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OPTIMIZATION OF INFRASTRUCTURE PROJECT PRODUCT PARAMETERS

The **subject** of the research is the means of determining the optimal set of parameters for the products of infrastructure projects. The **aim of the study** is to increase the efficiency of the implementation of infrastructure projects through the use of the developed model for substantiating the optimal parameters of their products. To achieve this goal, the following **tasks** have been solved: determination of the main options for "autonomy" of infrastructure projects; formalization of the dependences of the time, value and economic characteristics of infrastructure projects on the parameters of their products (infrastructure object) and the development of a conceptual model for optimizing these parameters; development of a mathematical model for optimizing the parameters of products of this category of projects. The following **methods** are used: system analysis, functional analysis, operations research. **Results**: it was found that the parameters of the product of infrastructure projects, on the one hand, ensure its commercial relevance, on the other hand, they determine the characteristics of the project (cost, risks, life cycle duration, etc.), which forms a complex system of requirements and restrictions for product parameters. As a result of the study, a conceptual and corresponding mathematical model for optimizing the parameters of an infrastructure project product has been developed for two situations: 1) for a situation of an "autonomous" infrastructure project, in which the infrastructure object being created does not imply commercial use, or its creation and commercial use is carried out within the framework of one project; 2) for a situation of two interconnected by means of a project infrastructure object - the creation of an object and its management (commercial use). Modeling is based on formalized dependences of the value, time and economic characteristics of the project on the parameters of its product. **Conclusions**: the model allows to determine at the initial stage of project development, within the possible range of variation, that set of parameters of its product that provides maximum value for stakeholders both when creating an infrastructure object and in the future when managing (operating) it.

Keywords: value; autonomy; infrastructure object; model.

Introduction

Infrastructure projects are an integral part of the development of a city, region, country, and their main purpose [1] is to provide the necessary conditions for the life of citizens, including electricity and gas supply, transport links, etc.

The product of infrastructure projects is an infrastructure object that can be described by a certain set of parameters. This product, on the one hand, must satisfy the interests of stakeholders, on the other hand, the parameters of the project product determine its cost, the duration of certain stages of the life cycle, etc. Thus, the need to balance the "needs to be obtained" with "how to get it" leads to the formulation of the problem of optimizing the parameters of the products of infrastructure projects.

In [2], it was suggested that all projects can be divided into two categories from the point of view of the certainty of the project product: the first category is projects in which the product parameters are clearly known and set; the second category is projects in which product parameters are set as a result of a comprehensive analysis of possible options within specified limits.

Infrastructure projects can fall into both categories. But more often the second way is used when only a thorough study and analysis of a certain conceptual option allows setting the required set of parameters. For example, when deciding on the modernization of the port terminal, it is necessary to decide on what capacity should be calculated, what depths at the berths should be provided, what should be the lengths of the berths, whether a railway line is needed and how long, etc. Thus, at the stage of initiating an infrastructure project, the parameters of its product are established. For this, appropriate models can be used that take into account the "all consequences" for a specific set of product parameters.

Analysis of literature and research

The development of a modern theoretical basis for project management is aimed not only at the sectoral specialization of projects, but, first of all, at the development of new concepts and methodologies (for example, [3-5]), which give impetus to the development of appropriate methods and models. Research is carried out related to transport and logistics projects (for example, [6-8]), and, naturally, special attention is paid in modern works to infrastructure projects (for example, [9-14]). Particular attention is paid to the value of infrastructure projects and, in particular, in [11, 12], the contribution of an infrastructure project to the development of modern socio-economic systems is studied. In [9, 10], time management methods for infrastructure projects were proposed based on a hybrid methodology that combines classical and new approaches to the implementation of the stages of the project life cycle. The stakeholder management of such projects was studied in [12].

Despite the relevance of the study of issues related to infrastructure projects, it should be noted that almost no attention is paid to the products of these projects, although, as mentioned earlier, for many such projects at the initial stages there is a need for additional research to justify the best (optimal) set parameters of the infrastructure facility. In particular, in [2], a similar approach was used to optimize the product parameters of the fleet replenishment project, in [15] - to optimize the parameters of the port terminal development project.

Taking into account the above, we believe that this idea can be used as the basis for research in the framework of the development of infrastructure projects.

Thus, the purpose of this study is to increase the efficiency of the implementation of infrastructure projects through the use of the developed model for substantiating the optimal parameters of their products.

Results

Conceptual model for optimizing product parameters of an infrastructure project. The specificity of infrastructure projects is that they can have varying degrees of autonomy. At the same time, the concept of "autonomy", that is, independence, isolation of a project, is not necessarily associated with the entry of this project into a portfolio or program. In this case, the lack of certain autonomy for the infrastructure project means, first of all, that the project is the basis for the implementation of the other projects, the products of which depend on the product of the infrastructure project. For example, as a result of many infrastructure projects, a tangible "product" is created (an infrastructure object: a bridge, a road, a ferry crossing, a port terminal, etc.), the management of which is a separate project for the company (companies), which receives the right to manage (operate) this object.

Thus, in such situations, there are two separate projects, the composition of the stakeholders of which, generally speaking, may overlap (for example, the future operator company participates as one of the investors in the infrastructure project), fig. 1.

