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RISK MANAGEMENT IN PROJECTS OF RESTORATION THE REGIONAL TRANSPORT STRUCTURE ON THE BASIS OF PARTICIPANTS' COMMUNICATION

The **subject** of the article is the processes of risk management and project communications. The components of the content of transport infrastructure rehabilitation projects, including communications between stakeholders, are considered. The **aim** of the work is to develop a method for assessing and managing the risks in transport infrastructure rehabilitation projects, taking into account the communication processes of the participants. The following **tasks** are solved in the article: systematization of risks in transport infrastructure rehabilitation projects in the form of relations between the project participants, creation of a graphic scheme of stakeholder communications, formalization of stakeholder communications with regard to the causes and possible parry of risks, development of a quantitative assessment model of the project risks with regard to stakeholder interests. **Methods** used: project management methodology, stakeholder theory, value theory, systems approach, matrix models. The following **results** were obtained: Opportunities, impact and risk status in relation to stakeholders of the transport infrastructure rehabilitation project were analyzed. The possibility of grouping risks in relation to the stakeholders of the project and the possibility of influence of stakeholder interaction on the available risk groups were considered. The risks that can directly affect the project or be affected by the interaction between the project stakeholders were identified. The formalized representation of risks and communications of project participants is presented. Opportunities to optimize the process of project risk management through the management of stakeholders and project communications have been identified. Quantitative project risk value model was developed to assess the effectiveness of actions to parry risks from stakeholders. **Conclusions:** project risk management can be more effective if tools and methods specific to stakeholder management and project communications are applied. The proposed formalization establishes a clear model of stakeholder interaction to parry risks. The model of quantitative assessment of the effectiveness of actions to parry risks will allow to evaluate the effectiveness of the management strategy and to make adjustments in time. In the future, this work will continue scientific research in the direction of developing models and methods of research of communications and risks of the project

Keywords: project management; stakeholders; transport infrastructure; interaction model; risk assessment.

Introduction

Success in the implementation of complex projects is associated with considerable uncertainty in the various factors accompanying the project. For example, the timing of the decision on financing and obtaining the result may not be too certain, although it is almost a key factor for every project.

As a result of the large-scale aggression of the Russian Federation in 2022, Ukraine suffers significant losses in the condition, quality and overall suitability of infrastructure facilities of entire regions. As of June 2022, the Ministry of Infrastructure sounded Ukrainian losses at 20-30% of prewar capabilities [1]. The scale of the damage varies from region to region and is not final, but it is already obvious that the country is waiting for a huge scale of projects to restore the lost infrastructure.

The specifics of transportation infrastructure rehabilitation projects include the involvement of significant financial resources, which may not be possible with significant schedule and outcome volatility. Failure to fully assess and account for all project risks can lead to significant and sometimes critical consequences, such as project non-completion or reduced overall benefits. This makes the field of risk management extremely critical and important to both project management and transportation system development projects in particular. After all, long-term and financially costly projects are particularly affected by a dynamic and uncertain environment [1].

The need to increase investment activity requires modern science to develop models and tools to qualitatively and reliably perform the tasks and carry out preventive measures to reduce the impact of project risks. Risk management is an effective tool for regulating changes in the economic environment[2].

Analysis of recent research and publications

A significant contribution to the domestic science in the field of research and development of methods and tools of risk management was made by such scientists as Bushuyev S.D. [3], Rach V.A., Zyuzyun V.O. [4], Druzhinin E.A. and others.

Risk assessment plays a key role in the management process. It may be done by economic, mathematical, statistical methods, by the method of expert evaluations or by a combined method. The main indicators, on the basis of which the mathematical and statistical assessment takes place, are the coefficient of variation and the degree of risk.

Rach V.A. showed the significance and difference of risks depending on the sphere and phase of the project, in which they can occur. Thus, according to the scientist, risks can be characterized by industry depending on the life cycle of the project and relative to the stakeholders of the project. He proposed the use of the risk pyramid and built a model that allows managers to effectively carry out risk management [5].

