ISSN 2708-2032
e-ISSN 2708-2040

INTERNATIONAL UNIVERSITY

INTERNATIONAL JOURNAL OF INFORMATION & COMMUNICATION TECHNOLOGIES

Volume 2, Issue 1
March 2021

ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ БІЛІМ ЖӘНЕ ҒЫЛЫМ МИНИСТРЛІГІ
МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РЕСПУБЛИКИ КАЗАХСТАН
MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

INTERNATIONAL JOURNAL OF INFORMATION AND COMMUNICATION TECHNOLOGIES

МЕЖДУНАРОДНЫЙ ЖУРНАЛ ИНФОРМАЦИОННЫХ И КОММУНИКАЦИОННЫХ ТЕХНОЛОГИЙ

ХАЛЫҚАРАЛЫҚ АҚПАРАТТЫҚ ЖӘНЕ КОММУНИКАЦИЯЛЫҚ ТЕХНОЛОГИЯЛАР ЖУРНАЛЫ

Том 2, Выпуск 1
Март 2021

Издание зарегистрировано Министерством информации и общественного развития Республики Казахстан. Свидетельство о постановке на учет № KZ82VPY00020475 от 20.02.2020 г.

Журнал зарегистрирован в Международном центре по регистрации сериальных изданий ISSN (ЮНЕСКО, г. Париж, Франция)

Выходит 4 раза в год.

УЧРЕДИТЕЛЬ:
АО «Международный университет информационных технологий»

ISSN 2708-2032 (print)
ISSN 2708-2040 (online)

СОДЕРЖАНИЕ

РАЗРАБОТКА ПРОГРАММНОГО ОБЕСПЕЧЕНИЯ И ИНЖЕНЕРИЯ ЗНАНИЙ

ИНФОКОММУНИКАЦИОННЫЕ СЕТИ И КИБЕРБЕЗОПАСНОСТЬ

ЦИФРОВЫЕ ТЕХНОЛОГИИ В ЭКОНОМИКЕ И МЕНЕДЖМЕНТЕ

CONTENTS

SOFTWARE DEVELOPMENT AND KNOWLEDGE ENGINEERING

INFOCOMMUNICATION NETWORKS AND CYBERSECURITY

DIGITAL TECHNOLOGIES IN ECONOMICS AND MANAGEMENT

МАЗМҰНЫ

БАҒДАРЛАМАЛЫҚ ҚАМТАМА ҚҰРУ ЖӘНЕ БІЛІМ ТЕХНИКАСЫ

ИНФОКОММУНИКАЦИЯЛЫҚ ЖЕЛІЛЕР ЖӘНЕ КИБЕРҚАУІПСІЗДІК

ЭКОНОМИКА ЖӘНЕ МЕНЕДЖМЕНТТЕГІ ЦИФРЛЫҚ ТЕХНОЛОГИЯЛАР

INTERNATIONAL JOURNAL OF INFORMATION AND COMMUNICATION TECHNOLOGIES
ISSN 2708–2032 (print)
ISSN 2708–2040 (online)
Vol. 2. Is. 1. Number 05 (2021). Pp. 119–128
Journal homepage: https://journal.iitu.edu.kz
https://doi.org/10.54309/IJICT.2021.05.1.016

УДК 004.94, 330

Aldibekova N.B., Tyan A.V., Omarov I.G., Mohamed A. Hamada, Alimzhanova L.M.
International Information Technology University, Almaty, Kazakhstan,

USING MATHEMATICAL MODELLING AND SOFTWARE PROGRAMMING IN PROJECT RISK MANAGEMENT

Nazira B. Aldibekova, second-year Master's student majoring in «Project Management», International Information Technology University.
Alexandra V. Tyan second-year Master's student majoring in «Project Management», International Information Technology University.
Issatay G. Omarov second-year Master's student majoring in «Project Management», International Information Technology University.
Mohamed A.H., PhD, Associate Professor, «Information Systems» Department, International Technology University.
Laura M. Alimzhanova, Cand. Sc. (Technology), Associate Professor of the Department of «Information Systems» of the International Information Technology University.

Abstract. The study describes the existing methods for quantitative and qualitative risk analysis and risk assessment software. The field of mathematical modelling is very much developing in economics, allow-ing for more in-depth research. Risk management also requires accurate justification of decisions about the importance of risk, which is made possible by accurate quantitative calculations, including mathematical modelling. The decision-making process within the project is based on the results of visual analysis, i.e., the study of the risk profile and the cumulative risk profile derived from the simulation. This research shows that quantitative risk methods in the project manager's toolkit are helpful in ob-taining complex calculations, but risk management cannot currently exclude the role of a project risk manager from the risk assessment pro-cess.

