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ABSTRACT

This dissertation aims to analyze and compare methods for assessing investments in technology and innovation, considering the challenges of a dynamic and uncertain business environment. By examining the impact of these investments on competitiveness and profit growth, the study provides insights to enhance decision-making accuracy and identifies factors influencing the choice of investment assessment methods. Through qualitative and quantitative research methods, including interviews with CFOs of Kazakhstani companies, the study investigates the use of real options and traditional methods, highlighting the barriers and proposing strategies for increasing adoption. The findings contribute to the field by endorsing financial techniques tailored to the unique characteristics of technology and innovation investments, promoting informed resource allocation and better management of risks in a changing market.

Keywords: Real Options, Kazakhstan, investments, technology and innovation, Net Present Value, Discounted Cash Flow.

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INTRODUCTION

The current corporate environment is continually evolving, necessitating organizational adaptation to maintain competitiveness. In this setting, technological and innovative investments become crucial elements that can guarantee the expansion, effectiveness, and success of enterprises. However, making informed decisions on the distribution of financial resources for technology and innovation investments is a challenging process that necessitates thorough evaluation and analysis. In this situation, it becomes necessary to create and implement financial tools for assessing investments in technology and innovation. Understanding these investments' effects on accomplishing objectives and raising performance is crucial to their evaluation.

The aim of this dissertation is to analyze and compare various methods for assessing investments in technology and innovations, considering the unique challenges posed by the dynamic and uncertain business environment, in order to provide insights that enhance decision-making accuracy and enable organizations to identify and capitalize on promising opportunities while effectively managing risks. The impact of investments on competitiveness, profit growth, process development, and other specific factors can all be taken into account within the context of this purpose.

In accordance with the purpose of the research, ***the research questions*** were formulated:

- What are the key challenges organizations face when evaluating and investing in innovative projects within today's dynamic and uncertain business environment, and how do these challenges impact the effectiveness of financial valuation methods?
- How does the valuation methods can help to eliminate the uncertainties associated with innovative projects, and what are the specific advantages it offers in assessing investments in technology and innovations?

- Which of the investment assessment methods are used by companies in Kazakhstan and the factors influencing the choice of a particular method?

Research methods: A qualitative and quantitative methodology was used to achieve the research aim, and data was acquired through in-depth semi-structured interviews with CFOs of Kazakhstani companies.

Sample method: The respondents in the sample were chosen based on their "accessibility," as determined by a "convenience approach".

The practical significance of this study lies in the assessment of whether businesses use real options or other traditional methods and investigate the underlying reasons that affect their decision-making procedures..

Being the first study to concentrate on real option practices in Kazakhstan and one of the most thorough studies carried out in this sector, our survey stands out as a pioneering endeavor. We used a combination of widely disseminated questionnaires and follow-up interviews with chosen CFOs to close this gap. In two ways, our paper contributes. First, practitioners can learn important lessons from how their peers use real options, which might encourage them to apply similar strategies to their own strategic frameworks. Second, by identifying the key barriers to real option use, academics can create and promote substitute real option strategies that are more likely to be accepted by practitioners.

Hypothesis 1: *Conducting a thorough assessment of investments in technology and innovation reduces the risk of potential financial losses and failure associated with ill-informed decisions.*

Hypothesis 2: *Systematic evaluation of investments in technology and innovation helps organizations determine the expected profitability of a project before implementation and adopt new technologies.*

Hypothesis 3: *The real option valuation (ROV) model, which incorporates flexibility and uncertainty, offers a more comprehensive and accurate approach to*

assessing the value of technology and innovation investments compared to the DCF and other models.

Hypothesis 4: *The DCF model tends to underestimate the value of technology and innovation investments due to its inability to capture the potential upside of innovative projects, whereas the ROV model provides a more accurate estimate by considering the value of managerial flexibility.*

Hypothesis 5: *The ROV model requires more extensive data inputs and complex calculations compared to the DCF model, making it less practical and accessible for organizations assessing technology and innovation investments.*

The tasks listed below will be completed within the parameters of the work in order to accomplish this goal:

- Examining current financial techniques for assessing investments in innovation and technology.
- Consideration of novel techniques (that differ from traditional) for financial appraisal that take into consideration the particulars of investments in science and technology.
- Evaluation of the different methods' efficacy and approval of the methods on the basis of real-world organizations.

The study's goal is to determine the efficient method of evaluation a technological and innovative initiatives from a financial standpoint.

The work's scientific novelty is in the endorsement of several financial techniques for assessing investments in technology and innovation that take into consideration the peculiarities of this field and produce more accurate and logical results. The study's practical relevance comes in the ability to apply various financial methodologies in organizations' day-to-day operations, which helps decision-makers allocate financial resources for investments in technology and innovation in an educated manner.

1. LITERATURE REVIEW

A pricing model for financial options was created in 1973 by F. Black and M. Scholes. R. Merton improved the Black-Scholes model and demonstrated its broad application in the same year. The discovery of real options first appeared in 1977 by M. Scholes and R. Merton. S. Myers introduced it, claiming that the company's value comes from two main sources: 1) the value of its current/existing assets, and 2) the possibility to purchase assets in the future at a reasonable price.

Term innovation has been used in literature to describe both the process that uses new knowledge, technologies, and the processes to generate new products as well as new or improved products themselves (Porter, M.E., 1990). In the literature, innovation at the organizational level include besides invention + its exploitation, initially proposed, also the development and implementation of the invention (Miller, Miller, Dismukes, 2005-2006). At the macroeconomic level, the Green Paper considers innovation synonymous with the production, assimilation and exploitation of successful new solutions for the economic and social problems, addressing individual and society needs (European Commission, 1995) and leads to transformations in global economy sectors (Jolly, 2008).

Investments in information technology (IT) often bear great uncertainty which arises, amongst others, from their complexity or from unpredictable, changing circumstances (Fichman et al. 2005, p. 74).