Druzhinin E.A. proposed the concept, principles and system scenario of the risk-oriented approach in project resource management. The scientist proposes to take into account the impact of the manifestation of multiple external and internal risks to justify the resources by joint modeling of project actions and actions aimed at eliminating the consequences of risk manifestation, which ensures the sustainability of the ongoing projects [6].

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Latkin M.O. proposes to use a system approach to describe risk management as a hierarchical system; including structural models (target model, functional model, organizational structure model) and process, models (process model of the implementation of management functions and communication model). The interaction between the individual models of the risk management system is provided by a number of matrix projections [7].

Foreign publications increasingly pay attention to current trends and the possibilities of their impact on the field of project management, in particular, risk management and communication. Wilson and co-authors investigated the possibilities of applying the value-based approach in risk management [8] and the possibilities of applying artificial intelligence for more effective risk management and communication in the project [9]. In recent years, scientists often address the topic of COVID-19 and its impact on the industry [10 - 12]. To date, it is relevant to study the risks of projects in supercomplicated critical conditions, such as wartime and post-war period.

The analysis of publications on risk management showed that the industry remains dynamic and attempts to describe processes and create tools continue with different approaches and tools. This indicates an incomplete process of basic knowledge and research methods, i.e., the development and search for new models must continue. It has also been determined that quite rarely the scientists pay attention to the branch specificity of the project and often do not adapt the resulting research tools to emergency conditions and challenges. Consequently, there is a need for closer integration of existing models into the current modern conditions and needs of the industry, for example, so important for the country and regions as the transport industry.

At the same time, the impact of communication technologies and communication management techniques as a means of risk management remains little explored. Popular methodologies in communication management and risk management refer to different areas of knowledge and rarely mention their relationship [13]. Although the setting up and streamlining of communication processes affects not only the awareness of project participants, but also their trust in each other and, accordingly, affects the reliability of decisions and risks of the project.

Highlighting the previously unresolved parts of the general problem. Purpose of the work

The purpose of the presented research is to develop a method for assessing and managing risks in transport infrastructure restoration projects, taking into account communication processes. The results should become a reliable tool for applying in practice and solving the problems of risk management strategies.

The article addresses the following objectives:

1. Systematization of risks in transport infrastructure rehabilitation projects through relationships between project participants.
2. Creating a graphic diagram of stakeholder communications.
3. Formalization of stakeholder communication processes, taking into account the causes and possible parry of risks.
4. Development of a model for quantitative assessment of project risks, taking into account the interests of stakeholders.

Main results of the study

The transport infrastructure is an integral part of the system in which it exists. It can be either the transport infrastructure of a country or a separate settlement within the framework of their own infrastructures and needs. The transport infrastructure reconstruction project has a number of differences in the life cycle of the project. Indeed, the preparatory stage plays a significant role. To avoid significant risks, there must be an assessment of the impact of the implementation process on the environment, on the interests of local residents, authorities, stable use and permanence, which may be critical and necessary. Also, a detailed study requires the logistical capacity of the region and the ability to manufacture and deliver the necessary construction materials, equipment and all necessary human resources must be quickly available. The financial component of the project should be balanced and work effectively throughout the duration of the project. During the work, special attention should be focused on safety issues, both for the population and workers, as well as the ecological systems of the region. Clear and effective management of communication between stakeholders will allow rapid and effective adaptation to critical conditions throughout the life cycle of the project.

Based on the analysis of possible stakeholders of transport infrastructure rehabilitation projects [15], the analysis of methods of applying the value-based approach, the analysis of modern methods of stakeholder management, each stakeholder may have its own interests, goals, expectations and risks in relation to the project [16]. Accordingly, the risks may have a different impact, assessment and status in relation to the stakeholder, as well as in relation to the stage of the project life cycle. Accounting for such risks, their control and management is an important part of the project manager's work, and sometimes a critical part of the work, because the most critical risks and their inadequate management can threaten the existence of the project as a whole.