Keywords: risk, risk management, optimization, mathematical modelling, software programming

Introduction

Every business or project inevitably faces uncertainties and risks that threaten its existence along the way. Project risk management is concerned with identifying and controlling risks before they occur [1]. During the project phase, various risks occur that can reduce performance and even lead to project failure. Therefore, the application of project risk management is important to achieve optimal performance in projects [2]. The risk management system is designed to provide an ideal balance between generating profits and reducing the costs of an enterprise and aims to integrate into the company's global management system, operations, and business plans. The risk management system will be most effective only if this factor is observed [3]. Both quantitative and qualitative methods are used to assess risks. Mathematical modelling belongs to the group of quantitative methods which provide a comprehensive assessment of the probability of risk and harm but have the disadvantage that they require the involvement of competent experts. Quantitative methods are more labour-intensive, but identify different alternatives for decision-making [4].

Qualitative risk analysis

Risks in the implementation of IT projects can be divided into three groups: risks related to the quality of the product being developed; risks related to the speed of development; risks related to the budget allocated for development. Shifting the focus to one group causes a change in the oth-er two. If you want to implement a project quickly and inexpensively, prepare for the appropriate

quality. You need to quickly get a high-quality result, provide the necessary budget, work to deadlines. IT projects are becoming larger and more deeply integrated into the business ecosystem. The focus today is no longer just on automating business processes, but on making them as efficient as possible in a short time. The business does not only develop digital products — it strives to create unique offers for customers and release them to the market faster than competitors. Against this background, the timing of the project is becoming increasingly important: if competitors release a similar product earlier, all efforts will be wasted. Quality requirements are constantly growing. Today, a high-quality product implies not only a user-friendly UI/UX, high performance, security, and availability. There is an increasing need in business professionals with both strong technical skills and industry knowledge [5].

Practical recommendations for managing IT project risks. Project risks require individual consideration and analysis, but the industry has already developed a set of practices that reduce the likelihood of major risk factors. Against the background of a fast pace and at the same time high uncertainty and unpredictability of results, it is not so much technical or organizational risks that come to the fore, as the risks associated with the divergence in expectations: business and IT team, users and business, business and partners, IT team and users. The technological world is developing very quickly, the initiator of the project often does not fully understand what exactly he will receive at the end of the project, because the vision of the final goal is formed after a series of experiments and testing hypotheses. If you do not establish business interaction with the IT team, the amount of work will increase, the development time will increase, and the budget will swell. That is, the result obtained in all parameters will differ from the expectations of the customer [6]. To prevent disappointment, it is recommended to consider the following points:

1. It is necessary to accurately identify all stakeholders of the project, that is, all persons who have certain requirements and expectations for the project and, equally important, can influence it (from a financial, organizational, regulatory point of view). The main task is to identify their expectations and concerns. This way you will eliminate the situation when at the final stage of work, it suddenly turns out that everything that has been done does not suit one of the key stakeholders, who up to this point did not take an active part in the project.

2. It is necessary to create a single information field for stakeholders and project participants. All initial information and agreements on the project should be recorded, and it is better to do it visually. First, because visual information is better perceived. Secondly, it will always be possible to return to the fixed source version in case of dispute or doubt. The project roadmap, which reflects the tasks and the order of their implementation and is publicly available, will provide a unified view of the project for everyone who needs this information, will quickly provide answers to many questions, which will save time on communication to find out the details.

3. Break down the project into small iterations (work cycles). Working in the mode of short iterations allows you to quickly identify risks, blockers, problems and eliminate them. The more work that is done before the problem becomes known, the more expensive it will be to fix the situation. Due to short periods, such additional costs are significantly reduced.

4. Establish regular feedback. This communication is provided by daily reports of the project manager, weekly demonstrations of progress and results of work. As a result, all interested parties regularly receive information about what is happening on the project. But such reporting is also useful for the team itself. For example, if there is a tendency to increase the budget, which can be clearly traced on the roadmap and in reports, the project manager can think in advance of cost optimization options and offer them to stakeholders. And one more tip: you should always start with the most important and complex, with what is critical for the project. This will allow identifying potential risks and adjusting the strategy even at the early stages of the project. The risks in the IT sector are largely due to the specifics of the industry: they are associated not so much with the occurrence of force majeure, but with the divergence of expectations and uncertainty of results. In addition, it is necessary to consider the peculiarities of this industry:

1. IT is a young industry.

2. Research is carried out constantly, innovations are introduced quickly.

3. The growth rate is very high. As a matter of fact, the IT industry is relatively young compared to other industries.

Quantitative risk analysis

Quantitative analysis is performed in relation to those risks that, in the process of qualitative risk analysis, were qualified as potentially or significantly affecting the competitive properties of the project. The purpose of the analysis is to determine the probability of achieving specific project goals, identify risks that require special attention, determine realistic and achievable goals for the cost, schedule, or content of the project. While considering the risks of the project, determine:

1. Monitoring and management.
2. Management planning.
3. Qualitative analysis.
4. Identification.
5. Quantitative analysis.
6. Response planning.