According to Hayes and Garwin (1982), the real cause of declining investment in Western nations is due to the fact that the methodologies utilized in investment decision-making, namely DCF analysis, have significant conceptual flaws and are, in some important ways, biased against investment.

According to Hodder and Riggs (1982), DCF analysis is frequently done incorrectly rather than being intrinsically biased against long-term investments. They contend that the application of DCF frequently ignores the varying degrees of uncertainty in various project phases (they note that risk frequently decreases in later

phases of a project, while excessive risk-adjustments are maintained) and management's own capacity to mitigate risk (for instance, through diversification). They make the point that the traditional NPV criterion would only take into account the most probable cash flow forecast and overlook the pay-off asymmetry. This is how traditional NPV underestimates the project's true worth when subsequent management decisions have the potential to increase revenues or reduce losses.

Myers (1984) contends that, theoretically speaking, a combination of DCF analysis and option valuation models would be suitable given that DCF is sometimes unsuitable.

Much research has been conducted in the field of real options. Different streams of literature have thereby researched different aspects, models, and applications of real options methodologies. Many studies have researched whether real options are actually used in companies but are only based on surveys and managers perceptions of their approaches to project valuation (Hartmann & Hassan, 2006; McGrath & Nerkar, 2004). Other studies have researched the effects of applying real options methodologies in projects over different industries (Lee, Shyu, & Dai, 2009; R. G. McGrath, 1997). The premise is that using a real options methodology yields a higher value in some kinds of projects than others. This could specifically be true for innovation projects, as real options approaches allow to account for the high outcome uncertainty in these projects better than traditional NPV-methods. An important reason why innovation projects are evaluated with real options is that the approach allows incorporating the flexibility of abandoning the project at different stages if conditions turn unfavourable. This abandonment usually is done by not performing an investment that is required to continue a project that requires multiple sequential investments to succeed (Copeland & Tufano, 2004).

2. RESEARCH METHODOLOGY

Different cash flow options that provide various performance indicators can be developed when the internal project parameters and the external economic environment are unknown. This makes it more difficult to formulate and defend managerial judgments using traditional procedures.

With the aim of identifying, interpreting and extracting data from studies by other researchers, the Literature review method was used in this study, whereby it is possible to verify evidence found over time in the studied area.

The research methodology includes an examination of the various financial valuation techniques currently in use, the testing of the new techniques on actual organizations, and a comparison of the outcomes of the various financial valuation techniques.

The following sections make up the work's organizational structure:

Section 1: *A theoretical analysis of financial approaches for valuing investments.*

Section 2: *Evaluation of the efficacy of various strategies using the examples of certain organizations.*

Section 3: *A comparison of the findings from the use of various financial valuation techniques.*

Such dissertation's format will make it possible to organize and present the findings of research on the financial methods-based appraisal of investments in technology and innovation.

The research of this article will consist of a quantitative and explanatory analysis based on primary/secondary financial data (through written correspondence/interviews, data from websites), i.e., this study will be based on the use of statistical techniques to verify which factors influence a given reality.

For explanatory analysis there conducted Case Study: Evaluating an Innovative Project Using Real Options Analysis, where we will follow a step-by-step process to identify and value real options, considering project stages, investment timing, and the possibilities of project abandonment or expansion.

The primary method of data collection in this research was semi-structured interviews with managers.

It is important to note that the names of the companies will not be indicated in order not to violate confidentiality.

Survey conducted in such a way that all CFOs of the organizations, chosen for the survey, received a customized email that included a cover text and a link to the online survey. We combined the online poll with follow-up phone calls to specific businesses to increase the study's effectiveness. The questionnaire was made available in the participants' native tongues as a courtesy to them. For your reference, Appendix 1 contains the final questionnaire's English translation.

We emailed non-respondents about a week after the deadline in an effort to boost response rates.

3. ANALYSIS OF THE OBTAINED RESULTS

3.1 General Description

For a number of reasons, evaluating investments in technology and innovation is a pressing and crucial problem in modern business.

First, innovations and technology are increasingly important for competitiveness in a market that is changing quickly. Realizing the need for new technologies and creative solutions, businesses work to create and use them in order to draw customers, enhance their goods and services, and streamline their operational procedures.

Second, large financial resources are needed to invest in technology and innovation. Businesses should have faith in these investments' success and be able to defend their choices to stakeholders and shareholders. When allocating budget and financial resources, investment assessment enables you to weigh the possible benefits and potential dangers of technology and innovation.

Third, firms are put under strain as a result of shifting consumer tastes and expectations. Customers are becoming more demanding and anticipate cutting-edge goods and services that can accommodate their shifting wants. Organizations may respond to these changes and create goods and services that satisfy market demands by evaluating their technology investments.

Fourth, environmental responsibility and sustainable development are becoming more and more important. For businesses looking to develop sustainably and satisfy the demands of environmentally conscious customers, investments in technology and innovation can help to create more environmentally friendly processes and products.

In light of these and other elements, the goal of this dissertation is to assess technological and innovative investments in order to comprehend their influence on organizational success. We work to offer useful advice and contribute to the

advancement of this field through the analysis of financial indicators, economic impact, influence on competitiveness, and impact on profit growth.

The relevance of reviewing investments in technology and innovation for companies may be summed up by the fact that doing so gives them access to the unbiased data they need to make wise decisions. Organizations can assess how effective it is to spend their resources in particular technologies and innovations by looking at financial indicators, expected returns, and investment risks. It also enables you to make the best possible use of your resources, including money, time, people, and infrastructure. Organizations can concentrate on the development and application of technologies that will deliver the best results and competitive advantages by determining the most promising and profitable investments. Such investments may play a significant role in boosting the organization's competitiveness. Investment analysis assists in identifying technologies and developments that can result in better products, services, and business processes as well as those that can give an edge over rivals. It's crucial to remember that there is danger involved with investing in this field. Organizations are able to evaluate and control these risks thanks to investment assessment. Organizations can lessen the possibility of failing investments and increase their adaptability to change by examining potential barriers, identifying potential risks, and implementing mitigation measures. The next crucial component of investment in this area is innovative potential and development. Organizations may encourage and develop creative ideas, recruit competent specialists, and improve their capacity for innovation by selecting the most promising and efficient investments. The evaluation of technology and innovation investments is crucial for businesses because it enables them to make well-informed choices, use resources efficiently, increase competitiveness, control risks, and foster the potential and growth of innovation. The relevance of reviewing investments in technology and innovation for companies may be summed up by the fact that doing so gives them access to the unbiased data they need to make wise decisions. Organizations can assess how effective it is to spend their resources in particular technologies and innovations by

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Investments in new technologies are characterized by significant and irreversible upfront cash outflows opposed to uncertain future cash inflows (Harmantzis and Tanguturi 2007, p. 110). There is still no unified option for assessing the efficiency of innovations in contemporary innovation management theory and practice. The distinction between investment to innovations and investment to other projects is the absence of a single, widely used system of evaluation focused on profitability.

