думич Єгор Андрійович (Думыч Егор Андреевич, Dumych Yegor Andreevich) – аспірант, Українська інженерно-педагогічна академія, м. Харків; тел.: (050) 930-39-79; e-mail: sianotalone@gmail.com.

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R. V. PETROVA, O. I. LIUBICHEVA, A. I. MOROZOVA

MATHEMATICAL MODELS AND INFORMATIONAL TECHNOLOGIES OF INNOVATIVE PROJECT ARRANGEMENT IN THE STAKEHOLDERS' SYSTEM

During the involvement of innovative projects into knowledge-intensive high-tech enterprises, the process of creating a system of interested stakeholder management becomes vital. The given work contains the results of conducted analysis concerning the problem of innovative potential management of high-tech enterprises. The necessity of the analysis of informational technologies in the conditions of the non-equilibrium economy is considered. Various models of project management in the system of stakeholders are presented in the work. The stages of Nicholas model are considered. A mathematical model is proposed for the management and investors of the project, in terms of maximizing profits under specified constraints.

Key words: innovative project, stakeholders, Mitchell's model, ASC model, informational technologies.

Р. В. ПЕТРОВА, О. І. ЛЮБІЧЕВА, А. І. МОРОЗОВА

МАТЕМАТИЧНІ МОДЕЛІ І ІНФОРМАЦІЙНІ ТЕХНОЛОГІЇ ОРГАНІЗАЦІЇ ІННОВАЦІЙНИХ ПРОЕКТІВ У СИСТЕМІ СТЕЙКХОЛДЕРІВ

При залученні інноваційного проекту в наукомісткі високотехнологічні підприємства актуальним процесом стає створення системи управління зацікавленими учасниками. Проведено аналіз проблеми управління інноваційним потенціалом наукомістких підприємств. Розглянуто необхідність аналізу інформаційних технологій в умовах нерівноважної економіки. Розглянуто різні моделі управління проектами в системі зацікавлених осіб. Розглянуто етапи використання моделі Ніколаса. Запропоновано математичну модель для керівництва та інвесторів проекту, в умовах максимізації прибутку при заданих обмеженнях.

Ключові слова: інноваційний проект, стейкхолдери, модель Мітчелла, ASC модель, інформаційні технології.

Р. В. ПЕТРОВА, О. И. ЛЮБИЧЕВА, А. И. МОРОЗОВА

МАТЕМАТИЧЕСКИЕ МОДЕЛИ И ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ ОРГАНИЗАЦИИ ИННОВАЦИОННЫХ ПРОЕКТОВ В СИСТЕМЕ СТЕЙКХОЛДЕРОВ

При вовлечении инновационного проекта в наукоемкие высокотехнологичные предприятия актуальным процессом становится создание системы управления заинтересованными участниками. Проведен анализ проблемы управления инновационным потенциалом наукоемких предприятий. Рассмотрена необходимость анализа информационных технологий в условиях неравновесной экономики. Рассмотрены различные модели управления проектами в системе заинтересованных лиц. Рассмотрены этапы использования модели Николаса. Предложена математическая модель для руководства и инвесторов проекта, в условиях максимизации прибыли при заданных ограничениях.

Ключевые слова: инновационный проект, стейкхолдеры, модель Митчелла, ASC модель, информационные технологии.

Introduction. The analysis of practical innovative development has shown that the management of innovative potential requires an appropriate update not only in the field of creating a technological platform and innovative products but also in terms of creating an organizational and economic mechanism for managing innovative activity. Of particular importance is the creation of a stakeholder management system when high-tech enterprises and organizations are involved in an innovative project. In order to organize effective project activities with the participation of all stakeholders, it is necessary to carry out a set of interrelated mathematical models.

Problem statement. The methodological problem of managing the innovative potential of knowledge-intensive companies is not only the establishment of stakeholder groups, but also the analysis of informational technology and the development of a network model of various resource exchange, the assessment of network density and centrality in a non-equilibrium economy.