Based on the analysis of the interaction between the stakeholders of the transport infrastructure rehabilitation project [17], all project stakeholders can be divided and grouped as follows: the project team, project executors, project suppliers, investors, authorities and society. Each of these stakeholder groups may have both internal risks that depend more on the internal processes of the stakeholder group itself, and external risks that determine the interrelated expectations of opportunities and problems of one stakeholder group in regard to others.

Risk management is defined as a set of tools, methods, forms and means of interaction of subjects of

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risk management in order to develop and implement management decisions aimed at preventing the risks of investment activities, reducing and overcoming the effects of its impact [14].

Risk management involves:

- the use of all possible means in order to avoid or reduce the degree of risk associated with significant losses;
- controlling risk in case it cannot be avoided completely;
- optimization of risk degree or reduction of probable losses;
- conscious acceptance of risk and preparation of all possible processes triggered by this risk.

According to the PMBOK methodology [13], risk management is divided into stages: planning, identification, qualitative analysis, quantitative analysis, response planning, and monitoring. Each of these procedures is performed at least once in each project. In spite of the fact that developers of the standard clearly separate these procedures, in practice they often can be implemented in a unified procedure, coincide and closely cooperate.

The grouping of risks and their representation by means of relations between participants of the project was offered in works Gritsenko L.L. [18]. In this paper, the groups of risks are expanded on the example of the outlined groups of stakeholders of transport infrastructure rehabilitation projects.

In the risk system, we can distinguish the groups of risks containing individual partial risks. In addition, partial risks to the project participant may be caused by another participant.

So, for example, for the performer of works and society in relation to the state there are the following groups of risks:

- political risks (change of power, change of officials, decline in political will, political crises);
- excessive influence of the state in the project (bureaucratic obstacles, corruption component, pressure of controlling bodies)
- financial risks (shortage and stoppage of funding, failure to fulfill assigned obligations, inability to fulfill promised simplifications and benefits).

Authorities and investors have the following partial risks in relation to performers:

- technical errors and low level of preparatory work;
- irrational chosen form of contract and partnership;
- poor quality of work; mistakes in the execution of works;
- unscrupulousness and outright fraud on the part of producers of works.

The following partial risks are possible for the authorities and executors in relation to the society:

- risks of protest sentiments in society;
- risks of public ignorance and failure to understand the value of the project.

The society may experience the following partial risks in relation to the government and the executor:

- risks of deterioration of the ecological condition of the region;
- risks of destruction and deformation of the usual way of life, places of habitation;
- the low quality of the obtained infrastructure.

The supplier group is one of the most isolated and primarily dependent on proper financing from the work producer, and the work producer, accordingly, will risk receiving equipment and goods of inadequate quality and with delays.

Table 1 shows the interrelation of groups of project participants because of their respective risks. The table does not reflect the project team, because they are interested in reducing the probability of each risk and interact with every other project participant [16]. The table is not exhaustive and complete, but can serve as an illustration of the relationship between project participants on the basis of risks.

Table 1. *Scheme of stakeholder communications, taking into account the causes and possible parrying of risks*

Project stakeholder	***Partial risks***	***Stakeholders interested in parrying partial risks***
Contractor (S_1)	Low level of preparatory work (r_1)	Authorities, investor
	Errors in the contract (r_2)	Authorities, investor
	Poor quality of work performance (r_3)	Authorities, society
	Unfairness and outright fraud (r_4)	Authorities, community, investor, suppliers
	Financial instability (r_5)	Authorities, community, investor, suppliers
	Non-compliance with environmental, moral standards (r_6)	Authorities, society
	Lack of attention to the environment, community sustainability, and historicity (r_7)	Authorities, society
Project provider (S_2)	Inadequate quality of goods and equipment (r_8)	The executor
	Problems with supply timing (r_9)	Executor
Investor (S_3)	Inadequate financial performance (r_{10})	Authorities, executor
Authorities (S_4)	Political instability in the region (r_{11})	Investor, society, executor
	Bureaucracy and excessive control (r_{12})	Performer, Supplier
	Financial instability in the region (r_{13})	Executor, investor
Society (S_5)	Protest sentiment (r_{14})	Authorities, executor
	Lack of awareness (r_{15})	Authorities