First factor, many inventions' profitability has a delayed strategic character. Second factor, the process of project conception and implementation is lengthy and

the external environment changes so frequently, innovative activity is conducted in an environment of uncertainty and heightened risk. As a result, it is challenging for experts to foresee and assess the outcome of the innovation at its inception.

Despite the absence of a unified evaluation system, it is nevertheless possible to formulate general conditions under which the project is considered as appropriate and effective. First, the most important thing is that the project corresponds to the general strategy of the company. The remaining factors are: if the net profit from the project is greater than the net profit from the profit if the amount of investment was invested in a bank deposit; the return on investment is relatively higher than the inflation rate; if we consider the time factor, then the profitability of the project in question is higher than the profitability of alternative projects in the same time period; return on assets increases after the completion of projects.

3.2 Risks

The concept of risk is closely related to the concept of uncertainty of results. Diverse causes of risk arise in companies engaged in the production of goods or the provision of services in the non-financial sector, as well as in the financial market and in commercial banks. The risk itself, that is, uncertainty, cannot be completely excluded, since any management decision is associated with investments "today" and expected results "tomorrow". At the same time, "tomorrow" cannot be fully foreseen or predicted by anyone.

The well-known management theorist Mintzberg (Mintzberg, 2001, p. 759, 770) writes that previously risk was understood in management exclusively as a danger, but with the advent of real options, the situation has changed.

When implementing a project, there is an innovation risk, as an example associated with a potential incorrect assessment of the future demand for the product or non-compliance with the specified quality level of the innovative product due to the use of outdated equipment. There actually different types of risks have to be

considered as technical risk, competition risk, legal risk, market and other a lot of minor risks.

Technical risk: Unforeseen technical problems may arise during the development or implementation of an innovative product. For example, difficulties in creating the necessary technological infrastructure or malfunctions in the operation of new systems or devices may delay the project or affect its success.

Competition risks: The introduction of an innovative product to the market may face competition from other companies offering similar products or solutions. Competitive advantages, such as price, quality, or the already established reputation of competitors, can make it difficult to position and successfully enter the market.

Legal risk: Innovative projects may face legal problems related to patents, copyrights or other intellectual property. Infringement of intellectual property rights can lead to legal proceedings, fines or even a ban on the sale of innovative goods.

Market risk: Changes in market conditions, including changes in consumer preferences, economic crises or unforeseen events, may affect the demand for an innovative product. Incorrect assessment of market trends or insufficient response to demand changes can lead to unsuccessful product positioning or failure to achieve expected results.

It is important to take these risk factors into account when planning and implementing an innovative project, as well as apply appropriate strategies and measures to manage them and reduce the impact on the success of the project.

3.3 Managerial Flexibility

Companies need managerial flexibility to be able to respond to uncertain changes in an effective manner. Companies can, for example, pause or abandon an IT investment in the case of a poor development or extend it until a positive development thanks to managerial flexibility. But traditional investment appraisal techniques, such as "net present value," are unable to take managerial flexibility into account. Critics

of science contend that IT investments are therefore undervalued (Trigeorgis 1996, p. 152). As for that needed a more accurate valuation, scientific literature advises using Real Options Theory (ROT) to value IT assets (Benaroch 2002, p. 47).

A real option is an opportunity available to the manager to use the flexibility inherent in the investment project or general decisions of the company. The use of real options is a modern and proactive approach to risk management. Flexibility built into projects requires special design, and projects with built-in flexibility have a high cost.

Table 1 – Examples of Possible Real Options by different types of Assets

Asset	Possible real options
Investment opportunity	Research into the possibility of postponing investments and reducing the scale of operations to save part of the initial costs, for example, when introducing a new product.
Production	Consideration of the possibility of expanding production by making additional investments and using different resources or producing different products.
Machinery and equipment	Consideration of the possibility of switching to idle mode when revenues do not exceed variable costs, or the sale of assets at residual value.
Contract	Study of the terms of termination of the contract
Technological patent	Transfer of the license or retention of certain rights.

Source: compiled by author based on existing data

The use of the real options methodology is appropriate in the following conditions: when the project result is associated with a high degree of uncertainty, when management personnel have the ability to make flexible decisions in response to new data about the project, and when the financial results of the project depend on the decisions made by managers. When evaluating a project using the discounted cash

flow method, the NPV value may be negative or slightly exceed zero. The evaluation of the project using real options takes into account the possibility of adaptation and flexibility, as well as long-term financial costs associated with the use of options, which helps to make more informed management decisions and increases the efficiency of the formation of the company's investment portfolio.

Table 2 - Real Option Types and Types of Managerial Flexibility

Real Option Type	**Type of Managerial Flexibility**
Option to abandon	It refers to the decision to stop working on a project or asset in order to recover its salvage value.
Option to expand	It refers to the potential to make an investment or start a project to grow a company's operations.
Option to wait	It refers to postpone the business decision.
Option to contract	It refers to the right to terminate a project at a later date if circumstances are adverse.
Option to switch	It refers to the choice to halt a project at some point in the future if the circumstances are unfavorable and resume it when the circumstances are advantageous.

