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METHODOLOGICAL ASPECTS OF THE ANALYSIS OF THE PROJECT FORM OF INNOVATION-INVESTMENT ACTIVITY

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The methodological foundations of microeconomic analysis of the project form of innovative investment activity are developed in the article. The concept of time acquisition of economic resource properties in the process of realization of an innovation-investment project is proposed. The concept of production function of project innovation-investment activity introduced by the author has been clarified and improved. Its properties have been defined. It is determined that the choice of the owner of an investment project for the term of its realization is in fact the choice of a way of placing in the time necessary for its realization of a contracting resource under the appropriate organizational and technological scheme of work execution. This choice is influenced by subjective and objective factors. The latter form the main criterion for the above selection. This is a criterion for minimizing the economic value of the project, which should be understood as the future value of the entire cost of its implementation, including implicit ones. The structure of the economic value of the project is analyzed in detail, the formation procedure and the interdependence of its components, are determined. As a result, it is established that the economic value of the project is played by two resources - contracting and temporary, so its value depends primarily on the value parameters of these resources - specific value added and interest rate. The process of optimizing the economic value of an innovation investment project initiates its implementation and is carried out according to the criterion of consensual coordination of the approaches of the contractor and the project owner to establish the contractual values †of the main parameters of its implementation, that is, the result of interaction of participants trying to achieve the project goals in the most rational way economic interests. This can be achieved by determining the cost of contracting resources, based on the ratio of supply and demand for the project and the project implementation time, taking into account the value and/or pressure of the time factor.

Keywords: innovation-investment activity, project, contracting and time resources, production function of project activity, economic cost of the project.

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Introduction and problem statement

It is widely accepted that the state and dynamics of socio-economic development in the modern world are largely determined by the scale and intensity of innovation and investment activity of economic entities. The Ukrainian economy is now far behind in terms of innovation and investment activity not only from the developed countries of the West, but also from its closest neighbors - Poland, Slovakia, Hungary and even Belarus. Moreover, such a lag has taken place throughout Ukraine's existence as an independent state. As a result, the technical and technological base of production in the country is significantly outdated, which poses serious challenges in various spheres of social development up to and including national security. Therefore, it is not surprising that the scientific and economic discourse in Ukraine is largely focused on the problems of modernization of the economy due to growth of volumes and dynamics of innovations and

investments, creation of favorable conditions and necessary infrastructure, correct choice of priorities and so on. In this regard, it should be noted that in Ukraine's characteristic conditions of limited investment resources are not less important, in particular, the factors of the efficiency and effectiveness of the most innovative and investment activity, which is carried out mainly in the form of relevant projects.

All these circumstances form a powerful request for theoretical and methodological, methodological and scientific and practical elaboration of all aspects of the project form of innovation and investment activity.

Analysis and research of publications

Problems of innovation-investment activity occupies an important place in the process of development of economic science and covers a huge scientific achievements, from the classics of economic thought of different times and to the leading scientists-economists of the present – M. Tuhan-Baranovskoho, M. Kondratieva, J. Schumpetera, S. Kuznetsa, G. Menscha, A. Kleinknechta, J. van Dayna, R. Fostera, J. K. Galbraitha, D. Bella, F. von Hayeka, P. Druckera, M. Portera, P. Romera, P. Aghiona, P Howitta, C. Jonesa, A. Tofflera et al. In Ukraine, this issue is also extremely topical, its various aspects are considered in the works O. Volkova, A. Halchynskoho, V. Heitsia, M. Denysenka, S. Illiashenka, L. Mykhailovoi, P. Pererv, A. Peresady, M. Pohorielova, H. Semenova, A. Semenova, V. Semynozhenka, A. Tkachenko, V. Tkachenka, R. Tiana, V. Fedorenka, L. Fedulovoi, B. Kholoda, S. Chymshyta, Yu. Shypulinoi and many other scientists. In particular, innovation-investment activity has been investigated in the context of innovative perspectives of Ukraine [1], problems of innovative development [2,3], issues of organization and management [4,5], formation and development of innovative potential [6], etc. It should be noted that specifically the project form of innovation-investment activity was investigated mainly in organizational-managerial context within the scientific field of project management [7,8]. Instead, the aspect of economic analysis of the project form of innovation-investment activity, especially at the theoretical and methodological level, remains poorly understood.

