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METHODS OF PROJECT RISK MANAGEMENT

Abstract. This article describes the methods of project risk management. The relevance of this topic is that any project, whether it is social, commercial or innovative, all of them are subject to risk. The main purpose of project risk management is to minimize the degree of risk, achieve a positive result. The risks identified during the implementation of the project can be managed, that is, using various methods of risk management, it is possible to predict in advance the onset of a risk event, to determine the extent of the damage and to use methods to reduce their extent.

To achieve this goal, it is necessary to conduct a risk analysis and select the necessary risk management methods. Risk analysis is the most important stage in the analysis of the project and is divided into qualitative and quantitative. A qualitative risk analysis is to identify all project risks, to classify them, and to determine the consequences. Quantitative risk analysis is to determine the degree of project risks. There are a lot of risk management methods, but it is necessary to choose the correct methods depending on the type of risk.

The article reveals the methodology of the expert risk analysis, a method of constructing a decision tree and methodology for identification and assessment of project risks. Each method has advantages and disadvantages.

Key words: risk, risk management, project, method, probability, consequences, risk degree.

Аңдатпа. Осы мақалада жоба тәуекелдерін басқару әдістері қарастырылған. Кез келген жоба бойынша, ол әлеуметтік, коммерциялық немесе инновациялық болса да тәуекел орын алады, сол себептен қарастырылып отырған тақырып өзекті болып табылады. Жоба тәуекелін басқарудың негізгі мақсаты – тәуекелдің деңгейін төмендету, оң нәтижеге қол жеткізу. Жобаны іске асыру кезінде анықталған тәуекелдерді басқаруға болады, яғни тәуекелдерді басқарудың әртүрлі әдістерін қолдана отырып, қауіп-қатер оқиғасының басталуын алдын-ала болжауға болады, залал мөлшерін анықтауға және олардың мөлшерін азайту әдістерін пайдалануға мүмкіндік береді.

Осы мақсатқа жету үшін тәуекелді талдап, тиісті әдістерді таңдау қажет. Тәуекелдерді талдау – бұл жобаны талдаудың маңызды кезеңі болып табылады және сапалы мен сандық түрлерге бөлінеді. Сапалық тәуекелдерді талдау – барлық жобалық тәуекелдерді анықтау, оларды жіктеу және салдарын анықтау. Сандық тәуекелді талдау – жобалық тәуекелдердің дәрежесін анықтау. Тәуекелдерді басқарудың көптеген әдістері бар, бірақ тәуекел түріне байланысты дұрыс әдістерді таңдау қажет.

Мақалада тәуекелді сараптамалық талдау, шешімдер ағашын құру және жоба тәуекелін анықтау мен бағалау әдістері қарастырылған. Әрбір әдістің артықшылықтары мен кемшіліктері болады.

Түйін сөздер: тәуекел, тәуекелдерді басқару, жоба, әдіс, ықтималдылық, салдар, тәуекел деңгейі.

Абстракт. В данной статье рассмотрены методы управления рисками проекта. Актуальность данной темы заключается в том, что любой проект, будь это социальный, коммерческий либо инновационный, все они подвергаются риску. Основной целью управления рисками проекта является минимизация степени риска, достижения положительного результата. Риски, выявленные в процессе реализации проекта, можно управлять, то есть используя различные методы управления рисками можно заранее спрогнозировать наступление рискового события, определить масштаб ущерба и использовать методы по снижению их степени.

Для достижения данной цели необходимо провести анализ рисков и выбрать определенные методы управления рисками. Анализ рисков является важнейшим этапом анализа проекта и делится на качественный и количественный. Качественный анализ рисков заключается в определении всех предполагаемых рисков проекта,

их классификации и определении последствий. Количественный анализ рисков заключается в определении степени рисков проекта. Методов управления рисками большое количество, но следует правильно выбирать методы в зависимости от вида риска.

В статье раскрыты методики проведения экспертного анализа рисков, метод построения дерева решений и методика идентификации и оценки рисков проекта. По каждому методу имеются преимущества и недостатки.