Source: compiled by author based on existing data

Real options are frequently valued financially in conjunction with Real Options Theory applications, most commonly using option pricing models from financial theory. The "BlackScholes Model" (BSM), created by Black and Scholes and Merton (1973), and the "Binomial Model" (BM), created by Cox, Ross, and Rubinstein (1979), are the two most often used OPMs.

The method of real options is frequently used when evaluating large strategic projects, including project implementation scenario analysis, forecasting both the full complex of effects, positive and negative, and the possibilities of scenario implementation, through the cost of a real option under conditions of significant

uncertainty in the development of market conditions (Schilling M.A., 2017). According to Agafonov A.A. (2015) and Kazbekov B.K. & Zhaparov (2012), there are also additional opportunities to acquire greater economic rewards, ground-breaking technological advancements, and/or opportunities to make up for potential damage as a result of project implementation.

3.4 Survey results and characteristics of the respondents

The primary aim of this survey is to assess the extent to which companies in Kazakhstan incorporate real options in their capital budgeting decisions. The survey seeks to determine the level of adoption and application of real options among Kazakhstani businesses. By gathering data and insights from a diverse range of companies, the survey aims to provide a comprehensive understanding of the current usage and awareness of real options in the capital budgeting practices of Kazakhstani firms.

Table 3 – Industry classification and real option use

Industry	Real Option Utilization	Respondents
Oil & gas	1	6
Energy	2	15
Bank, financial organizations & insurance	0	3
Construction	0	2
Transportation	0	1
Healthcare	0	2
Food & beverages	0	5
Communications & media	0	3
Retail & wholesale	0	6
Technology	0	2
Other	0	5

Source: compiled by author based on existing data

We select our population from industry giants to medium-sized businesses that can afford to consider innovative programs. Only 3 out of the 50 respondents said yes when we asked if their organization used real options analysis to evaluate projects or investments. This indicates a 6.0% utilization rate for real options in the sample. This rate is less than recent studies' findings, which include Block's (2007) survey of American businesses, which found a rate of 14.3%, and the 2011 surveys by Baker, Dutta, and Saadi and Baker, Singleton, and Veit on Canadian businesses, which discovered a rate of 16.8%. As we will see next, Scandinavian companies are smaller in size, have lower R&D intensity, and a lower fraction of technology companies, all of which are expected to negatively effect real option use.

Table 4 – Location of the organizations of the respondents

Location	Real Option Utilization	% of respondents	Respondents
South Kazakhstan	2	44%	22
North Kazakhstan	1	22%	11
West Kazakhstan	0	14%	7
East Kazakhstan	0	8%	4
Central Kazakhstan	0	12%	6

Source: compiled by author based on existing data

We also requested to mark the location/region of the organization participating in the questionnaire, so as not to see clearly that we cover all regions of the country. According to the results, you can see that most of the companies to participate in the questionnaire were selected from the Southern region of the country, which may have prompted the fact that out of 3 companies practicing the method of real options, 2 companies are just in this region.

Table 5 – R&D intensity

R&D intensity	Real Option Utilization	% of respondents	Respondents
0–1%	0	46%	23
1–2%	0	14%	7
2–3%	0	14%	7
3–4%	0	8%	4
4–5%	0	0%	-
5–6%	1	10%	5
6–7%	0	0%	-
7–8%	1	6%	3
>8%	1	2%	1

Source: compiled by author based on existing data

Our data also shows a strong positive association between the level of R&D and the uptake of real options. All 3 businesses that use Real Option method devote at least 5% of their revenues to R&D employ genuine alternatives (Table 5).

Table 6 – Use of other capital budgeting techniques

Technique	% of respondents	Respondents
Net present value (NPV)	74%	37
Internal rate of return (IRR)	51%	26
Hurdle rate	46%	23
Earnings multiple approach	25%	13
Payback period	66%	33
Other	16%	8

Source: compiled by author based on existing data

We asked the respondents to identify the conventional methods used by their businesses in order to get more information about their capital budgeting procedures. The Net Present Value method emerges as the most widely employed capital budgeting

tool, according to the results of our survey, as shown in Table 6. It is important to note that respondents could choose several options on this question.

Table 7 – Position of Real Options

	% of respondents	Respondents
Primary capital budgeting technique	0%	0
One of several techniques	0%	0
As a complementary tool to reinforce and validate findings from other methods	100%	3
Other	0%	0

Source: compiled by author based on existing data

According to the responses from Scandinavian real option users, it is evident that they perceive real options as a supplementary tool rather than their primary capital budgeting technique. None of the respondents reported using real options as their primary approach.

Table 8 – Real Option application reasons

	% of respondents	Respondents
New product invention	0%	0
Research & development	4%	2
Mergers or acquisitions	2%	1
Foreign investment	0%	0
Other	0%	0

Source: compiled by author based on existing data

Real option analysis users were also asked to identify the specific choice problems to which they utilized the method. The findings show that the context of research and development (R&D) and the introduction of new products is where real

option analysis is most frequently used. Following this, it is used in mergers and acquisitions projects, as shown in Table 8.

Table 9 – Reasons stated for not using real option

	% of respondents	Respondents
Insufficient support from top management	21%	10
The level of complexity is high	70%	33
Promotes excessive risk taking	0%	-
Other	9%	4

Source: compiled by author based on existing data

When non-users who were aware of real options were questioned about why they had not adopted the strategy, they were given three options to pick from or the choice to provide their own response (Table 9). The lack of clarity and transparency associated with real options was mentioned as one reason, but the demand for a high level of intelligence is unmistakably the main deterrent to adopting genuine options. The large percentage of non-users who are unaware of true options, which supports this finding and suggests that the majority of Kazakhstani CFOs share this viewpoint. Additionally, CFOs from public-sector enterprises claimed that because of their constrained investment mandates, real choices principles are not applicable to their capital budgeting process.