The purpose of the article

The purpose of this work is to launch a methodology for microeconomic analysis of the project form of innovation and investment activity (hereinafter referred to as project activity).

Presenting main material

In the course of the project activity, two integrated economic resources are combined – contracting and temporary – by allocating the required amount of contracting resource in time in accordance with the organizational and technological scheme adopted for the implementation of the project. The result of project activity is the creation of new value as a project object, in fact, the achievement of the goal of the project implementation process. Given this, it is possible to determine the general view of the two factor production function of the project:

$$S=F(R,T), \qquad (1)$$

where S is a quantified project object (or contract work on the project); R is the amount of contracted resource involved in the project implementation; T is possible duration of project implementation (quantitative description of time required for project implementation).

In Fig. 1 shows the project isoquant – a graphical view of the production function of the project or project activity (production, which is a set of services and works on the project implementation) in the coordinates «contracting resources R – time resource (possible duration of project implementation) T» [9,769]. It is similar to the curve of the production function of traditional production. The logical explanation for this kind of project isoquant is the following. Each project work requires a certain amount of time and a certain amount of contracting resources. You can speed up your work by increasing the number of performers, and vice versa. The interconnectedness of the work can affect this pattern (for example, a significant increase in the amount of contracting resources can only slightly reduce the duration of the project), but it cannot change it dramatically.

The production function of the project describes a number of organizational and technological schemes of project work, each of which is designed to mobilize time and contract resources in an amount sufficient to implement the project (performance of certain volumes of contract work). In other words, each isoquant point characterizes a certain

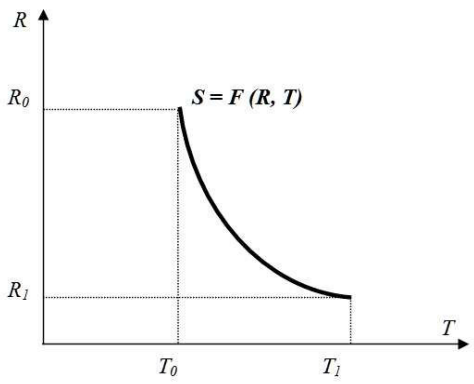

Fig.1. Isoquant project [9]

quantitative combination of time and contract resources. For each project there is a certain set (map) of isoquants, but only one of them (closest to the origin) represents the efficient use of resources for the best organization and technology of work for each organizational and technological scheme of their implementation (or for each combination of resources). Set of technically effective organizational and technological schemes for the technological level of the relevant contracting activity achieved in the world practice.

The production function of the project has the following properties.

1. Substitutionality of factors of production - contracting and time resources. This means that the contracting resource can be replaced by time and vice versa, thus changing the volume of the contracting resource flow (that is, its amount involved in each individual work period) in certain ratios (and to a certain extent). These ratios are determined by the second property.

2. Complementarity of factors of production. The presence of both of the above properties (substitutionality and complementarity) is explained by the fact that contracting and time resources, as noted, are combined by allocating the amount needed (implementation) of the contracting resource in time depending on the given duration of project implementation and, accordingly, accepted organizationally-technological scheme of its implementation.

3. All points of the map isoquant of a particular project are hypothetical except one (it is determined only after the project implementation process is completed).

4. A cost-effective organizational and technological scheme for the execution of the contract work on the project will not necessarily be technically efficient (it will not necessarily belong to the closest to the origin coordinate). For example, in the case of low labor costs, the cost of acquiring more technologically backward contracting resources may be lower than acquiring fewer advanced ones.

To overcome the impact of the fourth feature on the validity of further research, we introduce the concept of local technical effectiveness of organizational and technological schemes of project implementation, which should be understood as the best in terms of organization and technology of potential contractors to perform work on the project. Since the isoquant of technically efficient organizational and technological circuits may not be available for the implementation of a specific project, we will consider the closest to the origin of the isoquant coordinates of local technically efficient organizational and technological circuits. Due to the fact that the technological level of contracting activity in a certain sense is a consequence of the dynamics of the price situation in the resource markets, a cost-effective organizational and technological scheme for the implementation of a particular project will always be locally technically efficient.