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On the basis of this table it is possible to graphically depict the scheme of stakeholder communications, taking into account the causes and possible parry of risks (fig. 1). In the figure in the zones of the corresponding stakeholder the partial risks that can be caused by it are indicated. Arrows show stakeholder communications on the parrying of risks (or their group). The direction of the arrow indicates which stakeholder is interested in parrying the relevant risks (start) caused by another stakeholder (end).

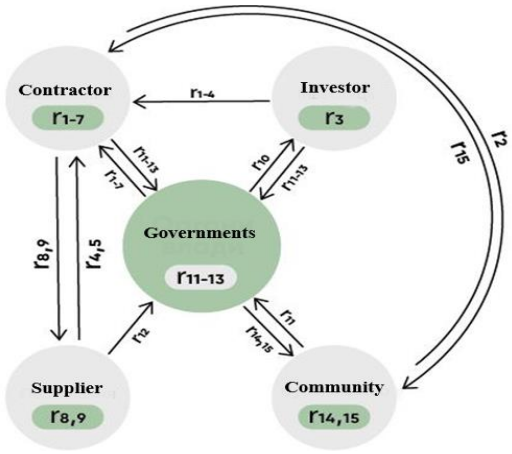

Fig. 1. Scheme of stakeholder communications, taking into account the causes and possible parrying of risks

It should be noted that such a relationship of certain stakeholders is typical, and has been noted in studies devoted to stakeholder management at the stages of the project life cycle [19].

For the formalized representation of risks and communications of participants, we introduce the following notations.

Partial risks constitute the set $R = \{r_k\}$, $k = 1..m$. Project stakeholders constitute the set $S = \{S_i\}$, $i = 1..n$.

Stakeholder S_i is interested in reducing the risks caused by stakeholder S_j. We denote this subset of risks by R_{ij},

$$R_{ij} \subset R.$$

Using the above designations, the generalized matrix of the relationship between stakeholders on risk-pairedness is presented in table 2.

Table 2. *Generalized matrix of interrelations between stakeholders on the parrying of risks*

	S_1	…	S_j	…	S_n
S_1	-	…	R_{1j}	…	R_{1n}
…	…	…	…	…	…
S_i	R_{i1}	…	R_{ij}	…	R_{in}
…	…	…	…	…	…
S_n	R_{n1}	…	R_{nj}	…	-

Risk management can be considered not only in the context of risk per se, but also in the context of stakeholder management and communication management, including between stakeholders. Building clear and transparent communication processes can not only reduce risk, but also build a robust system of trust between project members (fig. 2).

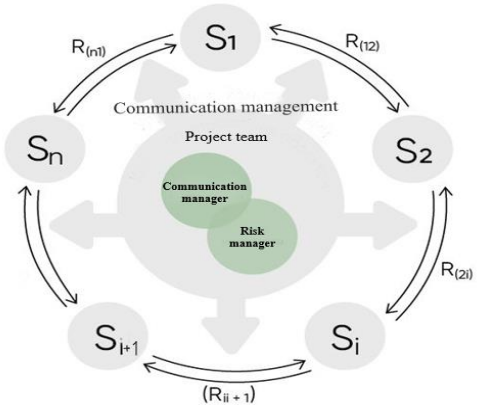

Fig. 2. Generalized model of project stakeholder communications management in order to reduce risks

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To achieve these goals, reliable and regular communication must be built between the party bearing the risk and the party for whom the occurrence of this risk is critical and important. For example, reducing the probability of the risk of "low level of preparatory work" can be ensured by effectively informing the parties both on the part of the contractor about the progress of such work, and on the part of the authorities by controlling and ensuring clear and transparent rules and standards for the performance of work. Or the reduction of the likelihood of protest sentiments among the population is achieved through an open and regular dialogue between the population (representatives of initiative groups, public organizations, etc.) and the authorities or the contractor. The population must also be informed through the media, social networks, advertisements or other means of disseminating information about the project, its safety, necessity and value.