At the same time, the characteristics of an object created in an infrastructure project affect the results of the project for managing this object. Such a "tandem" of projects is an example of *the lack of complete autonomy* for an infrastructure project in terms of the dependence of the parameters of its product and the product of an interconnected project. Let us characterize this thesis in more detail.

As a result of implementation of the infrastructure project the object of infrastructure (product of the project) with parameters $\left\{P_i \middle| \; i=\overline{1,n}\right\}$ is created. The composition of this set includes both quantitative and qualitative characteristics of the object (for example, reliability, durability, etc.) and is determined by the specifics of the infrastructure object.

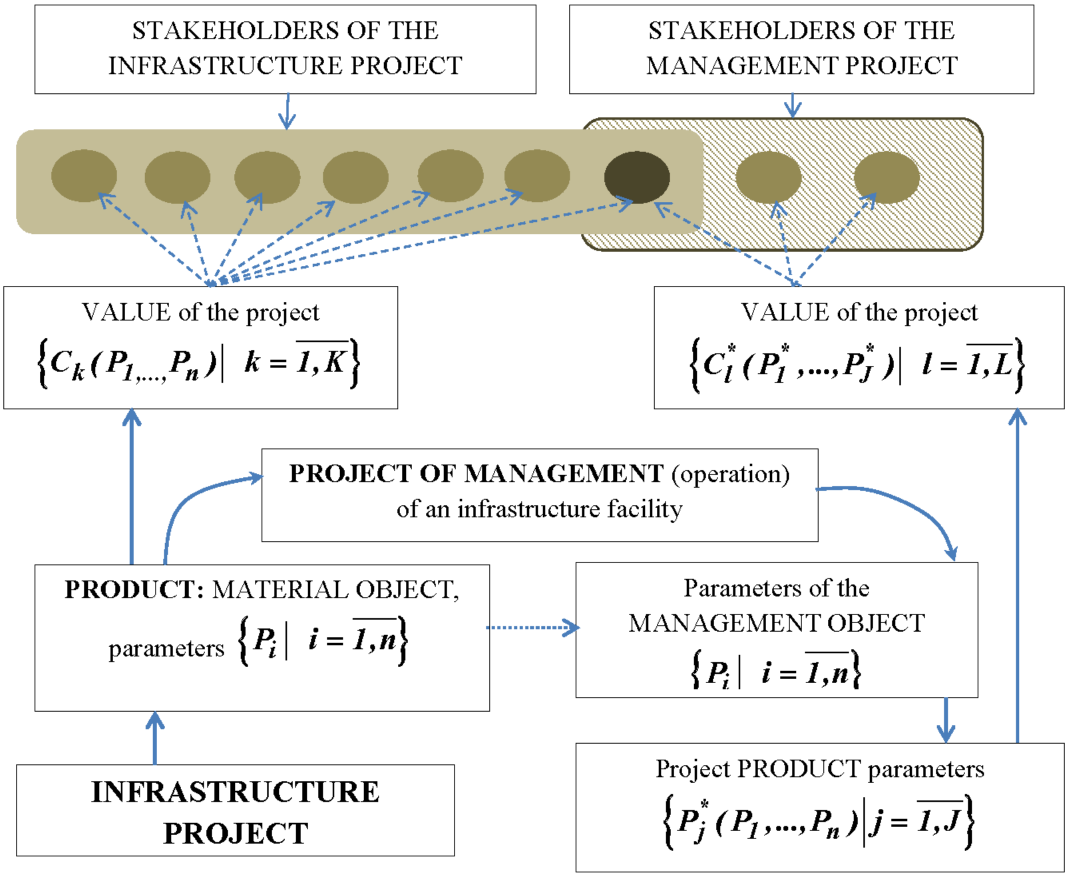

Fig. 1. Infrastructure project and related infrastructure facility management project

The value, as you know, is a universal characteristic of the project implementation results from the point of view of stakeholders, and for each of them the value of the project can vary significantly (the achieved high value for one stakeholder may not mean high value for another stakeholder at all); in addition, the "measure" of value can also be different for each stakeholder (for example, for one - the costs of the project, for the other – increasing the attractiveness of the region, for the third – the financial result, etc.). Thus, different levels of stakeholders of infrastructure projects have different levels of project value, which are the corresponding "reflectors" of the project results from the point of view of stakeholders' goals. Naturally, the value of an infrastructure project C_k depends on the parameters of its output product (that is, according to the results of the implementation of the infrastructure project):

$$C_k = C_k(P) = C_k(P_1,...,P_n), k = \overline{1,K}, \tag{1}$$

where K is a number of stakeholders in the infrastructure project; $P_i, i=\overline{1,n}$ – infrastructure project product characteristics; n – the total number of allocated characteristics of the project product. So, if the qualitative characteristics of the infrastructure facility are lower than the required (planned) ones, then, naturally, the project goal cannot be considered achieved, and, consequently, its value in fact decreases. (1) allows to take this into account, moreover, (1) allows, for example, on the basis of factor analysis, to establish what exactly and how influenced the decline in value, if it happened.