Suppose that in Fig. 1 shows the closest to the origin coordinates of an isoquant of a project. Then T_0 and T_1 are the limit values for the duration of the project: for any number of $R > R_0$ it is not possible to execute the project during $T < T_0$. At the same time, by attracting as little as possible to ensure the organizational and technological continuity of the project implementation process, the amount of contracting resource R_1 can be implemented within no longer than during T_1. Further minimization of the amount of contracted resources involved makes it impossible for the organizational and technological continuity of the project implementation process. Thus, the rational owner of the project will choose the term of its implementation in the range from T_0 to T_1.

The criteria for choosing the project implementation deadline can be both objective and subjective factors. But often the effect of a set of these factors (especially in the case of a reduction in the subjective weight) is reduced to the priority of the criterion of minimizing the economic value of the project.

The economic value of the project will mean the future cost of the aggregate of all costs of the project owner for its implementation, including implicit ones. All of these costs are related to contracting, because in a physical dimension, a project is a set of interrelated works that are performed in a certain sequence. It follows that the project implementation process is the process of contractors performing works whose scope, regardless of the technology used and the duration of the project implementation, is set. In this case, the actual amount of contracting work may differ from the planned (given) due to the probabilistic nature of future planning of processes and other factors, but due to the procedures and methods of planning, risk insurance, etc., worked out within the framework of project management methodology, this does not fundamentally affect the nature of the scope of work on the project. Therefore, if the planned volume of contracting works S_{pl} = const, then the total amount of contracting resource (reserve of contracting resource) required for the project implementation is a constant value. However, the amount of contracted resource involved in each individual time period (the volume of contracted resource flow) depends ultimately on the duration of the project. Then, in the general form, the economic value of the project (the economic value of the contracted work S) can be determined by the following formula:

$$C=\sum_{n=1}^{N}Q_n\sum_{t=1}^{T}q_{nt}(1+r)^t+\sum_{n=1}^{N}\sum_{t=1}^{T}m_{nt}(1+r)^t, \quad (2)$$

where C is the economic cost of the project; Q_n is the unit price of the nth contracting resource, which is the value added, created by the unit of the nth contracting resource (specific value added); N is number of different contracting resources involved in this project; T is term of project implementation; q_{nt} is a quantitative characteristic of the executive (labor) component of the nth contracting resource involved in the t period; m_{nt} is the cost characteristic of the supply (material) component of the nth contracting resource involved in the t period; r is the interest rate.

As can be seen from (2), the contracting (mainly labor) component of contracting resources plays an important role in shaping the economic value of the project. This is due to the characteristic feature of project-oriented production. Unlike conventional production, in which the share of the labor component is constantly reduced through capitalization due to mechanization, automation and robotization of production processes, the labor component in project-oriented production will always be key, it is much more difficult to capitalize due to the specifics of contracting work (in particular, through high proportion of organizational, managerial, creative and other components of heuristic character).

Also, the formation of the economic value of the project is significantly influenced by the placement of contracting time (contracting resource). This is primarily due to the change in the value of money over time. Assuming that we have the best conditions to finance the project - full pre-payment for contracting, the formula for determining the economic cost of implementing the project is somewhat simplified:

$$C=\sum_{n=1}^{N}(Q_nR_n+M_n)\cdot(1+r)^T, \quad (3)$$

where C is the economic cost of the project; Q_n is the unit price of the nth contracting resource, which is the value added, created by the unit of the nth contracting resource (specific value added); R_n is the total amount of labor component of the nth contracting resource; M_n is the total cost of the material component of the nth labor resource; N is number of different contracting resources involved in this project; T is term of project implementation; r is the interest rate.

It should be noted that the cost of the temporary resource will become clear if the project owner borrows funds to finance the project. If you use your own funds, the cost of the temporary resource will remain implicit.

To simplify the analysis of project activity, let's consider a hypothetical project that is implemented using the same type of contracting resource for period T on the condition of full prepayment of contracting works. If you use the value of the given interest rate, given the condition of prepayment of works, we will have:

$$C=(QR+M)\cdot\bar{r}, \quad (4)$$

where C is the economic cost of the project; R is the total amount of labor component of the same contractual resource; Q is specific value added of the same contractual resource; M is the total cost of the material component of the same contractual resource; $\bar{r}$ is given interest rate, $\bar{r}=(1+r)^T$.