Ключевые слова: риск, управление рисками, проект, метод, вероятность, последствия, степень риска.

Introduction

Entrepreneurial activity is closely connected with the concept of the risk. For successful conducting the activity in conditions of market economy the entrepreneur needs to release new types of goods and to render services that is directly connected with risk. In communication with it it is necessary to identify correctly risks, to define degree of risks and to own skills of their management.

Risk is a probabilistic event that can result in positive or negative consequences. If the occurrence of a risk event may result in both positive and negative results, it refers to speculative risks. If the results are negative, then such risk refers to the pure risks.

Risk is possibility of occurrence during project implementation of such conditions will lead to negative consequences (Tsamutali, 2013, 32 p.).

Risks are those risks which are identified, subjected to the analysis and with regard to which response actions can be planned (Kupeshova, 2016 a, 10 p.). Management of risks – process of acceptance and implementation of the administrative decisions directed to decrease in probability of realization of risk and minimization of the possible losses caused by its realization.

Project risk management – a set of measures aimed at identification of risks, measurement and control of risks within the project.

The purpose of management of risk consists in receiving the planned profit at the optimal ratio of profit and risk for the entrepreneur.

The purpose of creating a risk management system is to improve efficiency of work, reduce losses and maximize profits.

Material and Methods

This article examines the problems of project risk management, factors of emergence of risks, types of losses and methods of management of risks.

The main stages of the study include:

1. To give definition to the concepts “risk”, “risk management”, “risk management of the project”.
2. To define factors of emergence of risk.
3. To determine the features of qualitative and quantitative risk analysis of the project.

4. To reveal the content of the project risk identification and assessment methodology.

5. Disclose expert risk analysis.

6. Consider a method of building a decision tree.

High-quality management of risk increases chances of a control system of the project to achieve success in a long-term outlook, considerably reduces danger of inefficient implementation of the project (Mazur, 2009).

The analysis of risks is the most important stage of the analysis of the investment project. The analysis is carried out at a stage of development of the business plan of the project. This section of the business plan consists of identification of alleged risks of the project, the mechanism of their interaction, measures for decrease in risks, the interests of all parties in overcoming danger of risks, assessment of risks by experts, etc.

Carrying out the qualitative analysis begins with the identification of the project risks, the division of risks into groups and the arrangement in the order of their priorities. The arrangement of risks on degree of their importance for the further analysis or planning of response to risks can be executed by assessment of probability of their emergence and impact on the project. The qualitative analysis of risks is carried out on an extent of all vital cycle of the project and reflects all changes relating to risks of the project.

Before starting the analysis, it is necessary to determine factors of emergence of risk, risk classification and types of losses that may occur after the implementation of risk events.

The occurrence of the risk factors are divided into external and internal.

Project Manager during project management Taking into account external risk factors provides measures to reduce the level of risk, but does not affect them directly. Overall, external risk factors, the types are classified as follows:

- market risk factors is characterized by changes in the markets for procurement of materials and raw materials and sales of products of the project;
- development policies of competing companies;
- external economic risk factors include political stability in the social sphere, climatic situations, the policy of publication in the field of Finance and tax

policy, climatic conditions, demographic and social factors.

Project Manager taking into account the influence of internal risk factors, provides measures to reduce the level of risk and directly can affect on them. Internal risk factors are classified the following types:

– production factors related to project characteristics, equipment and technology used, organization and management of project operations;

– decision-making and their implementation in the process of risk management mistakes made by managers;

– financing of the project, defining financial position and ability to repay long-term and short obligations.

The main factors of project risks researched in Table 1, their negative impact on the project, and measures to reduce them are shown in the table below (Vishnyakov, 2007, 386 p).