The product (infrastructure object) obtained as a result of the implementation of an infrastructure project becomes an object of management (operation) in the corresponding project, which further determines the characteristics of the product of this project $P_j^*, j=\overline{1,J}$ (where J is the number of distinguished characteristics of the product of the infrastructure object management project) and its value $C_l^*, l=\overline{1,L}$ for each stakeholder:

$$P_j^* = P_j^*(P_{1,...,}P_n),\ j=\overline{1,J}\ , \tag{2}$$

$$C_l^* = C_l^*(P_1^*,...,P_J^*) = C_l^*(P_1^*(P_{1,...,}P_n),...,P_J^*(P_{1,...,}P_n)), \tag{3}$$
$$l=\overline{1,L},$$

where L is a number of stakeholders in the infrastructure facility management project. For example, the depths reached at the berths and on the approach channels to the port (characterized within the set of parameters of the infrastructure project $\left\{P_i \mid i=\overline{1,n}\right\}$ product) determine the characteristics of the transport service (services) provided at a given port terminal (in particular, services for loading / unloading on ships of a certain size, which the terminal can receive at the berth, which is included in the set of parameters for the product of this project - the project for managing the infrastructure object – $\left\{P_j^* \mid j=\overline{1,J}\right\}$).

Thus, the relationship between products and results (in the form of value) of an infrastructure project and an interconnected infrastructure project management project is identified. The conceptual model for optimizing the parameters of an infrastructure project product is as follows (fig. 2).

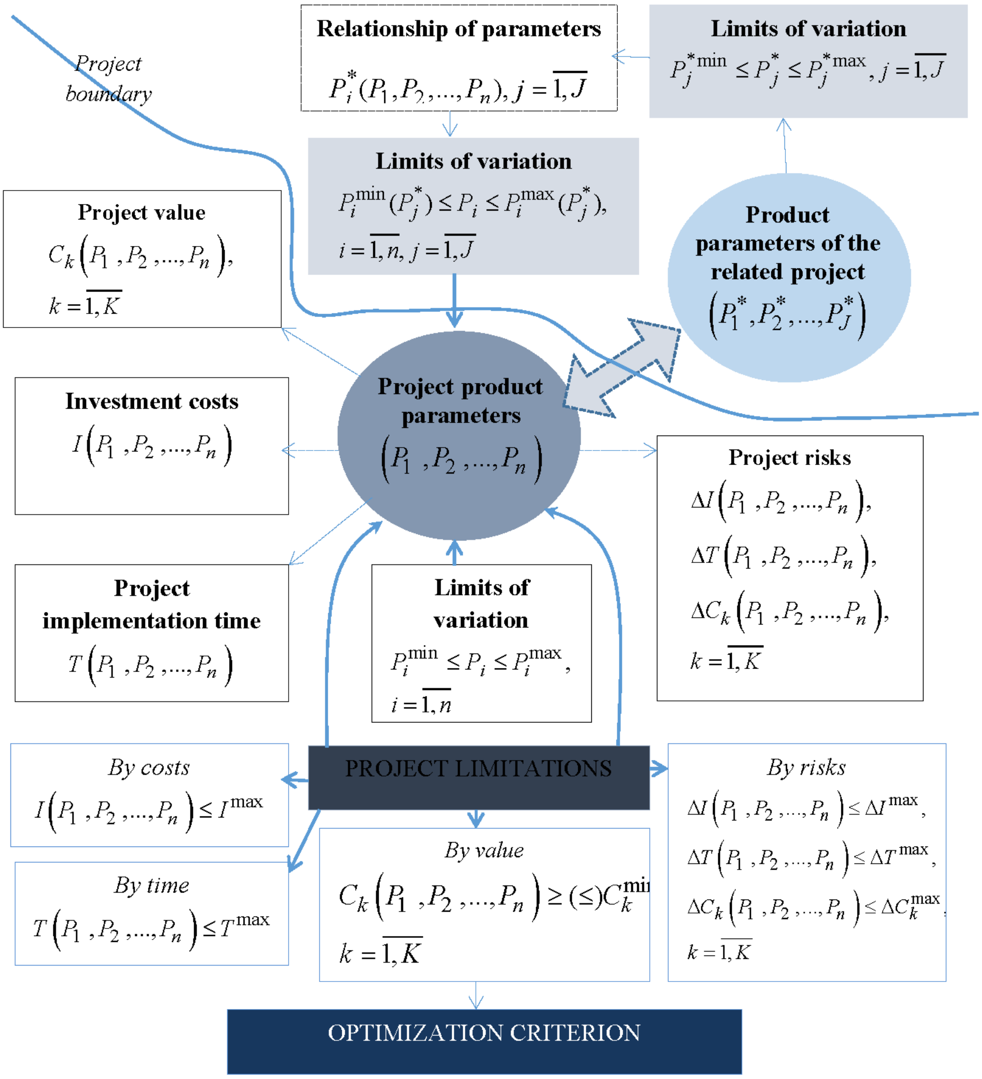

Fig. 2. Conceptual model for optimizing product parameters of an infrastructure project

A model for optimizing product parameters for an infrastructure project. Naturally, the parameters of the project product cannot be of an arbitrary level, and for each project, taking into account its specifics, certain restrictions are formed:

$$P_i^{\min} \le P_i \le P_i^{\max}, i = \overline{1,n}, \tag{4}$$

where $P_i^{\min}, P_i^{\max}$ characterize, respectively, the minimum and maximum permissible boundaries of the project product parameters. Note that in some cases, individual parameters of the products of infrastructure projects may be interrelated. For example, a certain depth of an approach channel without its corresponding width is meaningless. Therefore, this kind of relationship should be taken into account in the form:

$$P_v = P_v(P_1, ..., P_{\varphi_v}), v \in U_v, \tag{5}$$

where U_v is a set of project product parameters that depend on other parameters, φ_v is the number of parameters affecting a specific parameter P_v.