The best project management solution is found when some conditions are left undefined. This analysis presents a quantitative approach to project management decision-making under uncertainty. The main methods of collecting and presenting data for quantitative risk assessment are:

1. Surveys used to quantify the probability of occurrence and impact of risks on project objectives. The information required depends on the type of probability distribution used. For example, for some widely used distribution models, you need to collect information about the optimistic, pessimistic, and most likely scenario, and for other models, you need to collect information about the mean and standard deviations.

2. Expert assessment. Experts in this field, whether they are employees of the organization or are engaged from outside (for example, experts in the field of engineering or statistics), confirm the correctness of the data and methods.

3. Risk diagrams. A continuous probability distribution represents the uncertainty of values, such as the duration of planned operations and the cost of project elements. A discrete distribution can be used to represent uncertain events such as test results or a possible decision tree scenario. Most widely used for risk diagrams are the triangular distribution and the beta distribution [7].

Methods of quantitative risk assessment:

1. Method for analysing the sensitivity of performance criteria.
2. Analysis of the expected cash value.
3. Decision tree analysis.
4. Simulation modelling.

Quantitative risk assessment based on Simulation.

The task of determining the duration of the project can be divided into two tasks – task project planning (definition of project scope, scheduling, and resources) and objective quantitative assessment of the additional time required to prevent the consequences of occurrence of risk events [8].

Application of simulation modelling

Simulation modelling (simulation) is a common type of analogy modelling implemented with the help of a set of mathematical tools, special computer programs, simulators and special IT that allow you to create processes in the computer's memory analogy, with the help of which you can conduct a targeted study of the structure and functions of a real system in its "simulation" mode, optimize some of its parameters.

Simulation modelling is a common type of analogy modelling implemented using a set of mathematical tools, special simulating computer programs and programming technologies that allow using analogy processes to conduct a targeted study of the structure and functions of a real complex process in computer memory in the "simulation" mode, to optimize some of its parameters.

A simulation model is a special software package that allows you to simulate the activity of a complex object. It runs through parallel interaction of computational processes in the computer, which are analogous to the processes under study in terms of their time parameters (up to the time and space scales). For this type of modelling, the synonym computer modelling is used. Since the simulation model needs to be created, it requires special software - the simulation system. The specifics of such a system are determined by the technology of operation, a set of language tools, service programs and modelling techniques. The simulation model should reflect many parameters, the logic of the behaviour of the simulated object in time (time dynamics) and in space (spatial dynamics). Modelling of economic objects is related to the concept of financial dynamics of the object [9].

The use of qualitative and quantitative risk analysis: case study of «Kaztransgaz» JSC.

Using the example of Kaztransgaz JSC (KTG), we will analyze the risks of a large, export-oriented company, which is currently listed on the RK exchange and has a positive development trend. The activities of KTG and its subsidiaries and affiliates are commonly subject to impact of production and non-production risks. KTG is aware of the importance of risk management as one of the key components of the corporate governance system aimed at timely identification, assessment and adoption of measures reducing the risks that may affect the achievement of strategic and operational objectives of the Group, as well as the company costs and reputation.

The objective of KTG risk management is to provide reasonable assurance of the strategic and operational sustainability of the business. As part of the implementation of the vertical risk management process carried out by NC KazMunayGas JSC, identification, assessment, and monitoring of the risks of the KTG Group of Companies is carried out in the Automated Risk Management System (risk.kmg.kz) (hereinafter referred to as ARMS).

In the period from August 2 to October 1, 2019, key employees of all structural divisions of KTG and its subsidiaries and affiliates were interviewed on such risk management issues as:

1) identification of risks that may affect the achievement of the goals of the KTG group of companies.

2) the potential size of damage in case of realization of the risk is determined.

Below are the key risks of KTG and its subsidiaries and associates with the most significant impact on the Company's activities.

In the KTG Group of Companies, 67 inherent risks have been identified, which have been assigned risk codes in accordance with the Unified Risk Classifier of KTG and its SDCs, risk owners have been identified and action plans have been developed to minimize risks.

The group of companies KTG identified 21 key risks and displayed them on the Map of KTG key risks.

1. Risk of non-fulfillment by counterparty banks of their obligations.

Due to the current difficult situation in the banking market in the Republic of Kazakhstan there may be a default of the obligations on the part of financial institutions, which can lead to temporary or complete lack of their ability ion to withdraw the company funds.

2. Risk of non-compliance with financial and / or non-financial covenants.

Since KTG is a borrower and / or guarantor when receiving and lending to its subsidiaries and affiliates, it must comply with financial and / or non-financial covenants determined by the terms of loans.