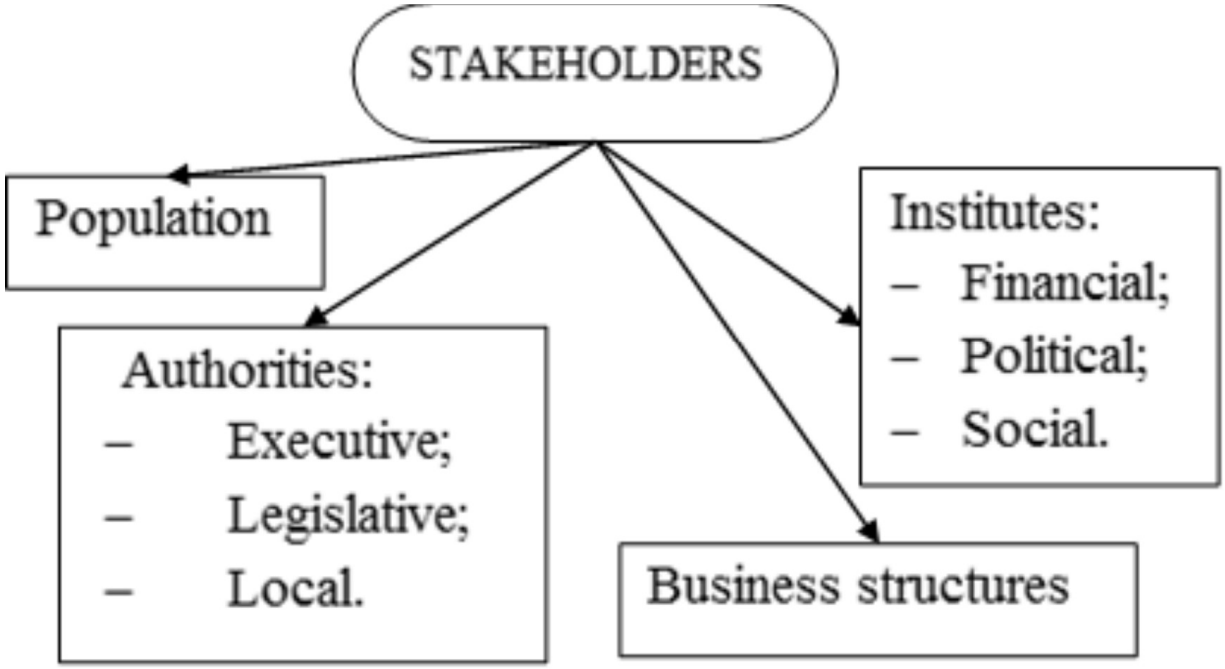

Fig. 1 – A system of stakeholders.

Stakeholders of innovative projects are legal entities and individuals or groups of persons whose interests are affected by the project during its life cycle. According to the international community of managers, the main groups of stakeholders include the following: shareholders and investors, creditors: banks and other credit organizations, partners and suppliers, buyers and customers, state and tax authorities, professional associations, media, non-governmental organizations, managers and senior management of the company, company staff, trade unions, competitors, local communities, public environmental, religious and other organizations [5] .

Thus, a system of stakeholders in the organization and analysis of the innovation project in general can be presented in fig. 1.

Accounting the interests of stakeholders is important at all stages of project management, as it will reduce the direct negative impact on the project and prioritize those projects that have the most positive impact on stakeholders. Contemporarily in the management of complex projects are used both well-known and newly created models, methods, algorithms, and software. However, the number of unsuccessful projects in relation to the successful reaches, according to various estimates, from 40 to 60 %. At the same time, information technologies for innovative projects should also be created for all stages of the innovation cycle in order to ensure the interaction of demand and supply of innovative products.

Model study. Since the early 1960s, science has proposed a wide range of models, methods of planning and project management with great functionality [1]. At the same time, it should be noted that the number of complex projects and the volume of investments in them were growing at a significant rate, exceeding the possibility of their effective management. As mentioned in McKinsey's independent division research report, "estimates of global infrastructure expansion project development costs will be $ 3.4 trillion per year between 2013 and 2030." [2] "90 % of megaprojects fail to cover all the costs, violate the executive schedule or goals because of underestimation of cost and overestimation of future requirements».

The choice of project management methods and tools is largely determined by which of the project stakeholders is considered as the subject of project management in each case. Different stakeholders in the same project have different expectations, roles, responsibilities and actions [6]. These differences significantly affect the formulation of their project objectives, the methods used, tools and technologies for solving management problems, focused on their specific needs.