Varying the parameters of the product of an infrastructure project P allows to vary the main characteristics of this project, and, above all, *the cost of the project* (the size of the required investments) I :

$$I(P) = I\left(P_1, P_2, ..., P_n\right). \tag{6}$$

The project implementation time T is also determined by a set of product parameters:

$$T = T\left(P_1, P_2, ..., P_n\right). \tag{7}$$

Project risks also naturally depend on product parameters. If from the whole variety of project risks at the stage of their aggregated consideration, we single out the risks of an increase in implementation time ΔT, an increase in investment costs ΔI, and a change in value towards deterioration ΔC_k (for example, if the value is the increase of attractiveness, then there is a decrease in value; if the value is a decrease in cost, then it excesses, etc.). Thus, the parameters of the project product determine the magnitude of the risks:

$$\begin{aligned} &\Delta I = \Delta I\left(P_1, P_2, ..., P_n\right), \Delta T = \Delta T\left(P_1, P_2, ..., P_n\right), \\ &\Delta C_k = \Delta C_k\left(P_1, P_2, ..., P_n\right), k = \overline{1,K}. \end{aligned} \tag{8}$$

Each project is associated with certain restrictions in terms of cost, time, risks, etc., therefore, based on the above dependencies, the following system of project restrictions is formed:

- by project costs (size of investment)

$$I(P) = I\left(P_1, P_2, ..., P_n\right) \le I^{\max}; \tag{9}$$

- by implementation time

$$T = T\left(P_1, P_2, ..., P_n\right) \le T^{\max}; \tag{10}$$

- by value

$$C_k\left(P_1, P_2, ..., P_n\right) \ge (\le) C_k^{\min}, k = \overline{1,K}; \tag{11}$$

- in terms of acceptable risks

$$\begin{aligned} &\Delta I = \Delta I\left(P_1, P_2, ..., P_n\right) \le \Delta I^{\max}, \\ &\Delta T = \Delta T\left(P_1, P_2, ..., P_n\right) \le \Delta T^{\max}, \\ &\Delta C_k = \Delta C_k\left(P_1, P_2, ..., P_n\right) \le \Delta C_k^{\max}, k = \overline{1,K}. \end{aligned} \tag{12}$$

For a situation of *a completely autonomous project*, the presented system of restrictions is complete, reflecting the basic requirements and characteristics.

For a project that is associated with a subsequent management (operation) project, the constraints associated with *the further commercial operation of the infrastructure facility* should be taken into account. For example, with a relatively insignificant increase in investment, the parameters of the approach channel for ships of significant size can be achieved, but further entry of ships into the port is not advisable due to, for example, the lack of the ability to process such size of shiploads in the port, or the demand for such a size parties in the region, etc. That is, the commercial operation of the infrastructure object *imposes its own limitations* that must be taken into account. Otherwise, the created infrastructure facilities are either used ineffectively, or their use is generally not advisable and these facilities gradually replenish the set of abandoned facilities.

Thus, restrictions are formed on the parameters of the project product associated with its further commercial operation:

$$P_i^{\min}(P_j^*) \le P_i \le P_i^{\max}(P_j^*), i = \overline{1,n}, j = \overline{1,J}, \tag{13}$$

which are established through the presence of relationships between the products of projects (infrastructure and management):

$$P_j^* = P_j^*(P_1, P_2, ..., P_n), j = \overline{1,J} \tag{14}$$

and based on the constraints on the product parameters of the infrastructure facility management project:

$$P_j^{*\min} \le P_j^* \le P_j^{*\max}, j = \overline{1,J}. \tag{15}$$

The optimization criterion, as a rule, is one of the value indicators [15], for example, the one that most closely matches the mission and the main goal of the project (that is, the value from the standpoint of the main stakeholder). If *the project is autonomous* (that is, it provides for both the creation and management of an infrastructure facility), then the indicator of economic efficiency (for example, the NPV of the project) acts as the "main" value. For such projects, the system of restrictions can also be supplemented with restrictions related to efficiency (for example, profitability, payback period, etc.):

$$E = E\left(P_1, P_2, ..., P_n\right) \le (\ge) E^*, \qquad (16)$$

where E – used performance indicator, and E^* – its limiting border – maximum or minimum, depending on the essence of the selected indicator.