Risk of non-fulfillment of obligations in terms of gas supply under the gas sale and purchase agreement (export)

The risk of occurrence due to several factors:

1. Increase in consumption in the domestic market.

2. Refusal to accept gas by the buyer.

3. Failure to fulfill obligations by the supplier.

Legislative changes in the requirements for doing business.

For the realization risks influenced by the following factors:

1. Restrictions in the implementation of entrepreneurial (production and commercial) activities of KTG.
2. Transfer of more than 50% of a stake in a business to a third party.
3. Lack of inter-holding cooperation.
4. Uncertainties, with a dependence on key partner - the transition to market relations with group companies KTG and JSC National Welfare Fund "Samruk-Kazyna" (the Fund), participation in tenders for the hire of vehicles and machinery, by a team of KTG and the Fund on the common companies' basis.

Uncertainties associated with dependence on a key partner (PJSC Gazprom)

This risk may occur due to the following factors:

1. PJSC Gazprom's refusal to purchase Central Asian gas.
2. The reduction in export deliveries of gas PJSC "Gazprom" in Europe, including the Ukraine.
3. The economic situation in Russia, a decrease in the volume of domestic gas consumption in Russia.
4. Failure to fulfill contractual obligations by PJSC Gazprom or gas suppliers.
5. Availability of the resource base of the country supplying gas to ~~"G~~azprom" under contractual obligations.
6. The state of the world economy.
7. Climate conditions.
8. Political and economic situation in gas supplying / consuming countries.
9. PJSC Gazprom's policy with gas consumers.
10. The negative position of PJSC "Gazprom" in matters related to tariffs increase for the transit of gas.
11. Increase in Russian gas production.

Fluctuation of tenge against the US dollar

There is a possibility of foreign exchange losses associated with changes in the US dollar exchange rate against the tenge, interest rates, the state of the market balance, inflation, economic and political conditions.

Qualitative risk analysis is necessary, as was shown above, to exclude, minimize risks and to maximize the benefits of KTG.

Based on the quantitative assessment of risks, we analyzed the financial and economic activities of the Group of Companies for 5 years; quantitative performance indicators are attractive for investors intending to acquire shares in the company. According to the results of the quantitative risk assessment done using the mathematic model, we analyzed the prices of the bottom of the first shares of KTG, and calculated the following: correlation coefficient, covariance, variance, and expectation. There was conducted a comparative analysis of quantitative indicators of Kazakhtelecom JSC, Kaztransgaz JSC and Kazakhtelecom JSC.

We also conducted calculations on the activities of the company JSC "KazTransGas", calculated its financial ratios, momentum in stock prices, the coefficients described above, however, based on the analysis the project was found to be attractive to investors, but the risk analysis described above does not allow to assess industry risks, strategic risks of the country, the volatility of the the oil and gas industry and political risks in Kazakhstan. The calculations carried out in the framework of our research were applied to this work.

Results

We have carried out a project analysis in two stages, each of which, in turn, is a complex process, consisting of several sub-stages and involving the use of different approaches.

Stage 1. We used the consolidated balance sheet of Kaztransgaz (Figure 1) to analyse the effectiveness of the investment project. In terms of classical financial analysis, there is only one criterion for assessing effectiveness - the presence or absence of profit from the project.

Consolidated statement of profit and loss of Kaztransgaz JSC, bln. Tenge						
	2014	**2015**	**2016**	**2017**	**2018**	**2019**
Revenue	328,97	374,32	501,96	581,76	921,18	1 103,07
Cost of sales	242,47	277,61	348,45	434,79	678,10	884,93
Gross profit	**86,50**	**96,71**	**153,50**	**146,96**	**243,08**	**218,14**
Impairment loss on property, plant and equipment	0,00	0,00	0,00	0,00	0,00	0,00
General and administrative expenses	-37,08	-27,34	-34,09	-21,45	-26,15	-42,34
Other operating income	14,20	11,37	7,44	5,06	6,12	10,13
Other operating expenses	-6,21	-8,84	-3,69	-8,46	-14,60	1,96
Operating profit	**57,42**	**71,90**	**123,17**	**122,11**	**208,43**	**187,90**
Finance income	3,01	7,99	13,25	14,53	13,88	17,70
Financial expenses	-15,27	-26,10	-27,21	-36,92	-38,98	-43,58
Income from exchange rate differences, net	-15,02	-60,50	2,18	0,37	-11,56	-11,56
Share of losses of jointly controlled entities	-37,18	-101,24	-3,46	0,63	16,75	224,24
Impairment of long-term investments held to maturity	0,00	0,00	0,00	3,64	15,11	0,00
Profit before tax	**-7,04**	**-107,95**	**107,93**	**97,09**	**203,64**	**374,70**
Income tax expense	-13,12	-1,53	-26,53	-24,65	-47,67	-39,92
Net profit	**-20,17**	**-109,48**	**81,39**	**72,44**	**155,98**	**334,79**

Figure 1 - Consolidated balance sheet of Kaztransgaz JSC

The analysis is carried out in two main areas:

1) Evaluation of the effectiveness of investment costs (Figure 2) determines the degree of attractiveness of the project in terms of its profitability. The efficiency analysis is calculated considering such indicators as discounted and simple payback period, net present value of the project, internal rate of return, return on investment.