By the way, this simplification is not far from reality, since the components of the economic value of any project involving various contracting resources can always lead to the same resource:

– reduced (to the same contractual resource) the total amount of labor component – $R=\sum_{n=1}^{N}R_n$;;

– he specific value added is given – $Q=\frac{\sum_{n=1}^{N}Q_nR_n}{\sum_{n=1}^{N}R_n}$;

– reduced (to the same contractual resource) the total cost of the material component – $M=\sum_{n=1}^{N}M_n\cdot$.

In formula (4) M=const and R=const because S_{pl}=const. The value of Q is formed in the contract market and, subject to the price policy adjustment of the project owner, is accepted for the project, provided that its implementation period allows a rational way to use the contract resource. If necessary, forcing the works or extending them, Q may deviate significantly from the market value. In the general case, the market value of Q is the basis for determining the contractual value of Q, taking into account the impact of the duration of contracting:

$$Q=f(T). \quad (5)$$

This impact, in turn, is determined on the basis of the ratio of supply and demand of contracting resources within a specific project for each possible term of its implementation. But the mechanism for generating the demand for contracting resources should be the subject of separate research. Then,

given (4) and (5), we have:

$$C=F(T;r). \quad (6)$$

Therefore, all things being equal, the economic value of the project depends on the duration of the project and the interest rate. That is, changing the amount of time resource (spent on the project implementation) determines some of the volatility of the economic cost of the project. But on what basis does the project owner decide to use a temporary resource? What objective factor is most influential in making this decision? Obviously, it is the interest rate that determines the value of the time resource.

It should be noted that the value of the material component of the contracting resource M is deterministic, since it is formed on the basis of prices drawn up in the relevant adjacent markets (for example, markets for laboratory tests and tests, equipment, construction materials, etc.), and its impact on time can be to some extent neutralized by logistics. Usually, the project owner makes the most important decisions on the price and timing of the project in the course of the agreements with the contractors, ie operating in the contract markets. Then the decisive role in shaping the economic value of the project will have its variable component - added value:

$$C_D = QR(1+r)^T, \quad (7)$$

where S_D is the added value of the economic value of the project; Q is specific value added of the same contractual resource; R is the total amount of labor component of the same contractual resource; T is project implementation term; r is the interest rate.

The decision to use the time resource rationally is to decide whether it is appropriate to replace it with a contractual resource (or vice versa). Suppose that the project owner has the ability to attract an additional amount of the contracting resource DR at the same price Q, and thereby reduce the project implementation time by the amount of ΔT. Then the value added in the economic value of the project will be:

$$C'_D = QR(1+r)^{T-\Delta T}, \quad (8)$$

where C'_D is the value added after shortening the project implementation period; Q is the price (unit value added) of the same contractual resource that has not changed; R is the total amount of labor component of the same contractual resource; T is project implementation term; ΔT is the magnitude of the project implementation deadline; r is the interest rate.

As can be seen from (8), a higher interest rate will lead to a more significant effect of the substitution of the time resource for the contractor on the value added, regardless of the value of ΔR. Although ΔR and ΔT are interrelated, however, only the volume of labor component of the same contractor resource R is shown in the formula, which is constant (the use of a larger by ΔR volume of labor component of the contractor resource during the shorter duration of T−ΔT does not work on the project will change the contractor resource R required to complete the project). Thus, the interest rate substitute for the time contractor depends largely on the interest rate. Attention should also be drawn to the possibility of attracting additional contractual resources in the case under consideration in the present case Q. Obviously, such opportunities can occur in real economic situations. But in the general case, when attracting more contracting resources to perform the project work in order to shorten the period of its implementation, the cost of contracting resources may increase, as noted above (5). This is due in particular to the fact that the specific value added is, first, the cost of the contracted resource (the demand factor for it in the project), and secondly, characterizes the contractor's cost of performing the work, that is, the factor of supplying the contracting resource in the project. In the second case, dependence (5) is a priori, and through the mechanism of interaction of supply and demand of contracting resource in the project the same kind of dependence is formed in the first case. All these considerations confirm the dependence of (6).