So, the model for optimizing the parameters of the product of an autonomous infrastructure project includes the following restrictions: (4), (9) – (12), (16) objective function (the value of the first stakeholder is conditionally selected as the main one):

$$Z = C_1\left(P_1, P_2, ..., P_n\right) \rightarrow \max_{P_1, P_2, ..., P_n}. \qquad (17)$$

If the project is partially autonomous, then the model for optimizing the parameters of the infrastructure project product includes constraints (4), (9) – (13), and objective function (17).

As a result of optimization, the parameters of the project product $P_1, P_2, ..., P_n$ are established, which characterize its certain physical characteristics (length, width, depth, height, etc.), operational characteristics (throughput, operating costs, service life before capital repairs, etc.), as well as quality characteristics (reliability, etc.).

Integral consideration of infrastructure project products and infrastructure facility management project.

In situations where the future operator of an infrastructure facility acts as one of the investors in the project for the creation of this facility (which is typical for such projects), his interests are represented in both projects, and, consequently, *the integral optimization* of the parameters of the products of both projects is logical for such a situation. In the above approach, the "interests" of an interconnected project when optimizing the parameters of an infrastructure project product were taken into account only as constraints (15). Integral optimization of these parameters is a separate task.

Since each project has its own goals and limitations, the optimization of the parameters of the products of each project is formally carried out within the framework of a separate optimization model. Nevertheless, there are interests of the above-mentioned investor, which are associated with both projects. Thus, in addition to two optimization models for each project, a model can be formed that optimizes the integral interests of the investor with some integral constraints for the two projects.

So, the model for optimizing the parameters of an infrastructure project product is formulated above. Let's consider a model for optimizing product parameters of an infrastructure facility management project $\left\{P_j^* \mid j = \overline{1, J}\right\}$.

For this project, generally speaking, investments may not be used, and the main investments are made in the process of creating an infrastructure facility. Nevertheless, many infrastructure facilities in the field of water transport (for example, port terminals) are characterized by the fact that construction and hydrotechnical works are carried out as part of the creation/reconstruction of the facility, that is, the "immovable" basis of the infrastructure facility is being created. At the same time, in the process of operating, the equipment is equipped with reloading equipment, which also requires certain investments.

Therefore, in the most general case, we will assume that within the framework of the infrastructure object management project investments are $I^*(P^*) = I\left(P_1^*, P_2^*, ..., P_J^*\right)$. If borrowed funds are used for investments, then corresponding costs arise $R_{inv}(I^*) = R_{inv}(P_1^*, P_2^*, ..., P_J^*)$, which are also determined by the terms of use of borrowed funds and shares of own funds (which is not emphasized in this work, since it goes beyond the scope of the study).

In addition, the operating costs R^e of an object depend not only on the parameters of the object, but also on the parameters of the product (for example, transport services), but also on the intensity of operation, that is, on the demand Q, which depends on the parameters of the product, therefore it is fair:

$$\begin{aligned} R^e &= R_1^e(P_1, P_2, ..., P_n) + \\ &+ R_2^e(P_1^*, P_2^*, ..., P_J^*, Q(P_1^*, P_2^*, ..., P_J^*)) = \\ &= R_1^e(P_1, P_2, ..., P_n) + R_2^e(P_1^*, P_2^*, ..., P_J^*), \end{aligned} \qquad (18)$$

where R_1^e and R_2^e accordingly, operating costs, which depend on both the "object" and the equipment/personnel associated with it.

The income from the object $D^e = D^e(P_1^*, P_2^*, ..., P_J^*)$ is also determined by the demand $Q(P_1^*, P_2^*, ..., P_J^*)$ and the parameters of the product (in this case, the service) $P_1^*, P_2^*, ..., P_J^*$.

Accordingly, the profit of the operator of the infrastructure facility is formed as:

$$\begin{aligned} &\Pi(P_1, P_2, ..., P_n, P_1^*, P_2^*, ..., P_J^*) = D^e(P_1^*, P_2^*, ..., P_J^*) - \\ &- R_1^e(P_1, P_2, ..., P_n) - R_2^e(P_1^*, P_2^*, ..., P_J^*). \end{aligned} \qquad (19)$$

It should be noted here that the above has been established $P_j^*(P_1, P_2, ..., P_n),\ j = \overline{1, J}$, however, some $P_1^*, P_2^*, ..., P_J^*$ are actually independent of $P_1, P_2, ..., P_J$. Therefore, in (19), the parameters of the products of both projects are indicated as parameters on which the profit depends.

The project of management (operation) of an infrastructure facility is certainly associated with certain risks, which, first of all, are manifested in a decrease in profits $\Delta\Pi$ due to an excess of planned operating costs

ΔR^e and a decrease in income ΔD. Thus $\Delta \Pi(P_1, P_2, ..., P_n, P_1^*, P_2^*, ..., P_J^*)$ is formed.

As an optimization criterion, an indicator of the economic efficiency of projects can be used (as the main value for an operator for such projects), for example $NPV(P_1, P_2, ..., P_n, P_1^*, P_2^*, ..., P_J^*)$, which is formed from income, operating costs, investment costs (if any), as well as the share of own funds invested in this project.