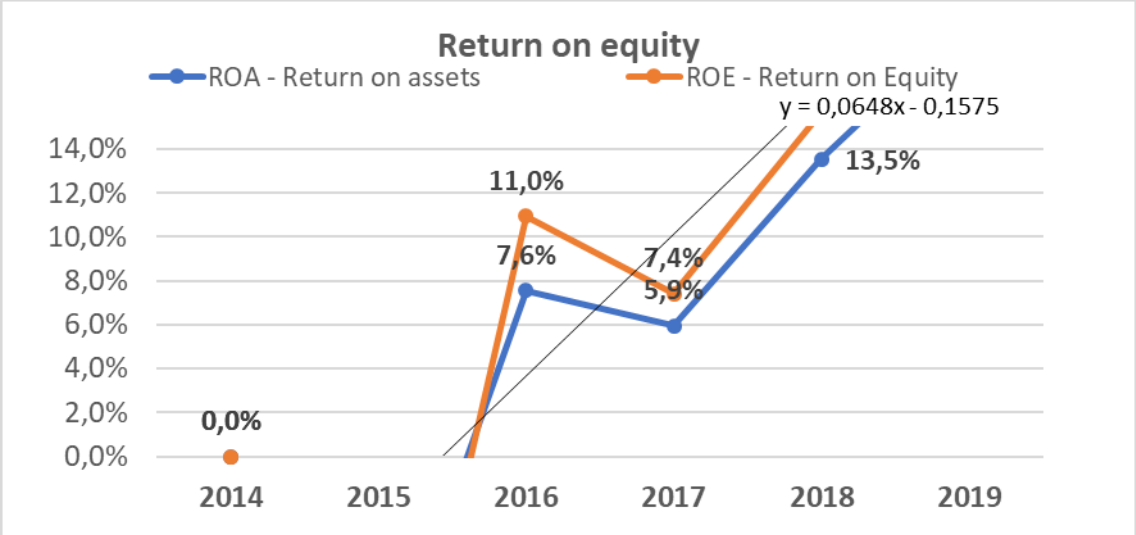

Figure 2 - Effectiveness of investment costs

2) Assessment of the financial viability of the project, that is, an assessment of the company's ability to pay off the project's obligations in full. It is carried out based on the settlement account model, based on the control of the positive balance of funds in each of the planning periods. To assess the effectiveness of an investment project from the point of view of the owner, investor, bank, or government authorities, it is necessary to consider the various components of the project. If only one set of performance indicators is formed, there may be a risk of inadequate presentation of the project from the point of view of other stakeholders.

Stage 2. Risk analysis is an integral part of any investment analysis. Investment risk is understood as the occurrence of an unfavorable event, because of which the implementation of the project may be threatened. There are two groups of risks:

1) Risks related to external factors. They are also called systemic or systematic, they are caused by processes occurring in the external environment and can be reduced by diversifying investment objects.

2) Risks associated with internal factors that reflect the quality of the company's management system and its general condition. Unlike systemic risks, internal risks can be mitigated through diversification.

We analyzed these indicators considering the JSCs' news feed, the company's development strategy, long-term plans, which are also described on the company's official website and financial statements posted on KASE [10].

The following methods can be used in risk analysis:

The method of expert assessments, involving a risk assessment by a specialist, based on the experience, knowledge, and intuition of the latter.

Statistical method - measuring risks using certain indicators that are calculated based on the predicted values of the object's profitability.

Both groups of risks, without taking countermeasures, lead to the same result - financial losses, while the magnitude of risks is directly dependent on the profitability of investment objects - with an increase in profitability, risks also grow.

For solving specific problems in the process of investment analysis appraisers use different methods that make it possible to obtain a quantitative assessment of investment activity from the point of view of its individual aspects both statically and dynamically:

Horizontal, or trend method. In the process of using this method, the growth rates of investment indicators are calculated for a certain period - a month, quarter, or year. The method is used to study the indicators of the reporting period and compare them with the previous period, to conduct analytical studies to determine the dynamics of growth at different times. For comparison, indicators for the previous period or a similar period of the last year can be taken, for example, the data of the first quarter of the reporting period are compared with similar indicators of the first quarter of the previous year.