Conclusions

1. The concept of time acquisition of economic resource properties in the process of realization of an innovation-investment project is proposed. Accordingly, the rational owner of the project considers the value of the time resource when attracting a contracting resource.

2. It is determined that the main objective criterion for choosing the owner of an investment project is the term of its realization, which is to minimize the economic cost of the project, which should mean the future cost of the whole set of expenses for its implementation.

3. It is established that the economic value of the project is played by two resources − contractual and temporary, so its value depends, first of all, on the value parameters of these resources − specific value added and interest rate.

4. It is confirmed that the process of optimizing the economic value of an investment project starts its implementation and is carried out according to the criterion of consensual coordination of the approaches of the contractor and the project owner to establish contractual values of the main parameters of its implementation. Consequently, the

optimization of the economic value of an innovation investment project is the result of the interaction of the participants trying to achieve the project objective in the most rational way, while ensuring their own economic interests (achievement of their own economic goals). It is established that this can be achieved only with the following approaches to determining the parameters of the implementation of an innovation investment project:

a) the specific value added will be determined on the basis of the demand-supply ratio and the supply of contracted resources for the specific project;

b) the project implementation time will be determined taking into account the value and/or time factor pressure.

5. It is stipulated that the innovation-investment project, especially in terms of its implementation, is a hierarchical system of economic interaction of participants (unlike the free competition market). At the same time, the difference between the project and the hierarchical systems of the type of firm is also quite significant, because the project participants on a contractual basis (in the process of optimizing the economic value of the project) make decisions about the parameters of its implementation, the distribution of responsibilities and responsibilities during implementation, and only then on the basis of the contract is formed functional hierarchy. At the same time, project participants remain equal and autonomous economic entities that behave rationally. As a result, within the project as an economic system, there are objective laws that, along with subjective factors, determine the course of its implementation. The most important of these patterns, which have a decisive influence on the process of optimizing the economic value of the project, is the formation of demand and supply of contracting resources within a specific project, which should be the subject of further research.

To sum up, it should be noted that the formalization of the project, like any systemic economic interaction, is rather conditional. However, it «works» in the sense of understanding the economic nature of project-oriented production, thus providing a methodological toolkit for microeconomic analysis of innovation and investment activity.

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МЕТОДОЛОГІЧНІ АСПЕКТИ АНАЛІЗУ ПРОЕКТНОЇ ФОРМИ ІННОВАЦІЙНО-ІНВЕСТИЦІЙНОЇ ДІЯЛЬНОСТІ

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У статті розроблено методологічні засади мікроекономічного аналізу проектної форми інноваційно-інвестиційної діяльності. Запропоновано концепцію набуття часом властивостей економічного ресурсу в процесі реалізації інноваційно-інвестиційного проекту. Уточнено та вдосконалено введене автором раніше поняття виробничої функції проектної інноваційно-інвестиційної діяльності, визначено її властивості. Встановлено, що вибір власником інноваційно-інвестиційного проекту строку його реалізації фактично є обранням способу розміщення у часі необхідного для його реалізації підрядного ресурсу за відповідної організаційно-технологічної схеми виконання робіт. На цей вибір впливають суб'єктивні та об'єктивні чинники. Останні формують основний критерій зазначеного вище вибору. Це критерій мінімізації економічної вартості проекту, під якою слід розуміти майбутню вартість всієї сукупності витрат на його реалізацію, в тому числі й імпліцитних. Детально проаналізовано структуру економічної вартості проекту, визначено порядок формування та взаємозалежність її складових. У результаті встановлено, що економічну вартість проекту відтворюють два ресурси – підрядний і часовий, тому її величина залежить, у першу чергу, від ціннісних параметрів

цих ресурсів – питомої доданої вартості та ставки процента. Процес оптимізації економічної вартості інноваційно-інвестиційного проекту започатковує його реалізацію і здійснюється за критерієм консенсусного узгодження підходів підрядника й власника проекту до встановлення договірних величин основних параметрів його реалізації, тобто є результатом взаємодії учасників, які намагаються досягти мети проекту найбільш раціональним способом, забезпечивши при цьому власні економічні інтереси. Цього можна досягти за умови визначення ціни підрядних ресурсів на основі співвідношення їх попиту та пропонування для даного проекту і строку реалізації проекту з урахуванням цінності і/або тиску часового фактора.