Thus, the model for optimizing the parameters of the product of the project of management (operation) of the infrastructure object is as follows:

Objective function:

$$NPV(P_1, P_2, ..., P_n, P_1^*, P_2^*, ..., P_J^*) \to \max_{P_1^*, P_2^*, ..., P_J^*}; \quad (20)$$

The limitation on the capacity/throughput (other similar characteristic) of the infrastructure object, $M^{\min}, M^{\max}$ respectively, the lower and upper boundaries, are established on the basis of the concept and experience of the commercial use of this object:

$$M^{\min} \le M(P_1, P_2, ..., P_n, P_1^*, P_2^*, ..., P_J^*) \le M^{\max}; \quad (21)$$

Limitation on the desired profit is $\Pi^{\min}$ and its allowable decrease is $\Delta \Pi^{\min}$:

$$\Pi(P_1, P_2, ..., P_n, P_1^*, P_2^*, ..., P_J^*) \ge \Pi^{\min}; \quad (22)$$

$$\Delta \Pi(P_1, P_2, ..., P_n, P_1^*, P_2^*, ..., P_J^*) \le \Delta \Pi^{\max}; \quad (23)$$

Investment restriction, where $I^{\max}$ is the maximum allowable level:

$$I\left(P_1^*, P_2^*, ..., P_J^*\right) \le I^{\max}; \quad (24)$$

Restrictions on acceptable values of control parameters:

$$P_j^{*\min} \le P_j^* \le P_j^{*\max}, \; j = \overline{1, J}. \quad (25)$$

Two comments should be made on this model:

1. When *considered locally* (that is, without taking into account the integral interests of the operating company in two projects), $P_1, P_2, ..., P_n$ act as exogenous parameters, and only the parameters $P_1^*, P_2^*, ..., P_J^*$ of the product of this project are subject to optimization.

2. When solving the problem, *the duration of the project is not considered*, a certain value of which is implied in (20). In (21) – (23), the considered indicators are referred to the annual time interval, which is traditional.

Integral consideration of two projects from the position of an investor-operator presupposes the presence of an "integrating" model, in which two local models are components.

One of the approaches used in such situations is that the criteria of local models are transformed into constraints, the lower bound of which is determined either on the basis of a target task within the project, or on the basis of a solution corresponding to the optimal value when solving a local problem. For example, if, as a result of the solution according to model (20) – (25), the value of the criterion for the optimal plan NPV^{opt} is obtained, then as the lower bound in the integral model, the value can be used

$$NPV^{\min} = \lambda \cdot NPV^{opt}, \quad (26)$$

where $0 < \lambda < 1$ is a coefficient specifying the permissible decrease in the optimal value of NPV in the local model. A similar approach is used when determining the lower bound for the criterion in the local model for optimizing the parameters of an infrastructure project product $C_1^{\min}$. The scheme of forming a model for the integral consideration of two projects (infrastructural, and an interconnected project for managing an infrastructure object) is as follows (fig. 3).

Such an integral consideration of the two projects allows us to take into account the specifics of the commercial operation of the infrastructure facility at the stage of its actual design (fig. 4).

The optimization criterion is the NPV indicator, taking into account the fact that the "trend" of projects is investment and provides for the commercial use of the facility:

$$NPV(P_1, P_2, ..., P_n, P_1^*, P_2^*, ..., P_J^*) \to \max. \quad (27)$$

Model control parameters are product parameters of both projects: $P_1, P_2, ..., P_n$, $P_1^*, P_2^*, ..., P_J^*$. The limitations of local models are fully included in the integral design consideration model. Objective functions of two local models are transformed into integral constraints:

$$Z_1 = C_1\left(P_1, P_2, ..., P_n\right) \ge C_1^{\min}, \quad (28)$$

$$Z_2 = NPV(P_1, P_2, ..., P_n, P_1^*, P_2^*, ..., P_J^*) \ge NPV^{\min}. \quad (29)$$

In addition, integral restrictions provide for a limit on investment resources S:

$$I_1\left(P_1, P_2, ..., P_n\right) + I_2\left(P_1^*, P_2^*, ..., P_J^*\right) \le S. \quad (30)$$

The main risk of the investor is the "shortfall" in profit, which causes a decrease in the efficiency of investments, that is ΔNPV appears, and so there is a natural limitation on the acceptable level of risk:

$$\Delta NPV(P_1, P_2, ..., P_n, P_1^*, P_2^*, ..., P_J^*) \le \Delta NPV^{\max}. \quad (31)$$

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Since the parameters of the projects' products are interrelated (in any case, some of them), the model should take into account the functional dependence of these parameters:

$$P_j^* = P_j^*(P_1, P_2, \ldots, P_n),\ j = \overline{1, J}\,. \qquad (32)$$

Note that the presented concept of forming an integral model can be used for other "trends" of projects, taking into account their specificity. This model is universal in nature, since the industry specificity is manifested only in the structure of indicators, and not in their essence. As a result of optimization according to model (27) – (32), the values of the optimal parameters of project products (infrastructural and interconnected with it) are determined, at which the interests of the investor are ensured from the point of view of NPV, subject to existing restrictions, either external or related to the requirements of investors.