The Mitchell’s model is a mechanism for grouping project stakeholders [3]. In order to implement this, relevant attributes have to be selected (a classic example is the power, legality and urgency of the requirements), which may have one or another interested party and on which depends the importance of stakeholders. Each stakeholder is evaluated as it possesses an attribute, which allows it to be attached to the class of significance. These classes are ordered based on the importance of the corresponding set of attributes. Thus, the importance of the interested party is assessed as the importance of the class in which it is included. The classical Mitchell’s model has the following form (fig. 2).

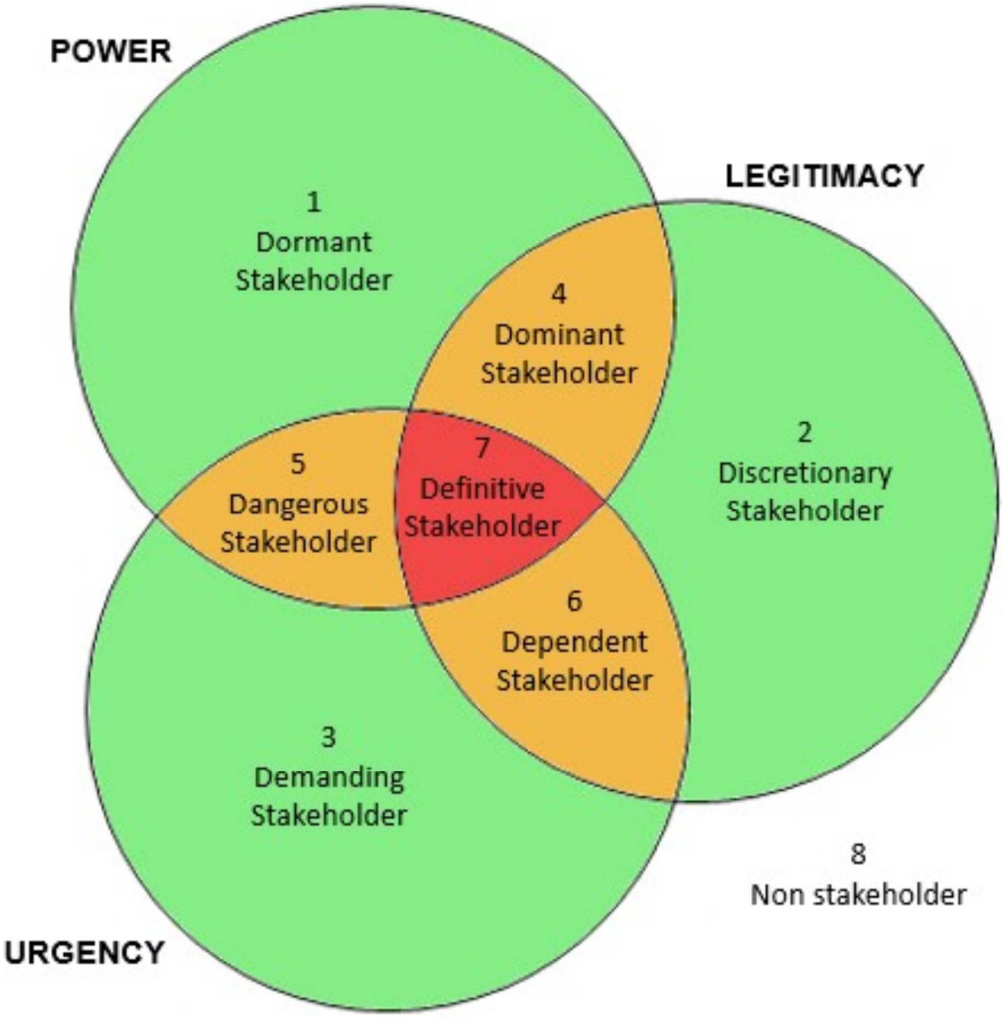

Fig. 2 – The classical Mitchell's model.

The Mitchell's model is used to group the stakeholders of the project, and for a detailed relationship between the stakeholders, it is necessary to use the Nicholas - Accountability Scorecard (ASC) model, which is a formalization of the system of responsibility indicators [4].