3.5 Real Options: Cases and examples

The timely development of a business with a common market, which directly depends on the quality of its core workers, is what gives a company its strategic competitive edge. Specific knowledge quickly becomes obsolete, particularly in high-tech businesses. In order to be a leader, a business needs experts that are driven to learn new things and have the capability to do so. Instead of attempting to forecast the future course of technology advancement (which is an external element outside the

company's control), the company should strategically employ professionals who are intellectually prepared to function in quickly changing external conditions. In fact, managerial knowledge and abilities should be developed in a way that keeps technical expertise as a distinct productive resource for the business.

Even great firms make mistakes in anticipating the growth of the industry, as was the situation with Motorola in the middle of the 1990s when they lagged behind in the transition to digital phones (despite having the required specialists on staff, the delay was the result of management errors). Another illustration is IBM, which entered the personal computer market too late and lost out to Apple Computer in terms of initial market share. With the release of IBM AT in the middle of the 1980s, IBM was able to recover market dominance. But soon after, IBM lost its dominance in the personal computer industry, even if the "IBM-compatible PC" standard was still in use.

Strong organizations are frequently overconfident in their resolve and fail to use actual possibilities, which is the cause of the loss of leadership.

The reason for the loss of leadership is due to ignoring real options - strong organizations are frequently overconfident in their resolve and neglect the use of real options.

Case Study

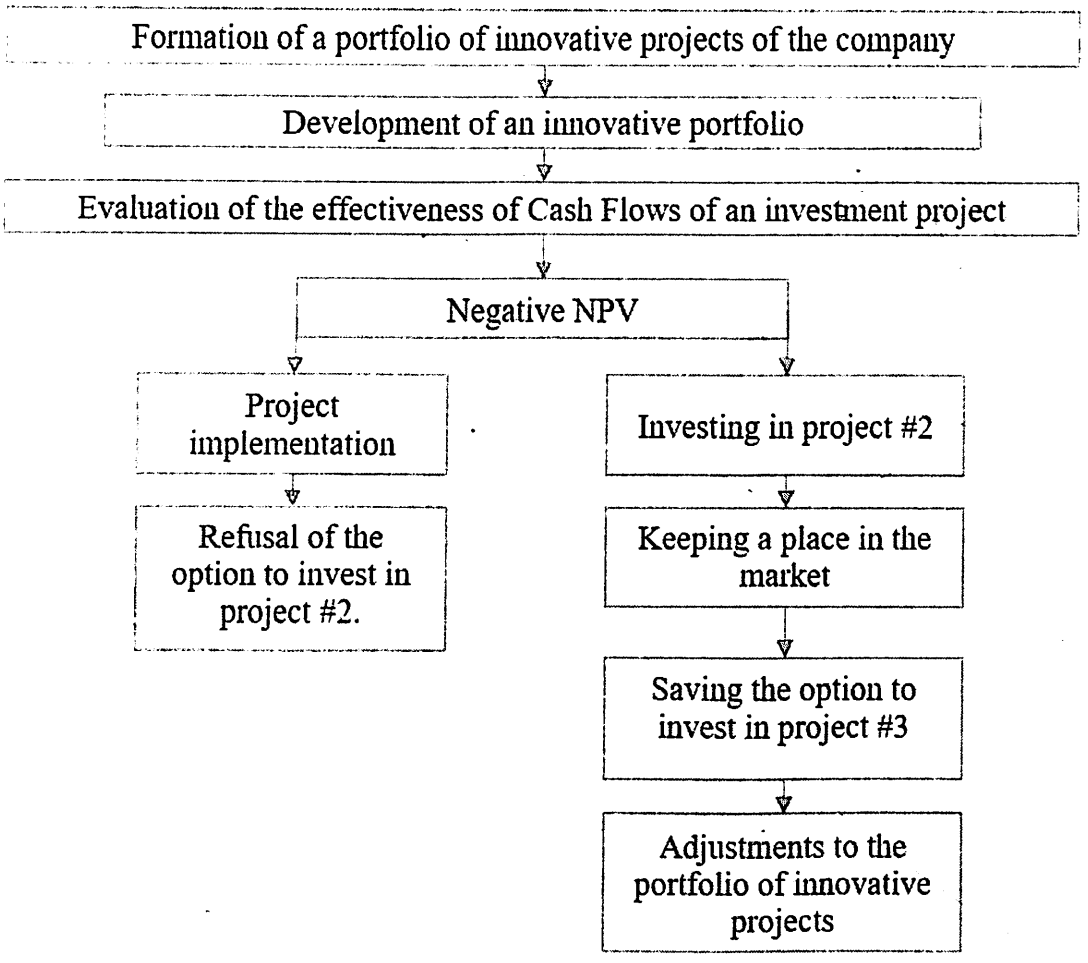
Companies exist with the hope of achieving success, but they realize that there are also failures. Flexibility and real options play an important role in dealing with potential failures. However, this struggle makes sense only if we believe that success will outweigh the costs associated with overcoming risks. The analysis of positive outcomes in adverse situations is one of the aspects of designing real options. It should be noted that this is not the only aspect, since when considering growth options, a cascade of consecutive options arises, each of which opens up new opportunities for the next one.

A real option is an active management tool aimed at maximizing value. Its essence lies in the fact that the owner of a real option can "cut off" unfavorable opportunities for a fee that corresponds to the price of the option. In the management of a company, it is often impossible to fully protect yourself from all risks, and the flexibility that a real option provides has a high cost. The option contract states: "I will make a deal if it is profitable, and I will refuse if it is not." An option is a valuable right and has its own price, known as the option price.

The metallurgical company uses a real option to maintain investments in the implementation of strategically important innovative initiatives, particularly in high technologies, which do not otherwise yield enough profitability. If Project #1 is successfully completed, the business will be granted a genuine call option to begin Project #2. Contracts for the manufacture of new goods or services, securing a position in the market, or producing more cash flow are examples of this.

The chance to invest in Project #2 is a call option given the uncertainties surrounding its potential earnings in the future. The strategic value of this continuing investment choice is significantly influenced by uncertainty. Based on the anticipated favorable or negative outcomes, the business can decide whether to invest in project #2 or to abandon it. In Figure 1, this is displayed:

Figure 1 - The method of accounting used to create a real option for future investment in a metallurgical company's investment portfolio.