Table 1 – The main risk factors of the project

	Risk factors	The impact on the project	Measures to reduce risk
1.	Lack of support for the project from the management of the client company	Increase in a date of performance of the works relating to the project	Appoint the responsible worker from the management of the companies of the customer for quality of the performed works and observance of terms on the project
2.	Violation of the interests of the project participants	Clearly or hidden sabotage on the part of individual members	Formation of the organizational structure of management at all levels of management, ensuring the interests of the project participants
3.	The of discrepancy of the participants opinions on important issues	Difficulty of adoption of project documents and works of result	Definition of relationships, rights, duties and responsibilities of project participants and management bodies
4.	Complete underestimation of the complexity of the project	Poor quality of work concluded in the framework of the term and budget specified	Identification of the required level of planning and use of resources
5.	The lack of motivation of employees to master of new technologies	The decrease in the efficiency of technology implementation	Formation of the personnel incentive system
6.	The complexity of development of new technologies,	High requirements for staff qualifications	Organization of training courses
7.	The lack of complete and accurate primary information	The discrepancy of the results of the project to the customer's requirements	Warning of the customer about the need for work on the collection, formation and analysis of additional information as a result of the study of existing documents of the contractor project
8.	The lack of timely funding	Losses from originally enclosed investments	The formation of the project budget and financial planning

The main types of losses and risks include:

Financial losses – the losses of monetary means connected by c inflation, change of a rate of currencies, not receipt of money from the provided sources, unforeseen payments, such as payment of penalties, additional taxes, etc.

Labor losses are losses associated with unexpected layoffs, as well as losses of time funds due to accidental, uncertain circumstances.

Social losses-deterioration of working

conditions of workers, harm to their health and life, the environment, etc.

Risk analysis is carried out for the purpose of:

1. Identification of project risks and their reasons of their emergence.

2. Determination of the probable negative consequences resulting from the occurrence of risk events.

3. Selection of measures to minimize risks.

The next stage of the analysis is a quantitative analysis of risks.

The quantitative risk analysis is a quantitative analysis of the impact of identified risks on a project objective. Quantitative risk assessment allows you to determine:

- probability of achieving the ultimate goal of the project;
- degree of risk impact on the project;
- risks requiring a speedy response, an also influence of their consequences on the project;
- amount of expenses for risk reduction;
- estimated completion dates for risk management.

The choice of methods of the analysis is defined for each project and depends on existence of time and on the budget of the project.

Quantitative analysis is carried out on the basis of use of the methods of probability theory, which is caused by the probabilistic nature of uncertainty and risks.

The main methods of risk analysis of the project include:

1. A probabilistic analysis. This method is carried out in accordance with the principles of probability theory. The probability of emergence of losses is determined on the basis of statistics of similar projects implemented in the past.

2. Expert risk analysis. The method is used in the absence or insufficient amount of information and is to involve experts to assess the identified risks. Experts assess risks and make recommendations for their effective management.

3. The method of analogues. Risk analysis is based on data from similar projects implemented in the previous period. This method is used when the main parameters of projects are similar.

4. Analysis of limit level indicators. The indicators of the limit level characterize the degree of sustainability of the project on the relation to possible changes in the conditions of its implementation. The break-even point is calculated to confirm the stability of the project.

5. Sensitivity analysis of the project. This method makes it possible to determine which risks have the greatest impact on the project, also to estimate to assess how the main indicators of the project at different values of the specified variables needed for the calculation are changing.

6. Analysis of project development scenarios is a method of forecasting by experts several possible variants of the situation and their comparative evaluation.

7. A method of constructing a decision tree. In difficult situations, when it is difficult to calculate the result of a project taking into account the

possible risks, use the method of creation a decision tree. The decision tree describes the situation under consideration, taking into account each of the available options.

8. Simulation methods. Methods consist on step-by-step finding of value of the resulting indicator at the expense of carrying out repeated experiments with model. The use of these methods is costly.

Different methods are used to determine the degree of risks. One of such methods is “Technique of identification and assessment of risks”.

Risk identification is the process of identifying risk elements, listing them and describing each of risk element (ISO/IEC 31010:2009).

The importance of risk identification is that it determines the completeness and adequacy of the risk assessment process (Ivanov, 2016, 42p.).

The important purpose of risk management is to improve project performance by means of systematic identification, appraisal and management of project-related risk (Kupeshova, 2016b, 10 p.).