For each group of key stakeholders, the contributions that the project receives from them and the incentives (benefits) that the stakeholders receive from the project are identified.

Informational technology plays an important role in the successful management of innovative projects. Their implementation, in most cases, is carried out in the form of a network of multifunctional informational systems, consisting of customizable modules that use different approaches to data storage, which allows accessing all stakeholders; network communication and methods of transmission of information resources, important for the transfer of information between stakeholders.

Since an innovative science-intensive project is implemented within an organization or a group of organizations, the priority is to use this model to determine the relationship and responsibility between the organization implementing the project, the organization initiating the project, between the cluster members and other projects of the company. In the framework of this model, they operate with the concepts of "contribution" and "stimulus-reaction" [7]. Thus, when analyzing stakeholders in the management of projects, the business analysis unit is the project, not the organization.

Deposits and incentives are ranked according to priority (importance). At the same time, an important aspect is an attitude of stakeholders to each other, the ability and capability to interact. When developing and compiling the matrix, it is necessary to identify conflict situations between stakeholders, both at the stage of project initiation and in the process of project implementation. After ranking, indicators for each contribution and incentive are determined and this information is recorded. The next stage is to create a database of stakeholders of the project, which will provide an opportunity to systematize information on the importance and role of all stakeholders in the project. Thus, the ASC model can be represented in the stages shown in fig. 3.

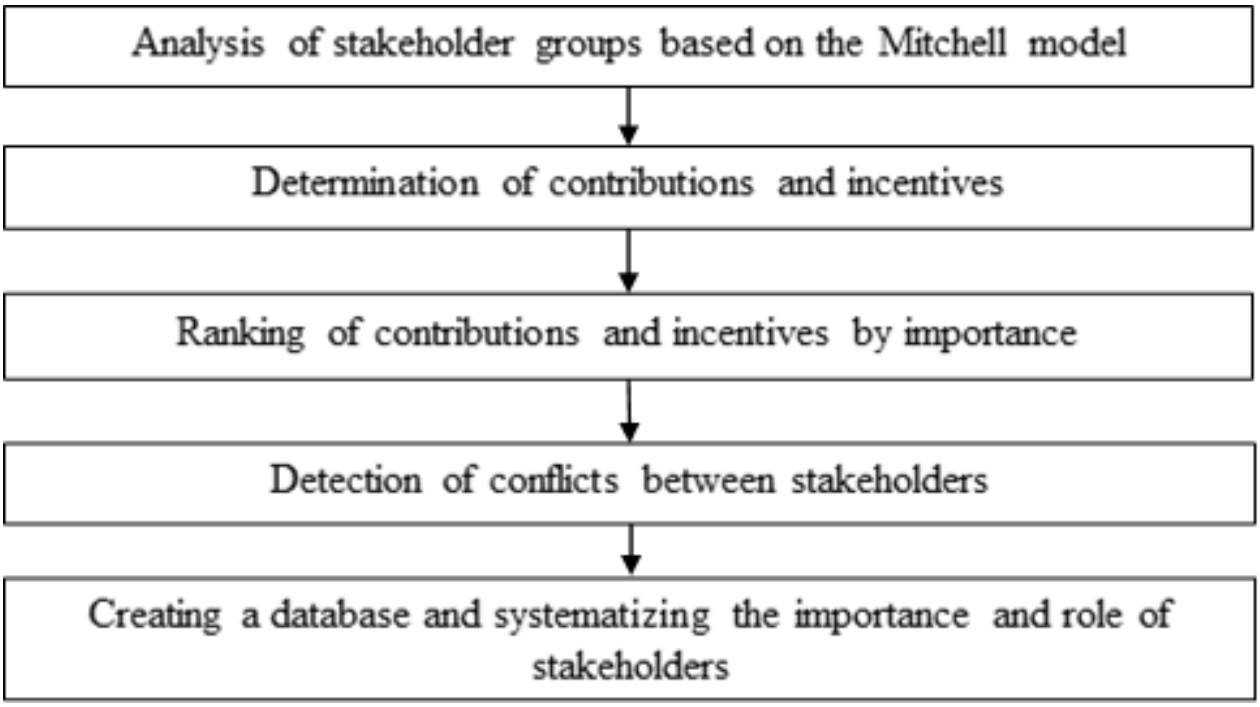

Fig. 3 – Stages of ASC model.