Source: compiled by author based on existing data

This option's value takes into account the metallurgical company's unique position in the market. For instance, an improvement in the market environment may compensate for Project #1's insufficient profitability, increasing the option's value. Project #2's implementation therefore gives real option for Project #3 and so forth. As a result, the value of this option demonstrates how valuable the prospect of a subsequent investment might be under circumstances when there is a high level of uncertainty and the market for goods or services is expanding quickly. Therefore, assessing and accounting for this possibility are crucial components.

We cannot announce the name of the company in question because of confidentiality, we cannot say that this company occupies a leading position in the

Metallurgical industry. Initially, a factory with a 3 million ton annual design capacity for steel production was to be built. Industrial infrastructure for this project had to be built, and the cost was projected to be around $2 billion.

Investing in this project is carried out in 3 stages:

First stage: at t=0 investment for R&D 50 k'USD, where expected P(success) equal to 80% and P(failure) equal to 20%. Option price equal to 50 k'USD, if project stop at the first stage.

Second stage (only if results of first stage finished by success, means based on the results of R&D, the company comes to a positive conclusion about the potential of the market): at t=1 investment to produce experimental sample of new product = 70 k'USD, where expected P(success) equal to 70% and P(failure) equal to 30%.

Third stage: (only if results of second stage finished by success, means experimental sample approved for production): at t=2 investment to produce approved new product = 500 mln. USD, where expected P (success) equal to 60% and P (failure) equal to 40%, which means it leads to the termination of the implementation of the innovation product/project).

Table 10 – Decision stages for a real option to abandon an innovative project

r= 14%

Investement			Cash Flow							
t=0	t=1	t=2	t=3	t=4	t=5	t=6	t=7	Joint probability	NPV	Total (Prob*NPV)
(50)	(70)	(1,000)	500	500	500	500	500	17%	440	74
(50)	(70)	(1,000)	200	200	200	200	200	28%	(353)	(99)
(50)	(70)	(1,000)	100	100	100	100	100	11%	(617)	(69)
			Termination of the project after ***stage 2***					24%	(111)	(27)
			Termination of the project after ***stage 1***					20%	(50)	(10)
								Final NPV of the project		**(131)**

Source: compiled by author based on existing data

Table 11 – Decision to DON'T accept an innovative project by the traditional NPV method

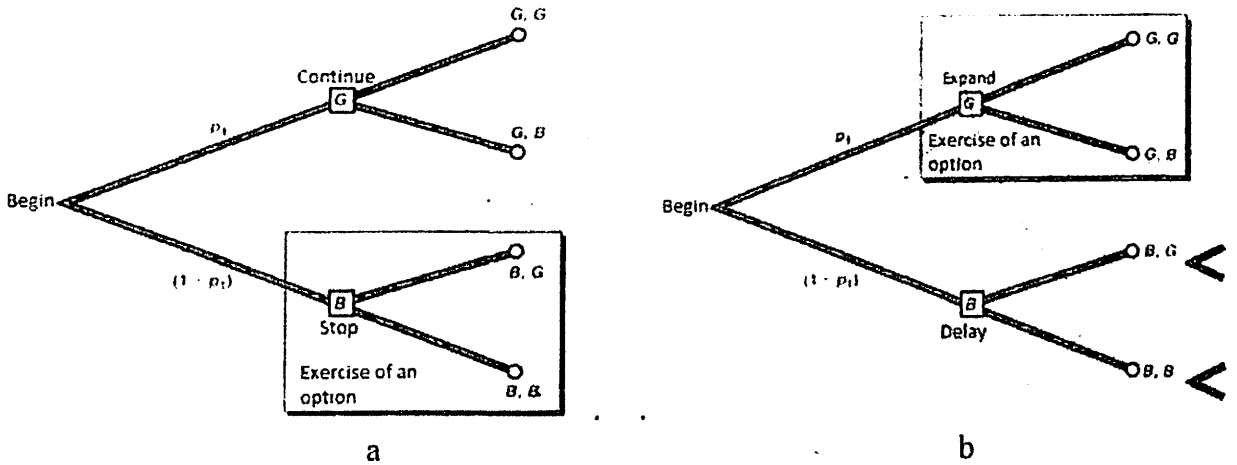
Investement			Cash Flow					NPV
t=0	t=1	t=2	t=3	t=4	t=5	t=6	t=7	
(1,120)	-	-	265	265	265	265	265	**(420)**

Source: compiled by author based on existing data

In the event that the project is not successfully implemented, the metallurgical firm is protected by the availability of a real option for abandoning the project. A **put option** with an exercise price equal to the market worth of the innovation project's assets might be used to symbolize this choice. This option allows the corporation to abandon the project if it discovers that the project's assets may be utilised or sold for a higher profit, or if the market environment deteriorates significantly. As a result, the corporation will be able to partially recoup its losses by selling the project's assets or using them to make more profitable investments. This choice offers the business flexibility and defense against potential project execution difficulties.

Consideration of the option to sell the project presents an opportunity for the investor to stop the project and accept irrevocable losses. The project completion option implies the development of a strategy that creates an asymmetric situation where this project may be unprofitable for the company, but may be of interest to other firms or related opportunities. In this case, you can save part of the investment, as the project can be transferred or sold to other interested parties.