Literature review

During the preparation of this article the works of foreign and domestic scientists on the topic were studied. Thus, Bakker examines the effectiveness of various methods of project risk management (Bakker, 2011, 209 p.). M.Schieg considers risks of quality, personnel, expenses and time (Schieg, 2006, 77 p.). According to Didraga, risk management offers genuine and significant benefit to organizations, their project and stakeholders. (Didraga, 2013, 86 p.). E. Kutsch, and M. Hall in their writings consider several factors that can reduce the likelihood that formal project risk management is used (Kutsch, 2009, 73 p.). Y.Zhang suggests that any project execution is always accompanied by risks and the studies on project risks and risk interdependence have always been the topics of concern in academia and practice (Zhang, 2016, 820 p.). R.Dyer in the article «Cultural sense-making integration into risk mitigation strategies towards megaproject success» defines the concepts of “risk “and” risk management” (Dyer, 2017, 1341 p.). S.Vrhovec believes that organizational risks need to be diagnosed in order to identify the underlying root causes (Vrhovec, 2015, 1270 p.). Stewart and Deng argue that risk managers generally pay insufficient attention to the probability of occurrence of risk events when conducting risk analysis (Stewart, 2014, 204 p.). J.Liu and others note in their work that risk assessment can be divided into qualitative and quantitative methods (Liu, 2017, 204 p.). Sara and others believe that identifying risks in the project

definition phase is a critical task, since the risks that can be detected are strategic and must be removed before taking the decision to start with the project (Sara, 2014, 327 p.). Also, they offer to manage risks at each stage for the successful completion of the project. Y.Rolik assumes that the main purpose of the risk management cycle is preparation for the occurrence of risks, namely risk management planning (Rolik, 2017, 278 p.). According to L. Abdullah, the risks critical to a client are associated with complexity, contract, execution, financial, legal, the organizational environment, planning and control, scope and requirements, the team, and the user (Abdullah, 2012, 1930 p). R.Yim and others suggest that project managers should ensure that every employee involved in a project has access to the necessary information and that information is up-to-date and complete (Yim, 2015, 874 p). F.Zuo and others argue that "Project risk is defined as an uncertain event causing damage or loss, which is considered to be threatening in project management due to the fact that it exerts effects on project objectives such as schedule, cost and quality" (Zuo, 2018, 241 p). E.Kutsch and M.Hall consider that project risk management involves a choice between which information is utilized and which is deemed to be irrelevant and hence excluded (Kutsch, 2010, 245 p). According to C.Muriana and G.Vizzini, quantitative risk assessment and management allows for fast decision-making (Muriana, 2017, 320 p.). According to the authors of the article «The project risk management process, a preliminary study» Rodrigues-da-Silva and J.Crispima, a process of risk management in projects is a rational chain of practices taken by decision-agents in order to keep the implementation of the project under certain conditions (Rodrigues-da-Silva, 2014, 944 p).

Results and Discussion

The project risks identification consists in definition of all the estimated project risks capable

to affect negatively on the end result, and also in the definition of the factors influencing their level. Important not only to predict the estimated scratches, but also to define how these scratches can affect the project and how the consequences can be serious. Identification and risk analysis assumes carrying out a qualitative and quantitative analysis of the risks (Ivanov, 2008, 32 p).

Quantitative assessment and risk analysis consists in identification of risk factors and assess their significance, that is the analysis of probability that there will be certain undesirable events and will negatively influence achievements of the goals of the project (Gurov, 2012, 203 p).

Qualitative analysis consists in definition of the estimated risks of the project, research of their features, emergence factors, and identification of consequences of these risks realization. At this stage the classification of the identified risks is formed.

One of methods of quantitative assessment of risks is the technique of identification and assessment of risks.

The quantitative assessment of risks allows defining the followings:

- probability of an ultimate goal of the project achievement;
- extent of the risk influence on the project;
- the scratches demanding the fastest reaction, and also the influence of their consequences on the project;
- volumes of expenses for the decrease in the risk degree;
- the estimated completion dates on the risk management.