It is recommended that the results of trend analysis be presented in the form of graphs to facilitate the determination of the trend line. We analyzed data for 5-6 years since the analysis is necessary in the long term, excluding the period of the company's formation.

Vertical, or structural method. In the process of this analysis, the proportion of individual indicators of the company's investment activity is calculated. Typically, the vertical method is used to analyze investments, investment resources and cash flows from investment activities. Results obtained using the vertical method are also presented graphically.

The comparative method is the examination and comparison of the same indicators in different groups. For example, comparing the data of the company's investment activity and industry average indicators or the reporting indicators with the planned ones. The method is used for monitoring the company's current investment activity. In the process of analysis, the degree of deviation of the reported indicators from the normative ones is revealed, the reasons for these deviations are clarified and recommendations for correction are formed.

The coefficient method (analysis) is based on calculating the ratio of various absolute indicators of the company's investment activity among themselves. An example is shown in Figure 3. During the analysis, the relative indicators of investment activity and their impact on the level of the company's financial condition are determined. Most often, investment analysis uses the coefficients for assessing the profitability of investment activity, the turnover of operating assets and invested capital, and the coefficients for assessing financial stability.

Figure 3 - Example of the coefficient method

The integral method (Figure 4) is usually used when buying securities to form the volume of net investments in the investment object. Using this method, it is possible, by selecting an ~~–e~~ffective portfolio", to reduce the level of risk and improve the ratio of the considered indicators in favor of profitability.

№	Price ai	d ai	Ea-d ai	(Ea-d ai)^2	A&B	Price bi	d bi	Eb-d bi	(Eb-d bi)^2	B&C	Price ci	d ci	Ec-d ci	(Ec-d ci)^2	A&C
2014	827.5	0.00	0.341	0.11606	-0.0021	1050	0	-0.0062	3.832E-05	-0.0022	12160	0	0.36076	0.1301473	0.1229
2015	755.0	-0.09	0.428	0.18344	0.11156	770	-0.2667	0.26048	0.0678478	0.1701	8606	-0.2923	0.65303	0.4264469	0.27969
2016	990.5	0.20	0.144	0.02065	0.04345	726	-0.3086	0.30238	0.0914342	0.1807	9280	-0.2368	0.5976	0.3571275	0.08588
2017	1331.5	0.61	-0.268	0.07202	0.07297	1329	0.26571	-0.2719	0.0739322	-0.048	14400	0.18421	0.17655	0.0311695	-0.0474
2018	1376.0	0.66	-0.322	0.10378	0.133	1477	0.40667	-0.4129	0.170451	0.17954	21835	0.79564	-0.4349	0.1891225	0.1401
2019	1376.0	0.66	-0.322	0.10378	-0.0413	909	-0.1343	0.1281	0.0164084	-0.1733	33000	1.71382	-1.3531	1.8307618	0.43589
		0.3407		0.0999548	0.05294		-0.0062		0.0700187	0.05113		0.3608		0.4941292	0.16951
				0.3161563	0.63276				0.2646104	0.27489				0.7029433	0.76274
				0.9280411					-42.744759					1.9485104	
	Kaztransgaz					Kaztransoil					Kazahtelekom				

Figure 4 - Example of the integral method

The choice of the method for the analysis of investment activity depends on which indicators are required to be investigated during the procedure. It is not uncommon for evaluators to use all analysis methods simultaneously, especially when a comprehensive picture is required.

An investment project is a set of technical and economic solutions and organizational and financial measures for the implementation of funds and their implementation into an investment object in the form of research, development, construction and installation, test works and services to achieve the desired social and economic efficiency.

Project analysis is a methodology for a comprehensive assessment of the advantages and disadvantages of projects, alternative ways of using resources, considering their macro- and microeconomic consequences.

Types of analysis design:

- Technical analysis, study of the proposed location and scale of the object, the types of technological processes used, materials, equipment and tooling, work schedule, availability of capital and labor, necessary infrastructure, methods of implementation, operation, and maintenance of the investment project (it was not carried out by us, so the information is closed).
- Economic analysis, determining the value of an investment project in terms of the effect obtained and the costs incurred, i.e., its effectiveness in relation to the national, regional and other interests (the analysis has been made; the company is economically attractive).
- Organizational analysis, identifying the competence of the ability of administrative personnel to successfully solve all tasks for the implementation of an investment project (the staff has a very high profile in the RK market)
- Social analysis, establishing the impact of an investment project on changing social relations and the development of the social sphere, psychological environment, and people's behavior (a socially significant project in Kazakhstan)
- Financial analysis, substantiation of the sufficiency of investment resources for the implementation of an investment project in a timely manner, preparation of an approximate balance of income and expenses resulting from profits and losses (the company is economically attractive).
- Environmental analysis, consideration of existing natural conditions and the potential impact of an investment project on the environment, forecasting possible environmental consequences.