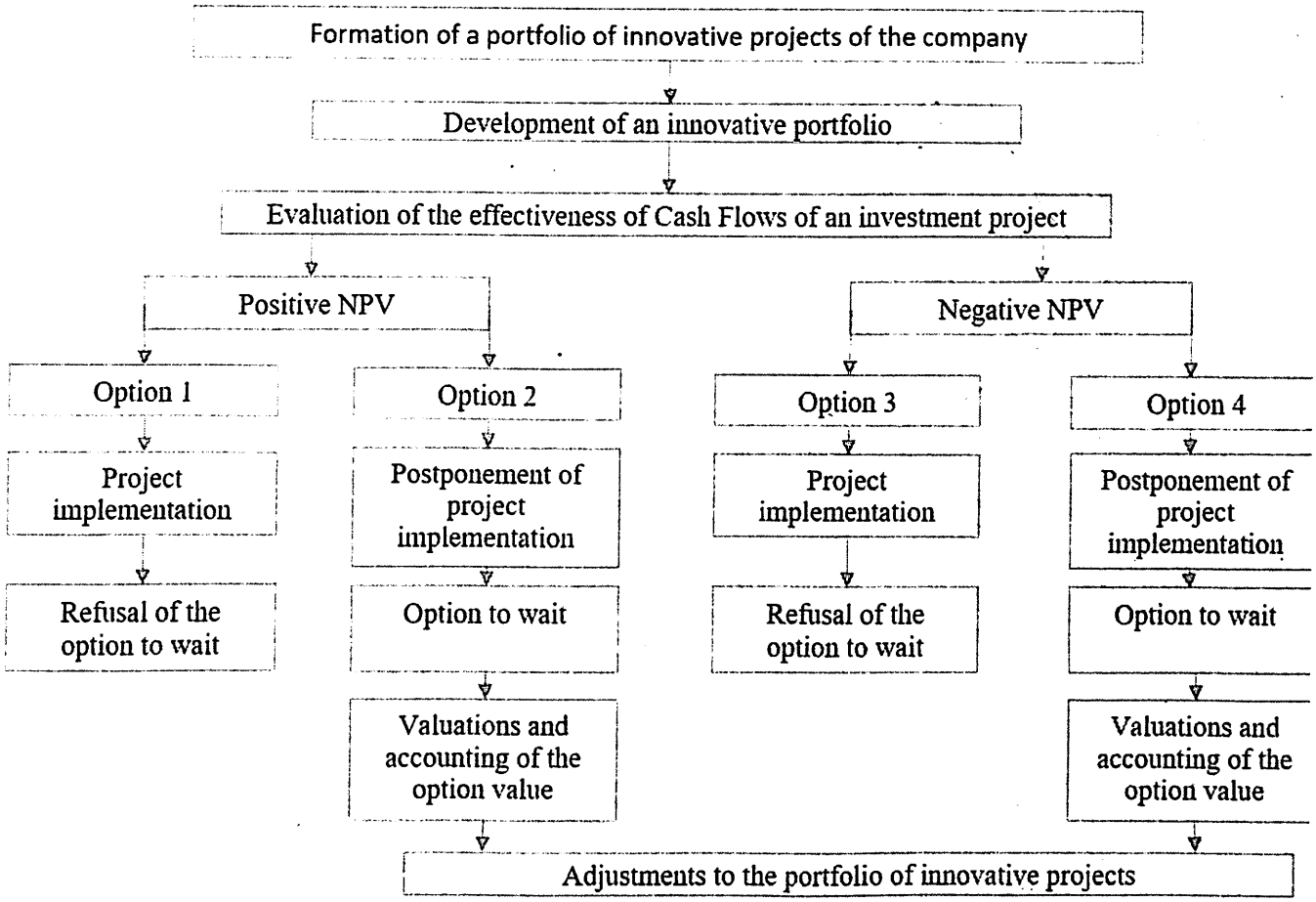
Figure 2 - Samples of Option: a – put-option (option for abandoning the project);b – call-option (option for a delay)



Source: compiled by author based on existing data

Similar to a **call option** for an innovative project that is the option to delay the implementation of investments which allows you to wait and assess the situation. Even though a project promises to be profitable enough to start, there are occasions when delaying the commencement of the project will allow you to make a better decision and lower the risks involved. Postponing the project's implementation is the most appealing option, when there is a high degree of risk and uncertainty, when the missed/ delayed, during the postponement period, expected cash flows will not have a significant impact on the project's financial performance (see Figure 3). If new information becomes available, management will be able to make more informed decisions that will improve the project's effectiveness. The metallurgical company's exclusive right (patents for inventions, know-how, distinctive technologies, etc.) shows that other market participants won't be able to occupy this niche, which is a crucial requirement for this.

Figure 3 – The method of accounting used to create a real option to wait for the investment to study the situation, in a metallurgical company's investment portfolio.



Source: compiled by author based on existing data

Model

To increase the effectiveness of the creation of a company's investment portfolio, accounting and the cost of genuine options for projects are crucial. Based on the premise that any opportunity for a metallurgical company can be analyzed as a real option granting the right to create, acquire, return, or sell an asset within a certain period of time, the method of evaluating real options is used to assess the effectiveness of investment projects.

Due to the fact that the well-known formula for calculating the value of a project under uncertainty using real options does not take into account some long-term costs associated with the use of these options, the authors present an updated

formula for calculating the expected net discounted income (NPV) of a project under uncertainty taking into account real options:

$$\underline{NPV} = \sum_{i=1}^{n} NPV_i x P_i$$

where "P" is the Probability of realization considering project and NPV_i is the discounted net income of each project implementation scenario, defined as:

$$NPV_i = \sum_{t=0}^{T} \frac{CF_t}{(1+E)^t} - \frac{CRO}{(1+E)^t} - \frac{DACAWURO}{(1+E)^t} =$$

$$= \sum_{t=0}^{T} \frac{R_t - C_t^{-It}}{(1+E)^t} - \sum_{t=0}^{T} \frac{I_t}{(1+E)^t} - \frac{CRO}{(1+E)^t} - \frac{DACAWURO}{(1+E)^t}$$

CF_t – Cash Flow, R_t – Current Realization in monetary terms, C_t^{-It} – Current Cost/Expenses in monetary terms after investing to the project, I_t – Investments, CRO – Cost of Real Option, $DACAWURO$ – discounted additional costs associated with the use of real options, E – Discounting rate.

$$1 + E = (1 + r_f) \cdot (1 + \alpha) \cdot (1 + r)$$

Where r_f – risk free rate, α – Inflation rate, r - non-systematic component of the overall risk of a particular project.