Thus, the management of each risk requires additional standardization and can cause excessive bureaucracy. In order to reduce the risk of project bureaucracy, it is suggested that information technology be used extensively to reduce routine processes and automate control of communication and document exchange.

In order to quantify the possible risks caused by project stakeholders at different stages of the project life cycle, the following parameters should be considered: p_k - the probability of partial risk r_k; d_k - the possible losses of the project caused by risk r_k, $k = 1..m$.

The probability of risk is assessed by expert methods or by a decision maker - risk manager.

Possible losses of the project are expressed in a cost degree (although it can be the cost of time or a decrease in the quality of work performed).

The negative impact of partial risks on the main indicators of the project is shown in table 3.

Table 3. *Impact of partial risks on the main parameters of the project*

Partial risks	***Main parameters of the project***		
	Cost	***Duration***	***Quality of work***
Low level of preparatory work (r_1)		+	+
Errors in the contract (r_2)	+	+	+
Poor quality of work performance (r_3)			+
Unfairness and outright fraud (r_4)	+	+	+
Military instability (r_5)	+		
Non-compliance with environmental, moral standards (r_6)			+
Lack of attention to the environment, community sustainability, and historicity (r_7)			+
Inadequate quality of goods and equipment (r_8)			+
Problems with supply timing (r_9)		+	
Inadequate financial performance (r_{10})	+		
Political instability in the region (r_{11})	+	+	
Bureaucracy and excessive control (r_{12})	+	+	
Financial instability in the region ((r_{13})	+		
Protest sentiment (r_{14})		+	
Lack of awareness (r_{15})	+	+	

To quantify the effectiveness of actions to parry risks from stakeholders, the following parameters should be considered [16]: *In* – interest (degree of interest) of a stakeholder in the project, *V* – degree of power (influence) on the project, *A* – resources (of different types), which the stakeholder has for participation in the project.

Let us denote the set of interests of separate stakeholder groups by $I = \{I_j\}$, $j = 1...mi$. The degree of interest of each stakeholder is measured by x_{ij}, in the general case $x_{ij} \in [-1,1]$, $i = 1...n$, $j = 1...mi$. Note that due to the method of harmonization of interests with project goals, a set of stakeholders is selected for which $x_{ij} > 0$ [20].

The total degree of interest of the i-th stakeholder in the project is defined as

$$In_i = \max\left(1, \sum_{j=1}^{mi} x_{ij}\right),$$

and only positive stakeholder interest is taken into account.

The set of stages of the life cycle (LC) of the project we denote as $E = \{e_l\}$, $l = 1..t$. Stakeholder influence coefficients on the project reflect the value of the matrix $K = \|k_{il}\|$, $i = 1..n$, $l = 1..t$, where k_{il} – level of influence of the *i*-th stakeholder at the *l*-stage of the project life cycle, *t* – number of stages of the project life cycle, $k_{il} \in [0,1]$.

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Thus, it is possible to determine the probability of risk parrying rk by the *i*-th stakeholder at stage l of the life cycle as a function of

$$q_{ikl} = f\left(In_i, k_{il}\right)$$

under the conditions:

а) risk r_k belongs to the group of risks in which the *i*-th stakeholder is interested, i.e.

$$r_k \in R_i, R_i = \bigcup_j R_{ij} \ ,$$

where R_i - groups of risks, in which *i*-th stakeholder is interested, includes all the risks that are the subject of communication with other stakeholders, which cause these risks,

б) risk r_k may occur at stage *l* of the life cycle.

Let us note that if risk r_k can occur at different stages of the life cycle, then the probability of its parrying by the *i*-th stakeholder is $q_{ik} = \min_l q_{ikl}$.