Results of the research study

Only such a multilateral and detailed analysis creates the prerequisites for an objective evaluation of the investment project in question. The conclusions of the industry are not very attractive, in the development of alternative energy sources this project will not be attractive in the future, from

an environmental point of view, as shown by the share price analysis in Fig. 4. From the point of view of attractiveness and retrospective analysis of industry development, shares of Kazakhtelecom JSC are promising for investment, in this case we would also like to mention that the modern risk analysis tools, including mathematical modeling, suggest that shares of Kaztransgaz JSC are attractive, but with diverse skills of information gathering and analysis, we, as project managers, are more inclined towards projects with a future perspective, i.e. industry communications, alternative energy sources, electric vehicles and, of course, the copper mining sector, as all of the above sectors require significant copper reserves, which are predicted to increase the share price of these companies.

We started this work on the Advanced Financial Management course, analyzing financial activities (working with macros, deriving an algorithm for calculating indicators for the possibility of analyzing financial indicators), supplementing the materials on the Project Quality and Risk Management course, assessing the investment portfolio, considering the calculation of dispersion, covariance, and other indicators, and now we summarize our findings in this research work. We would like to continue the work using a programming language such as Python to automate data and enable project managers to make the right decisions.

Conclusion

This research paper focuses on the problem of risk management projects and how to deal with it. Unfortunately, only a few projects are currently completed on time, they fall beyond the project budget and often do not comply with it. This brings about huge losses for the company. One of the reasons for this is often the lack of a risk management system. The study lists the main project risk management methods and develops a Monte Carlo simulation methodology. It also shows why this methodology is given special attention.

Currently, investment projects require a lot of attention. The success rate of projects is quite low. All this is aggravated by the huge loss of company profits. Project risk management is necessary to avoid failure.

There are many different methods for evaluating project outcomes. We studied and described the Monte Carlo simulation method, made a full assessment of KazTransGas JSC's financial condition, calculated the probability indicators and provided calculations for the valuation of KazMunaiGas JSC, KazTransGas JSC and Kazakhtelecom JSC shares. Available share price data was entered, and value analysis was performed. The Monte Carlo modelling method is an extension of the scenario approach to risk analysis and at the same time it belongs to the group of probabilistic-theoretical methods of risk analysis. The modelling can be divided into three stages: building a mathematical model, running the modelling, and analysing the results.

In the initial stage, a mathematical model is built, and risk variables (random components of the project's cash flow) are selected based on an assessment of the flexibility and predictability of the variable. Based on available statistical data and expert information, a distribution right is selected for each risk variable that considers the "probabilistic dependence" conditions of the variable.

Modelling is carried out using specially developed computer programmes, and the number of simulation experiments is selected using mathematical statistics methods.

The decision-making process within the project is based on the results of visual analysis, i.e., the study of the risk profile and the cumulative risk profile derived from the simulation. We wanted to show that these methods in the project manager's toolkit are helpful in obtaining complex calculations, that calculations made with positive financial analysis and positive dynamics of project risk assessment and management cannot currently exclude the project manager from risk assessment. But the calculations made do not consider other factors such as political risks, industry news and other factors that artificial intelligence in the form of various programs cannot analyse.

REFERENCES

1. T. Zayed, M. Amer, and J. Pan, ―Assessingrisk and uncertainty inherent in Chinese highway projects using AHP,‖ *Int. J. Proj. Manag.*, vol. 26, no. 4, pp. 408–419, 2008, doi: 10.1016/j.ijproman.2007.05.012.
2. J. Zeng, M. An, and A. H. C. Chan, ―Afuzzy reasoning decision making approach based multi-expert judgement for construction project risk analysis,‖ *Assoc. Res. Constr. Manag. ARCOM 2005 - Proc. 21st Annu. Conf.*, vol. 2, no. September, pp. 841–852, 2005.
3. S. Sherri, ―LatestTrends in Travel,‖ *JournalofHotelandBusinessManagement.*, vol. 7, pp. 71–75, 2016.
4. E. V. Oktaeva, ―Mathematicalmodels and methods of risk assessment,‖ *Young Sci.*, vol. 16, pp. 310–313, 2016, [Electronic resource]. URL: https://moluch.ru/archive/119/32975/.
5. V. S. Nikolaenko, ―Risk Management in IT-projects Valentin,‖ *Public Adm. Electron. Bull.*, vol. 54, pp. 63–88, 2016.
6. M. Menshinsky, ―Risksin IT projects: what to look out for,‖ *Econ. Life*, vol. 34, pp. 1–5, 2020.
7. A. A. Guzhin and V. G. Ezhkova, ―Riskmanagement and methods of management of risks,‖ *Innov. Invest.*, vol. 2, pp. 185–189, 2017.
8. E. R. Mukhina, ―FUNDAMENTALSOF RISK MANAGEMENT,‖ pp. 80–82, 2554
9. L. Faingloz and J. Tolujew, ―SimulationModelling Application in Real-time Service Systems: Review of the Literature,‖ *Procedia Eng.*, vol. 178, no. 112, pp. 200–205, 2017, doi: 10.1016/j.proeng.2017.01.096.
10. ―JSCKazakhstan Stock Exchange.‖ [Electronic resource]. URL: https://kase.kz/ru/ (accessed Dec. 14, 2020).

