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RESEARCH PAPER

The Quantitative and Qualitative Assessments of Investment Risk in Government Development Projects (Case Study: Joint Oil Fields of Iran and Iraq)

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Abstract

Common energy fields are one of the defining poles of energy diplomacy between countries. Iran's role with 28 common oil and gas fields in the Middle East, the world's fastest energy pole and the largest source of oil and gas, is very decisive. Among Iran's neighbors, Iraq is very important with the largest number of common fields. This study presented a qualitative and quantitative project risk assessment using a risk assessment matrix and the expected monetary value risk analysis to identify the most important risks of joint oil field projects. Accordingly, the two scenarios of the contract for the partnership in the production of the Sepehr and Jafir oil fields are compared with the oil contract for the buyback of the North Azadegan field by calculating the Expected Monetary Value for each Decision Tree Path. As a result, it is observed that by considering the risks obtained from the calculations of the risk assessment matrix in each contract, and also with the equal risk share, the production sharing contract has an expected monetary value equal to 7.228 billion dollars. This option also includes the lowest investment risk for National Oil. Also, by using the risk assessment matrix, we found that political conflicts are the largest share of risk and a deterrent to the development of oil fields, and the willingness of large oil companies to invest in Iraqi oil facilities confirms that the importance of political conflicts is much greater than lack of physical infrastructure risk.

Keywords: Governmental Construction Projects, Oil Projects, Quantitative and Qualitative Risk.
JEL Classification: Q48, C54, G32, L74, L78.

1. Introduction

Project financing is one of the most challenging issues in the field of capital markets. It has always been a question for shareholders or investors whether it is possible to predict the return on investment given the economic changes and fluctuations or not.

Because if it is possible to predict the return on investment and provide models for it, more reliable conditions will be created for the investment, and the decision to invest and determine the desired portfolio will be facilitated. This issue will help to expand investment in the financial market.

Investment decisions in projects are often made based on the net present value of cash flows from the project. However, any change in the assumptions of calculating costs and revenues can lead to significant changes in the calculation of project cash flows and net present value. During situations where project profitability is subject to fluctuations due to changes in the estimating assumptions of cost and revenue, complementary risk indicators can play an effective role in improving investment decisions. Considering the changes in basic assumptions and making decisions based on the risk caused by these fluctuations can lead to more rational investment decisions (Raei et al., 2012)

Risk management is the process by which project risks are identified and considered, and it is tried to reduce potential project risks. Risk means danger and includes any possibility of an event harming the project, and managers must consider all of these risks and opportunities in their planning (Furlong et al., 2017)

The selection and use of appropriate methods for risk analysis and planning techniques to deal with such risks have a long history. He also stated that traditional methods to identify such risks are not very effective and it is more necessary to adopt more efficient ways. This necessity is increased in Iranian oil and gas projects, which have unique energy geography in the region and the world. And it should be considered that Iran has about 28 joint fields with its neighbors, and the other side in the last two decades has started large-scale unilateral investment. Therefore, concentrated exploitation of these fields and investment in this sector is logically very important. Noori and Khoshchehre (2016) state that this approach has been the basis of decision-making when Iran has been subject to the most severe sanctions by Western countries, and this issue has caused large oil companies to be reluctant to participate and invest in Iranian projects. On the other hand, the lack of transparency and the people's lack of trust in the stock exchange market, unfortunately, prevented the country from equipping domestic resources and investments toward the development of joint fields.

Investing in joint oil field projects requires considering project risk for investors because project risk is one of the most important factors influencing the pricing of oil contracts. Therefore, identifying the risk of joint oil projects is of great importance. Despite the existence of many oil fields in Iran, not much research has been conducted

in this field (such as joint oil fields with Iraq), and this article is one of the first studies of its kind. In this research, using a standard questionnaire, a contingent list of risks was identified for joint oil field projects, and using the decision tree method, an appropriate strategy to deal with these risks was selected.
The remainder of this paper is organized as follows. Section 2 reviews the literature on the subject matter, and in Section 3, the model and the data are described. Finally, Section 4 concludes the paper.