Ключові слова: інноваційно-інвестиційна діяльність, проект, підрядний і часовий ресурси, виробнича функція проектної діяльності, економічна вартість проекту.

МЕТОДОЛОГИЧЕСКИЕ АСПЕКТЫ АНАЛИЗА ПРОЕКТНОЙ ФОРМЫ ИННОВАЦИОННО-ИНВЕСТИЦИОННОЙ ДЕЯТЕЛЬНОСТИ

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В статье разработаны методологические основы микроэкономического анализа проектной формы инновационно-инвестиционной деятельности. Предложена концепция обретения временем свойств экономического ресурса в процессе реализации инновационно-инвестиционного проекта. Уточнено и усовершенствовано введенное автором ранее понятие производственной функции проектной инновационно-инвестиционной деятельности, определены её свойства. Установлено, что выбор собственником инновационно-инвестиционного проекта срока его реализации фактически является избранием способа размещения во времени необходимого для его реализации подрядного ресурса при соответствующей организационно-технологической схеме производства работ. На этот выбор влияют субъективные и объективные факторы. Последние формируют основной критерий указанного выше выбора. Это критерий минимизации экономической стоимости проекта, под которой следует понимать будущую стоимость всей совокупности затрат на его реализацию, в том числе и имплицитных. Детально проанализирована структура экономической стоимости проекта, определён порядок формирования и взаимозависимость её составляющих. В результате установлено, что экономическую стоимость проекта воспроизводят два ресурса – подрядный и временной, поэтому её величина зависит, в первую очередь, от ценностных параметров этих ресурсов – удельной добавленной стоимости и ставки процента. Процесс оптимизации экономической стоимости инновационно-инвестиционного проекта начинает его реализацию и осуществляется по критерию консенсусного согласования подходов подрядчика и собственника проекта к установлению договорных величин параметров его реализации, то есть является результатом взаимодействия участников, которые пытаются достичь цели проекта наиболее рациональным способом, обеспечив при этом собственные экономические интересы. Этого можно достичь при условии определения цены подрядных ресурсов на основании соотношения их спроса и предложения для данного проекта и срока реализации проекта с учетом ценности и/или давления временного фактора.

Ключевые слова: инновационно-инвестиционная деятельность, проект, подрядный и временной ресурсы, производственной функции проектной деятельности, экономическая стоимость проекта.

METHODOLOGICAL ASPECTS OF THE ANALYSIS OF THE PROJECT FORM OF INNOVATION-INVESTMENT ACTIVITY

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The methodological foundations of microeconomic analysis of the project form of innovative investment activity are developed in the article. The concept of time acquisition of economic resource properties in the process of realization of an innovation-investment project is proposed. The concept of production function of project innovation-investment activity introduced by the author has been clarified and improved. Its properties have been defined. It is determined that the choice of the owner of an investment project for the term of its realization is in fact the choice of a way of placing in the time necessary for its realization of a contracting resource under the appropriate organizational and technological scheme of work execution. This choice is influenced by subjective and objective factors. The latter form the main criterion for the above selection. This is a criterion for minimizing the economic value of the project, which should be understood as the future value of the entire cost of its implementation, including implicit ones. The structure of the economic value of the project is analyzed in detail, the formation procedure and the interdependence of its components, are determined. As a result, it is established that the economic value of the project is played by two resources – contracting and temporary, so its value depends primarily on the value parameters of these resources – specific value added and interest rate. The process of optimizing the economic value of an innovation investment project initiates its implementation and is carried out according to the criterion of consensual coordination of the approaches of the contractor and the project owner to establish the contractual values of the main parameters of its implementation, that is, the result of interaction of participants trying to achieve the project goals in the most rational way economic interests. This can be achieved by determining the cost of contracting resources, based on the ratio of supply and demand for the project and the project implementation time, taking into account the value and/or pressure of the time factor.

Keywords: innovation-investment activity, project, contracting and time resources, production function of project activity, economic cost of the project.

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