The NPV of the project is therefore the sum of the net present income from the project that is anticipated under uncertain circumstances, excluding the possibility of its adaptation to changing conditions, the cost of actual options that are available or built into the project and offer the possibility of adapting the project, as well as discounted long-term costs associated with the use of these options. This comprises:

1. The company must objectively account for the following elements:

a) The cost of project termination, which is typically unknown in advance and subject to fluctuate over time.

b) Investment opportunity costs, which are similar to the price of a real option.

c) The potential for investment costs to become fixed costs, such as those associated with specialized goods, services, equipment, employing, training, and firing employees, and advertising.

2. the potential for losing strategic focus as a result of excessive managerial decision-making freedom when examining corporate strategies.

3. the requirement for a company to adapt its organizational culture and business methods.

Due to all of these variables, investors typically wait to start investing if there is a chance to put it off and the income is not enough to outpace long-term average costs.

4. CONCLUSION

In our current research, we start by acknowledging that the expansion of technology-driven companies, which have contributed significantly to the growth of World economy in recent years, presents significant obstacles when applying traditional valuation methods. To address this, we propose the adoption of an options-based approach for valuing and managing technology-intensive growth companies. Our approach incorporates a sequential model of new product development and utilizes an option tree evaluation methodology.

In this study the author presents the results on the questions related to investment assessment methods, factors stimulated to use chosen methods and analyses of comparison between traditional method and real option method in the case study.

To learn more about the CFOs of Kazakhstan's companies' strategies for evaluating investments, we ran a survey specifically for them. Only 3 of the 50 respondents said they used real options while evaluating investments. In comparison to results from recent research carried out in the United States and Canada, this use rate is lower. Smaller company sizes, lower levels of R&D intensity, and a smaller number of technology-focused organizations are some of the causes of Kazakhstani companies' lesser adoption of real options.

According to our research, real option analysis is more likely to be used by larger organizations with higher levels of R&D intensity and capital expenditures. It also depends on industry classification, as the energy, oil and gas sectors, which are more developed than other industries in the nation, are more likely to incorporate real option analysis.

The apparent complexity and need for in-depth knowledge are the main justifications given for not using real options. Main part of the of respondents (70%) said they were not aware with real option principles or strategies, because of the the complexity of the procedures. It was found to be the biggest barrier among individuals

who are aware of real options but are not implementing them. Some non-users, however, publicly or clandestinely adopt real options as a paradigm or style of thinking. The real option approach's acceptance among practitioners may rise if it were made simpler.

According to the results of the case study, traditional net present value analysis used incorrectly might undervalue a possible investment and lead to poor decisions, particularly in circumstances when there is a lot of uncertainty. The asymmetric character of returns in uncertain contexts, where future actions may result in favorable outcomes, is not taken into account by classic NPV analysis. Instead, it frequently uses a risk-adjusted discount rate to penalize future uncertainty.

The real options method is an efficient strategy for lowering the risk of investing in actual projects while analyzing the corporation's investment potential. When investing money, using this strategy can enable the investor have less duties and more rights. The availability of strategic leverage, which enables investment managers to modify the project implementation process depending on changes to the project's implementation circumstances, is another significant benefit of employing real options. This makes it feasible to prevent substantial losses and take advantage of shifting circumstances to hasten the development of the company.

The firm will have a competitive edge if it can evaluate investment ideas using the real options method more objectively. Making better informed investing selections is made possible by this strategy, which enables you to gain more benefits from risk and uncertainty. The firm can examine the possible advantages and hazards more thoroughly and accurately by evaluating more options and opportunities when investing in real projects utilizing actual options.

As a result, the real options approach is a crucial instrument for analyzing investment prospects since it helps to lower risk, increase flexibility, and enhance evaluation of the efficacy of the corporation's investment projects. As a result, the

business is able to take advantage of the market's variation and make decisions that will advance its growth and competitiveness.

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APPENDICES

Appendix 1. Survey instrument

1.1. Demographic questions.

1. My company/organization primarily operates within the following industry:

a) Oil/gas & oil service
b) Energy
c) Construction
d) Retail & wholesale
e) Transportation
f) Food & beverages
g) Bank/finance & insurance
h) Communications/media
i) Healthcare
j) Technology (software, biotech, etc.)
k) Other

2. My company/organization located in which part of the country:

a) South Kazakhstan
b) North Kazakhstan
c) West Kazakhstan
d) East Kazakhstan
e) Central Kazakhstan

3. What is your company's profit margin (EBITDA margin)?

a) <0%
b) 0–4%
c) 5–9%
d) 10–14%
e) 15–19%
f) >20%
g) Not applicable

4. What percentage of total revenue is spent on R&D activities?

a) 0–1%
b) 1–2%
c) 2–3%
d) 3–4%
e) 4–5%
f) 5–6%
g) 6–7%
h) 7–8%
i) >8%

1.2. Main objective questions

5. Does your company use real option analysis to evaluate projects/ investments?

a) Yes
b) No

6. Which of the following capital budgeting techniques does your company use? (Select all that apply)

a) Net present value (NPV)

b) Internal rate of return (IRR)

c) Hurdle rate

d) Earnings multiple approach

e) Payback period

f) Other

1.3. Main questions for non-users

7. Are you familiar with the principles and techniques for real option analysis?

a) Yes

b) No

8. Why does your company not use real option analysis?

a) Insufficient support from top management

b) The level of complexity is high.

c) Promotes excessive risk taking

d) Other

1.4. Main questions for users

9. How does your company use real option analysis?

a) Primary capital budgeting technique

b) One of several techniques

c) As a complementary tool to reinforce and validate findings from other methods

d) Other

10. In my company, real option analysis is utilized for the following decision-making processes: (Select all that apply)

a) New product invention

b) Research and development

c) Mergers & acquisitions

d) Foreign investment

e) Other

11. After making an investment decision, does your company still use real option analysis in its ongoing operations? (e.g. to decide whether to expand or abandon a project)?

a) Yes

b) No