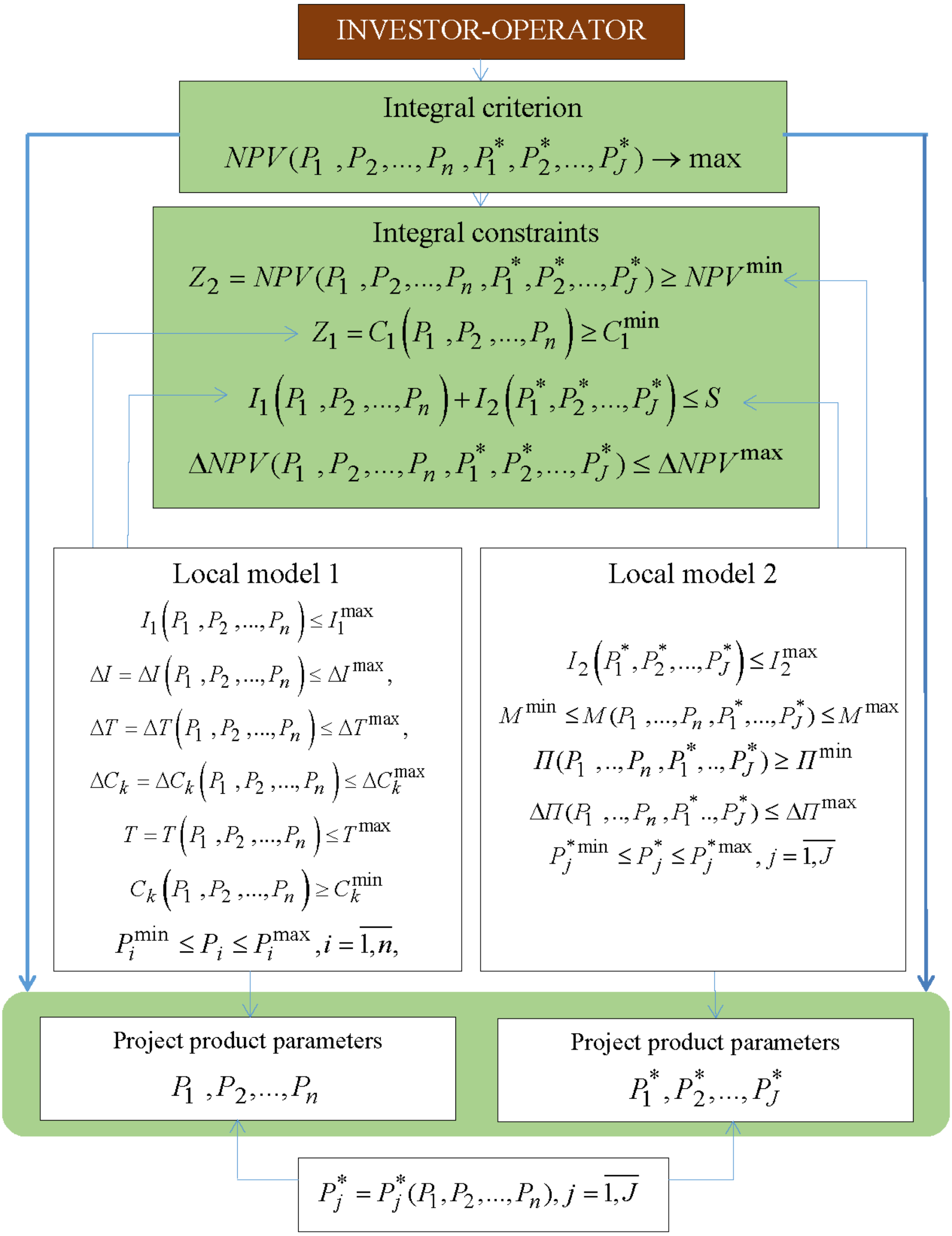

Fig. 3. Scheme of the formation of a model of integral consideration of two interrelated projects

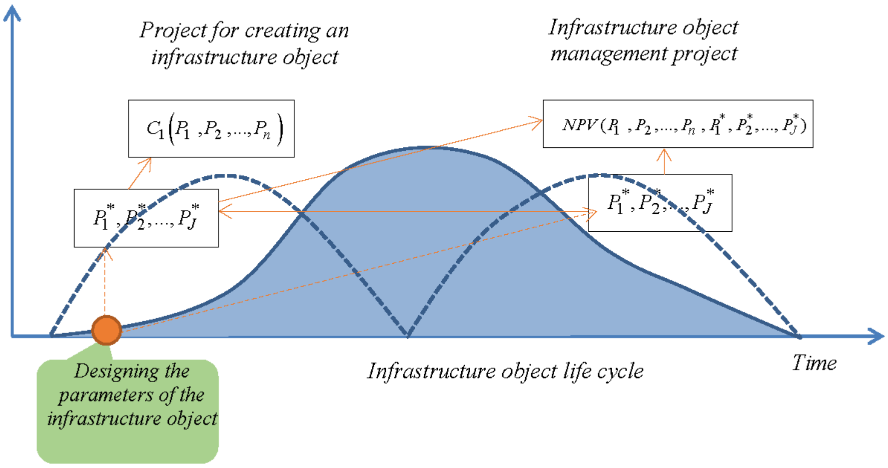

Fig.4. Accounting the specifics of the commercial operation of an infrastructure facility at the design stage

Conclusions

In this study, a mathematical model has been developed for optimizing the parameters of an infrastructure project product for two situations: 1) for a situation of an "autonomous" infrastructure project, in which the created infrastructure object does not imply commercial use, or its creation and commercial use is carried out within the framework of one project; 2) for a situation of two interconnected by means of a project infrastructure object – the creation of an object and its management (commercial use). Modeling is based on taking into account the dependences of the value, time and economic characteristics of the project on the parameters of its product.