The quantitative assessment of risk r_k (possible losses for the project), taking into account its probability, is the product of $p_k d_k$.

Assessment of the necessary resources for its parry, taking into account the interest and power of stakeholders is $\sum_{j=1}^{n_k}(1-q_{ik})a_i$, where q_{ik} - probability of the *i*-th stakeholder to parry risk r_k , a_i - resources of the *i*-th stakeholder, represented in monetary form.

Thus, the reduction in the risk cost is

$$\Delta_k = p_k d_k - \sum_{i=1}^{n_k}(1-q_{ik})a_i \, .$$

If $\Delta k > 0$, then the risk remains and management decisions must be made to increase the intensity of communication between the stakeholder who is the cause of the *k*-th risk and many interested stakeholders, or to attract additional (insurance) resources to the project.

Conclusions and prospects for further development

Consideration of the main features of transport infrastructure reconstruction projects and their differences in relation to projects in other industries allowed to determine the range of stakeholders, taking into account the specifics of these projects.

The opportunities, impact and status of risks in relation to the stakeholders of transport infrastructure reconstruction project were analyzed. The systematization of risks in transport infrastructure reconstruction projects in the form of relationships between the project participants was carried out. The possibility of grouping risks in relation to the project stakeholders and the possibility of influence of stakeholder interaction on implicit groups of risks were deployed. A table and graphical schemes of the relationship between groups of project participants due to the relevant risks and methods of their parrying have been created.

Risks that may directly affect the project or be affected by interactions between project stakeholders are identified. A formalized representation of the risks and communications of project stakeholders has been provided. Opportunities to optimize the process of project risk management through the management of project stakeholders and communications have been identified. The model of quantitative assessment of the cost of risks of the project to assess the effectiveness of actions to parry the risks of stakeholders has been developed.

Scientific novelty is the improvement of the method of risk assessment and management in transport infrastructure reconstruction projects, which, unlike existing ones, is based on the systematization of risks, taking into account the interests and power of stakeholders and will assess the degree of risk and effectiveness of its parry based on the analysis of communication processes.

Thus, project risk management can be more effective when tools and methods specific to stakeholder management and project communications are applied. The proposed formalization establishes a clear model of stakeholder interaction for the parrying of risks. The model of quantitative assessment of the effectiveness of actions to parry risks will allow to evaluate the effectiveness of the management strategy and to make adjustments in time.

The developed method is an integral part of the information technology of risk management and communications of transport infrastructure reconstruction projects. In the future, this work will allow to continue scientific research in the direction of developing models and methods of research of communications and risks of the project.

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УПРАВЛІННЯ РИЗИКАМИ В ПРОЄКТАХ ВІДНОВЛЕННЯ ТРАНСПОРТНОЇ ІНФРАСТРУКТУРИ РЕГІОНУ НА ОСНОВІ КОМУНІКАЦІЙ УЧАСНИКІВ