The identification of the organization executing the project and the organization initiating the project (in case of their discrepancy), investors and the definition of their contributions and incentives visualizes the position of stakeholders. When managing stakeholders, it is necessary to take into account the influence of the human factor, the presence of conflict situations between team members and stakeholders.

In some cases, stakeholder management is considered to be a static process. However, since project management is iterative, stakeholder management also needs to be considered in dynamics. In addition, consideration of the time factor in stakeholder management will determine the distribution of contribution and incentive across the life cycle phases [8].

For a certain point in time (the selected control point), a stakeholder interest profile is formed, which is compared with the planned interest profile. Based on the analysis, recommendations for working with stakeholders are developed.

Thus, having analyzed in detail the characteristics of stakeholders, it can be highlighted, that the problem of stakeholders should be regulated at the level, the achievement of which requires the involvement of a particular group of stakeholders. Any activity, either business or industrial, bases on the usage of certain resources. In an unstable and non-equilibrium economy, it is necessary to properly consider all the risks of an innovative project, especially if it is also knowledge-intensive, it is necessary to assess the resources and potentials of its participants. Only by agreeing among themselves and uniting temporarily or permanently in interest groups (research and production clusters), stakeholders have a chance of success of the project.

Mathematical model. Consider a model for project management and investors who make strategic decisions [7]. The main criterion of management for the investor is to maximize profits under the specified restrictions in the form of the number of funds and the timing of the project. We introduce the following notations:

V_i – value of investor's resource at the moment of time i – stage of project lifecycle; C_i – project costs at the moment of time i – stage of project lifecycle; P_i – planned profit at the moment of time i – stage of project lifecycle; T_1, T_2 – beginning and end of project.

Then the model of the organization of the investment project for the investor will be as follows:

$$P_i \to \max, \text{ when } T_2 - T_1 = \min \text{ and } C_i \le V_i. \quad (1)$$

Thus, the task of maximization of profit at minimum time of project and amount of investment greater than or equal to the cost of the project is to be solved. This model helps to achieve the goals of one of the stakeholders, namely investors. To achieve the goals of all parties, it is necessary to consider models for each of the parties, and then group them using Mitchell's model and ranking contributions using the ASC model. It uses four types of technologies that provide functional solutions in the field of innovation management:

– semantic;

– collaboration;

– visual;

– scaling.

Summing up, the improvement of stakeholder management processes of the project is quite relevant in modern conditions, as the influence of stakeholders on the project is growing every year, and it will be a big mistake of the project manager not to take this into account.

Conclusion. Establishment of stakeholder groups, the analysis of information technologies as well as the development of a network model is a methodological problem of innovation potential management. Stakeholders' interests should be taken into account at all stages of the company's life cycle. Mitchell's model was identified as the most suitable for accounting the interests of all stakeholders, which together with the ASC model will create a database and systematize the roles of all stakeholders. It was concluded that the problem of stakeholders should be regulated at the level, the achievement of which requires the involvement of a group of stakeholders. When considering mathematical models of the managers and investors of projects the task is to maximize profit with minimal project dates and amount of investment greater than or equal to the cost of the project.

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Information about authors / Відомості про авторів / Сведения об авторах

Petrova Roksana Vadimovna (Петрова Роксана Вадимівна, Петрова Роксана Вадимовна) – PhD, Department of Economic Cybernetics and Management of Economic Security, Kharkiv National University of Radio Electronics, Kharkiv; tel.: (067) 775-13-57; e-mail: roksana.petrova@nure.ua.

Liubicheva Olga Igorivna (Любічева Ольга Ігорівна, Любичева Ольга Игоревна) – Master's student, Kharkiv National University of Radio Electronics, Kharkiv; tel.: (050) 551-84-76; e-mail: olha.liubicheva@nure.ua.

Morozova Anna Ivanovna (Морозова Анна Іванівна, Морозова Анна Ивановна) – Senior Lecturer, Department of Systems Engineering, Kharkiv National University of Radio Electronics, Kharkiv; tel.: (095) 211-81-82; e-mail: anna.morozova@nure.ua.