The model allows, at the initial stage of project development, to determine, within the possible range of variation, the set of parameters that will provide maximum value for stakeholders both when creating an infrastructure object and in the future when managing (operating) it.

The model is universal and not tied to a specific field of activity, which makes it possible to develop it in terms of taking into account applied aspects, for example, a specific type of laws.

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ОПТИМІЗАЦІЯ ПАРАМЕТРІВ ПРОДУКТУ ІНФРАСТРУКТУРНОГО ПРОЄКТУ

Предметом дослідження є засоби визначення оптимального набору параметрів продуктів інфраструктурних проектів. **Метою** дослідження є підвищення ефективності реалізації інфраструктурних проектів за рахунок використання моделі обґрунтування оптимальних параметрів їх продуктів. Для досягнення даної мети вирішені наступні **завдання**: визначення основних варіантів "автономності" інфраструктурних проектів; формалізація залежностей часових, ціннісних та економічних характеристик інфраструктурних проектів від параметрів їх продуктів (об'єкта інфраструктури) і розробка концептуальної моделі оптимізації даних параметрів; розробка математичної моделі оптимізації параметрів продуктів даної категорії проектів. Використовуються наступні **методи**: системний аналіз, функціональний аналіз, дослідження операцій. **Результати**: встановлено, що параметри продукту інфраструктурних проектів, з одного боку, забезпечують його комерційну затребуваність, з іншого боку - обумовлюють характеристики проекту (вартість, ризики, тривалість життєвого циклу і т.п.), що формує в комплексі систему вимог і обмежень для параметрів продукту. В результаті дослідження розроблено концептуальну і відповідну математичну модель оптимізації параметрів продукту інфраструктурного проекту для двох ситуацій: 1) для ситуації "автономного" інфраструктурного проекту, при якій створюється об'єкт інфраструктури, який не передбачає комерційне використання, або його створення і комерційне використання здійснюється в рамках одного проекту; 2) для ситуації двох взаємопов'язаних за допомогою об'єкта інфраструктури проекту – створення об'єкта і управління ним (комерційного використання). В основі моделювання – формалізовані залежності ціннісних, часових і економічних характеристик проекту від параметрів його продукту. **Висновки**: модель дозволяє на початковому етапі розробки проекту визначити в рамках можливого діапазону варіювання той набір параметрів його продукту, який забезпечує максимальну цінність для стейкхолдерів як при створенні об'єкта інфраструктури, так і в подальшому при управлінні (оперуванні) ім.

Ключові слова: цінність; автономність; об'єкт інфраструктури; модель.

ОПТИМИЗАЦИЯ ПАРАМЕТРОВ ПРОДУКТА ИНФРАСТРУКТУРНОГО ПРОЕКТА

Предметом исследования являются средства определения оптимального набора параметров продуктов инфраструктурных проектов. **Целью** исследования является повышение эффективности реализации инфраструктурных проектов за счет использования разрабатываемой модели обоснования оптимальных параметров их продуктов. Для достижения данной цели решены следующие **задачи**: определение основных вариантов "автономности" инфраструктурных проектов; формализация зависимостей временных, ценностных и экономических характеристик инфраструктурных проектов от параметров их продуктов (объекта инфраструктуры) и разработка концептуальной модели оптимизации данных параметров; разработка математической модели оптимизации параметров продуктов данной категории проектов. Используются следующие **методы:** системный анализ, функциональный анализ, исследование операций. **Результаты:** установлено, что параметры продукта инфраструктурных проектов, с одной стороны, обеспечивают его коммерческую востребованность, с другой стороны – обуславливают характеристики проекта (стоимость, риски, продолжительность жизненного цикла и т.п.), что формирует в комплексе систему требований и ограничений для параметров продукта. В результате исследования разработана концептуальная и соответствующая математическая модель оптимизации параметров продукта инфраструктурного проекта для двух ситуаций: 1) для ситуации "автономного" инфраструктурного проекта, при которой создаваемый объект инфраструктуры не предполагает коммерческое использование, либо его создание и коммерческое использование осуществляется в рамках одного проекта; 2) для ситуации двух взаимосвязанных посредством объекта инфраструктуры проекта – создания объекта и управления им (коммерческого использования). В основе моделирования формализованные зависимости ценностных, временных и экономических характеристик проекта от параметров его продукта. **Выводы**: модель позволяет на начальном этапе разработки проекта определить в рамках возможного диапазона варьирования тот набор параметров его продукта, который обеспечивает максимальную ценность для стейкхолдеров как при создании объекта инфраструктуры, так и в дальнейшем при управлении (оперировании) им.

Ключевые слова: ценность; автономность; объект инфраструктуры; модель.

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