The probability of their realization is determined by this technique after the identification of all the estimated risks of the project (Mukhtarova, 2016, 103 p).

The probability of the risk realization is determined by the 5th ball scale, the qualitative and quantitative characteristic is given. The higher is the point, the higher is the probability of the project risk realization (Table 2).

Table 2 – Probability of the project risk realization

Points	Probability	The qualitative characteristic	The quantitative characteristic
5	The highest	Probability of the risk realization is the highest. The risk can be implemented often.	Once a month
4	High	Probability of the risk realization is high. In the course of the project risk realization it can be implemented several times.	1 time in several months
3	Average	There is a probability of the risk realization.	1 time a quarter

2	Low	Probability of the risk realization is low. The risk in the similar projects was never implemented. Despite this it is necessary to carry out monitoring as its realization is possible under the certain conditions.	Once a year
1	The lowest	Probability of the risk realization is the lowest. The risk in the similar projects was never implemented. Despite this it is necessary to carry out monitoring as its realization is possible under the certain conditions.	1 time in 2 and more years

Further it is necessary to reveal the negative consequences in case of the risk realization. At the influence definition of the negative consequences

in the case of the risk realization it is necessary to define the influence extent of each risk on the ultimate goal of the project (Table 3).

Table 3 – Influence of the negative consequences in the case of the project risk realization

Points	Degree of impact	Description
5	Catastrophic	In case of the risk realization, the condition of the project is catastrophic
4	Critical	Consequences from the risk realization are very considerable, at the competent risk management it is possible to lower them to a particular degree
3	Admissible	Consequences from the risk realization are not considerable also can be completely corrected
2	Low	Consequences from the risk realization are not considerable
1	Slight	In case of the risk realization the consequences are absent

At probability of the risk realization to the project manager and the risk the manager needs to consider the actions for the risk management.

Effectiveness of the actions for the risk management is determined by the 5th ball scale (Table 4).

Table 4 – Effectiveness of project risk management activities

Points	Description
1	Actions for the risk management are of the high performance
2	Used actions are effective
3	Actions are estimated at the average level, they are less effective
4	Actions for the risk management are not effective
5	Actions for the risk management of the project are absent

Following the results of three tables the rating of the project risk is defined. The rating of the risk is equal to the work of indexes (points) according to these tables.

For example, the risk rating = $4 \cdot 3 \cdot 4 = 48$ points

Further the digital expression of the risk rating is defined (Table 5).

Table 5 – Digital expression of the project risk rating

Meanings	Degree of risk	Definition
from 40 and over	The highest	Actions for the risk management have to be prepared prior to the project implementation, otherwise, not to avoid the consequences
from 30 to 39	High	Actions for the risk management have to be defined or at their existence improved
from 20 to 29	Average	Actions have to be defined or at their presence improved in the established periods
from 10 to 29	Low	Occurrence of the risk events should be supervised, but to define actions for the risk management is not necessary
To 10	The lowest	

The degree of the project risk is determined by an index of the risk rating. If the risk degree is the highest

or high, it is necessary to consider actions for decrease in the risk degree as soon as possible (Table 6).

Table 6 – Effect risk management practices for project success (Bakker K, 2011, p 5)

Risk management Practice	Effective contribution to project success
Risk management Planning	Indicate importance of actions, communicate intended actions
Risk identification	Initiate action, create awareness, create common view, create commitment, sharing concerns, clarify Expectations
Risk registration	Setting direction
Risk analysis	Direction of actions, create acceptance of risk, indicate impact
Risk allocation	Initiate action
Risk reporting	Setting direction, setting priorities, create awareness, create commitment, clarify expectations, create positive feelings, establish trust
Risk control	Initiate action, direct action

Expert risk analysis is applied in case of absence or insufficient volume of information and consists in involvement of experts for risk assessment. The selected group of experts assesses the project and its individual processes according to the degree of risks and makes recommendations for effective risk management. The expert group may consist of independent experts, as well as members of the project group, who have extensive experience in this sphere of activity. Expert risk analysis, as well as other methods, has advantages and disadvantages. The advantages are: no need for accurate baseline data and expensive software, the ability to carry out assessment before calculation of efficiency of the project, as well as simplicity of calculations.