Предметом дослідження в статті є процеси управління ризиками та комунікаціями проєкту. Розглядаються складові змісту проєктів відновлення транспортної інфраструктури, зокрема комунікації між стейкхолдерами. **Мета** роботи – розробка методу оцінювання та управління ризиками у проєктах відновлення транспортної інфраструктури з урахуванням комунікаційних процесів учасників. В статті вирішуються наступні **завдання:** систематизація ризиків у проєктах відновлення транспортної інфраструктури у вигляді відношень між учасниками проєкту, створення графічної схеми комунікацій зацікавлених сторін, формалізація комунікації зацікавлених сторін з урахуванням причин та можливого парирування ризиків, розробка моделі кількісної оцінки вартості ризиків проєкту з урахуванням інтересів стейкхолдерів. Застосовані **методи:** методології управління проєктами, теорія стейкхолдерів, теорія цінностей, системний підхід, матричні моделі. Отримано наступні **результати:** Проаналізовано можливості, вплив та статус ризиків відносно стейкхолдерів проєкту відновлення транспортної інфраструктури. Розглянуто можливість групування ризиків відносно стейкхолдерів проєкту та можливості впливу взаємодії стейкхолдерів на нявні групи ризиків. Визначено ризики, що напряму можуть впливати на проєкт або піддаватися впливу взаємодії між стейкхолдерами проєкту. Надано формалізоване представлення ризиків та комунікацій учасників проєкту. Визначено можливості оптимізації процесу управління ризиками проєкту через управління стейкхолдерами та комунікаціями проєкту. Розроблено модель кількісної оцінки вартості ризиків проєкту для оцінювання ефективності дій з парирування ризиків зі сторони зацікавлених сторін. **Висновки:** управління ризиками проєкту може мати підвищену ефективність при застосування засобів та методів, характерних для управління стейкхолдерами та комунікаціями проєкту. Запропонована формалізація встановлює чітку модель взаємодії стейкхолдерів для парирування ризиків. Модель кількісної оцінки ефективності дій з парирування ризиків дозволить оцінити ефективність стратегії управління та вносити корективи вчасно. В подальшому, дана робота дозволить продовжити наукові дослідження в напрямку розробки моделей та методів дослідження комунікацій та ризиків проєкту.

Ключові слова: управління проєктами; стейкхолдери; транспортна інфраструктура; модель взаємодії; оцінка ризику.

УПРАВЛЕНИЕ РИСКАМИ В ПРОЕКТАХ ВОССТАНОВЛЕНИЯ ТРАНСПОРТНОЙ СТРУКТУРЫ РЕГИОНА НА ОСНОВЕ КОМУНИКАЦИЙ УЧАСНИКОВ

Предметом исследования в статье являются процессы управления рисками и коммуникациями проекта. Рассматриваются составляющие содержания проектов восстановления транспортной инфраструктуры, в том числе коммуникации между стейкхолдерами. **Цель** работы – разработка метода оценки и управления рисками в проектах восстановления транспортной инфраструктуры с учетом коммуникационных процессов участников. В статье решаются следующие **задачи:** систематизация рисков в проектах восстановления транспортной инфраструктуры в виде отношений между участниками проекта, создание графической схемы коммуникаций заинтересованных сторон, формализация коммуникаций заинтересованных сторон с учетом причин и возможного парирования рисков, разработка модели количественной оценки стоимости рисков проекта с учетом интересов стейколжеров. Применяемые методология управления проектами, теория стейкхолдеров, теория ценностей, системный подход, матричные модели **методы:**. Получены следующие **результаты:** Проанализированы возможности, влияние и статус риска в отношении стейкхолдеров проекта восстановления транспортной инфраструктуры. Рассмотрена возможность группирования рисков в отношении стейкхолдеров проекта и возможности влияния взаимодействия стейкхолдеров на имеющиеся группы рисков. Определены риски, которые могут напрямую влиять на проект или подвергаться влиянию взаимодействия между стейкхолдерами проекта. Представлено формализованное представление рисков и коммуникаций участников проекта. Определены возможности оптимизации процесса управления рисками проекта посредством управления стейкхолдерами и коммуникациями проекта. Разработана модель количественной оценки стоимости рисков проекта для оценки эффективности действий по парированию рисков со стороны заинтересованных сторон. **Выводы:** управление рисками проекта может иметь повышенную эффективность при применении средств и методов, характерных для управления стейкхолдерами и коммуникациями проекта. Предлагаемая формализация устанавливает четкую модель взаимодействия стейкхолдеров для парирования рисков. Модель количественной оценки эффективности действий по парированию рисков позволит оценить эффективность стратегии управления и вносить коррективы в срок. В дальнейшем данная работа позволит продолжить научные исследования в направлении разработки моделей и методов исследования коммуникаций и рисков проекта.

Ключевые слова: управление проектами; стейкхолдеры; транспортная инфраструктура; модель взаимодействия; оценка риска.

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