Алдибекова Н.Б., Тян А.В., Омаров И.Г., Мохамед А.Х., Алимжанова Л.М.
Использование математического моделирования и программного обеспечения в управлении проектными рисками

Алдибекова Назира Бауыржановна, магистрант второго курса специальности «Управление проектами» Международного университета информационных технологий.
Тян Александра Владимировна, магистрант второго курса специальности «Управле-ние проектами» Международного университета информационных технологий.
Омаров Исатай Галимович, магистрант второго курса «Управление проектами» Международного университета информационных технологий.
Мохамед Ахмед Хамада, ассоциированный профессор кафедры «Информационных систем» Международного университета информационных технологий.
Алимжанова Лаура Муратбековна, к.т.н., ассоциированный профессор кафедры «Информационные системы» Международного университета информационных технологий.

Аннотация. В исследовании описаны существующие методы количественного и качественного анализа риска и программное обеспечение для оценки риска. Область математического моделирования очень сильно развивается в экономике, что позволяет проводить более глубокие исследования. Управление рисками также требует точного обоснования решений о важности риска, что становится возможным благодаря точным количественным расчетам, включая математическое моделирование. Процесс принятия решений в рамках проекта основан на результатах визуального ана-лиза, т. е. на изучении профиля риска и кумулятивного профиля риска, полученного в ре-зультате моделирования. Авторы работы хотели показать, что эти методы в инструментарии менеджера проекта помогают в получении сложных расчетов, но в настоящее время ме-неджмент не может исключить риск-менеджера проекта из оценки рисков.

Ключевые слова: риск, управление рисками, оптимизация, математическое моделирование, программное обеспечение

Алдибекова Н.Б., Тян А.В., Омаров И.Г., Мохамед А.Х., Алимжанова Л.М.
Жобалық тәуекелдерді басқаруда математикалық модельдеу мен бағдарламалық жасақтаманы қолдану

Аңдатпа. Осы зерттеуде тәуекелдерді талдаудың қолданыстағы сандық және сапалық әдістері мен бағдарламалық жасақтамасы сипатталған. Математикалық модельдеу саласы экономикада өте қарқынды дамып келеді, бұл терең зерттеулер жүргізуге мүмкіндік береді. Тәуекелдерді басқару сонымен қатар нақты сандық есептеулердің, соның ішінде математикалық модельдеудің арқасында мүмкін болатын тәуекелдің маңыздылығы туралы шешімдерді дәл негіздеуді талап етеді. Жоба аясында шешім қабылдау процесі визуалды талдау нәтижелеріне, яғни модельдеу барысында алынған тәуекел профилін және жинақталған тәуекел профилін зерттеуге негізделген. Біз жоба менеджері құралдарындағы әдістердің күрделі есептеулерді алуға көмектесетінін көрсеткіміз келді, бірақ қазіргі уақытта менеджмент жоба менеджерін тәуекелдерді бағалаудан шығара алмайды.

Түйін сөздер: тәуекел, тәуекелдерді басқару, оңтайландыру, математикалық модельдеу, бағдарламалық қамтамасыз ету

INTERNATIONAL JOURNAL OF INFORMATION AND COMMUNICATION TECHNOLOGIES

МЕЖДУНАРОДНЫЙ ЖУРНАЛ ИНФОРМАЦИОННЫХ И КОММУНИКАЦИОННЫХ ТЕХНОЛОГИЙ

ХАЛЫҚАРАЛЫҚ АҚПАРАТТЫҚ ЖӘНЕ КОММУНИКАЦИЯЛЫҚ ТЕХНОЛОГИЯЛАР ЖУРНАЛЫ

Ответственный за выпуск	Есбергенов Досым Бектенович
Редакторы	Далабаева Айсара Касымбековна Садганова Эльмира Абуовна
Компьютерная верстка	Туратауова Айжаркын Ахметовна
Компьютерный дизайн	Туратауова Айжаркын Ахметовна

Редакция журнала не несет ответственности за недостоверные сведения в статье и неточную информацию по цитируемой литературе

Подписано в печать 26.03.2021 г.
Тираж 500 экз. Формат 60x84 1/16. Бумага тип.
Уч.-изд.л. 10.1. Заказ №158

Издание международный университет информационных технологий
Издательский центр КБТУ, Алматы, ул. Толе би, 59