Disadvantages are: difficulty in attracting experts, subjectivity of assessments and provision of all confidential information to them.

The experts involved to assessment of risks have to:

- to have access to all available information of o the project;
- to have the necessary level of creative thinking;
- to have the sufficient level of knowledge, abilities and skills in this sphere of activity;
- to be free from personal preferences in the project relation;
- to be able to estimate any number of the identified risks.

Expert risk assessment of the project can be considered in the following form.

1. Identify risks that can significantly affect the final result of the project.

2. The identified risks should be prioritized from high risk to lower risk. For this purpose, it is determined which of them will have the greatest impact on the progress of the project.

3. To estimate ponder ability (rank) of each of the listed risks. The sum of the ranks of all risks must be equal to one. In other words, the sum of column 3 of table __ must be equal to one.

4. Experts estimate each type of risk on all projects (columns 4-6) on a 100-point scale.

5. Integrated assessment of influence of each risk (column 7 – 9) turns out by multiplication of weight of each risk on assessment of this risk for each project (column 3 is multiplied by columns with 4 on 6 respectively). The integral expert estimation of priority of variants of the project is defined as the sum on columns 7 – 9 on a vertical. Let's consider an example. Consider 3 confectionery shops: «Slastyona» – A, «gourmet» – B and «fairy Tale» – C. it is Necessary to determine which of the confectionery shops will be less risky and profitable. In this case, you can use expert risk analysis (Table 7).

Table 7 – Expert risk assessment

№	Risks	bec	Expert risk analysis			Integrated assessment		
			A	B	C	A	B	C
1	2	3	4	5	6	7	8	9
1	Decrease in demand for the products of the project	0,3	50	65	80	15	19,5	24
2	Competitivenessofproducts	0,25	70	80	90	17,5	20	22,5
3	Price changes of products (flour, sugar, vanilla, yeast, etc..)	0,2	80	70	50	16	14	10
4	The technical equipment of shops	0,15	75	70	50	11,25	10,5	7,5
5	The operational risks (related to personnel)	0,1	80	70	30	8	7	3
	Sum					67,75	71	67

Thus, the less risky project is project C, i.e. confectionery shop « fairy Tale».

The method of creating the decision tree allows defining and estimating alternative decisions, to calculate result of the project.

At creation of a tree of decisions it is necessary to know:

Points of adoption of decisions – time moments when there is a choice of alternatives.

Point of a random event – the moment of time when a random event occurs with one or another result.

Branches are the lines connecting points of adoption of decisions to points of a random event. The branches proceeding from a point of adoption of decisions show possible decisions, and the lines a proceeding from knots of random events represent possible results of a random event.

Probabilities are the numerical values located on branches of a tree and designating probability of approach of these events. The sum of probabilities is equal in each point of adoption of decisions to 1.

The expected value (consequences) is located in the end of a branch and is the quantitative expression of each alternative.

The decision tree is constructed left to right and begins with the decision which needs to be accepted. This decision is displayed in the form of a square. From the square draw the quantity of branches equal to number of alternative decisions. At the end of each branch, draw a circle, indicating the occurrence of a permissible random event, from which the branches come out – the possible results of a probabilistic event.

Conclusion

In the process of implementing the project there may be various risks. The main goal of the project is successful completion of the project and receiving maximum profit. In this regard, it is necessary to determine the risks of the project and reduce their degree. This article describes the methods of project risk management. The following results were obtained:

1. Definitions of the concept “risk”, “risk management”, “project risk management” are given.
2. Factors of emergence of risk are defined
3. The features of qualitative and quantitative analysis of project risks are determined
4. Disclosed is a method of identifying and evaluating the risks of the project.

5. The expert analysis of risks is considered
6. The method of decision tree construction is considered

Thus, in the process of project management, these methods can be used and thereby reduce the degree of project risks.

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