2. Literature Review

In countries that rely on the oil economy, the oil and gas industry has always been a key decision-maker for other sectors of the economy due to revenue generation on the one hand and the supply of energy resources on the other.
Investment in the upstream part of Iran's oil industry will be conducted by government revenues and following the provisions of the five-year plans and annual budget laws from domestic sources and other sources specified in the budget law and private sector investment following the needs of each sector and relevant laws. According to the theoretical foundations of investment, any investment project is associated with risk and return.
A project is a set of sequential and dependent activities or processes for production (goods or services) that have their unique characteristics. Each project has a specific beginning and ending. It has a temporary status, which is implemented gradually; projects can be implemented at different levels in organizations. A work team can consist of one person or one work team (Keshk et al., 2018). The main aim of a project is to meet its operational needs based on the nature of the project while achieving the plan, budget, and quality objectives; failure to achieve such goals can be due to the failure of contractors to face unpredictable risks. Risk management, as part of project management, includes the processes of conducting risk management planning, identifying, analyzing, planning, responding, and controlling risks on a project. Therefore, the task of risk management is to transform many unknown risks into known hazards through risk identification, assessment, and control. In general, project risk management aims to reinforce positive events (opportunities) and reduce negative events (threats) in the project (Hosny et al., 2018). Project risk management is the practice of identifying, evaluating, and preventing or mitigating risks to a project that have the potential to impact the desired outcomes. The Project Management Institute

(PMI) has taken a broader view of risk in terms of threats and opportunities. This definition is separated in the table below (PMI, 2017).

Table 1. Risk in Terms of Opportunities and Threats

Risk	
Any uncertainty in the project that, if it occurs, will affect one or more objectives.	
Opportunity	**Threat**
Any uncertainty in the project that, if it occurs, will positively affect one or more objectives.	Any uncertainty in the project that, if it occurs, will negatively affect one or more objectives.

Source: Project Management Institute, PA, USA, 2017.

Risk assessment is a set of steps used to assess related risks that are divided into two stages: risk analysis and risk assessment. The risk assessment process is followed by iterative methods and ends when the risk is sufficiently reduced. The main purpose of risk assessment tools is to rank different dangerous situations (scenarios) based on their risk indicators to identify overwhelming (unacceptable) risks and prioritize them (Chinniah et al., 2018). Risk assessment methods are divided into two major groups, including qualitative and quantitative assessment. In qualitative assessment, risks are described using descriptive phrases and sentences, and it is tried to provide adequate details of the risk to find appropriate ways to respond to it. However, in quantitative assessment, numerical values are used to explain the dimensions and importance and the effects of risk on project objectives individually or in groups (Alijanzadeh and Azadnia, 2016). Qualitative risk means measuring the extent of a potential risk impact and measures the impact of different types of risk on project objectives. Qualitative risk assessment is important because it is necessary to determine the importance of each risk and choose the coping method. This assessment depends on some computational and computerized tools. One of these tools is the assessment matrix. This assessment is measured by experts as a range of numbers. This range is between 0.05 and 1.00; 0.05 is very low and 1 is high (Keshk et al., 2018). Quantitative risk means a quantitative description of the risk according to the probability of occurrence, the consequences of the risk, the monetary value, or any other unit. Quantitative analysis with high accuracy determines the probability of occurrence of timing risks and the final cost of the project and linearly determines the process of project risk management (Szymański, 2017).

Chiara and Garvin (2008) point out that making decisions about the financial feasibility of these projects depends to a large extent on the overall risk of the project.

The financial risk assessment of BOT projects is typically conducted with a combination of Monte Carlo simulation and cash flow analysis. In this article, a new set of Markovian processes, the Martingale variance model and the general variance model, are proposed as alternative modeling tools for BOT risk changes. The practical case of this paper is a BOT transport project, and its results show that failure in the correct modeling of project uncertainties may lead to incorrect estimation of project financial risk. In this case, if the evaluation is too considerate, decision-makers may reject a financially justifiable project.
Xie et al. (2010) stated that decision-making in the field of oil and gas projects is facing many risks, including feasibility risk, geographical risk, and technical risk, financial risk, environmental risk, and political risk. They were also able to identify effective risks using an adaptive algorithm designed to manage dynamic risk based on a Variable Precision Rough Set in oil investment projects, at each stage of which the experts' opinions supported the system. After analyzing the risks associated with each investment, they managed to select the appropriate investment portfolio with the least tolerable risk.
Supriyadi (2013), while deeply examining the common method for risk analysis in the evaluation of oil projects, concludes that these kinds of analyses do not provide complete information about the risks and uncertainties facing the project. Therefore, he has tried to present a new framework as the main element of risk by emphasizing the essential role of uncertainties so that creating a complete picture of risk and uncertainty provides more efficiency in the decisions of decision-makers.
Kashk et al. (2018) recognized the risks of the project using quantitative and qualitative methods. He believes that risk management is one of the most important aspects of project management, which means classification, analysis, planning, identification, evaluation, and strategy for response and risk avoidance. In this article, using the qualitative method, a list of risk priorities was obtained, and after weighing the risks using the risk assessment matrix, their importance was determined. Then using the decision tree method, the appropriate strategy to deal with these risks was determined.
Kraidi et al. (2019) created a semi-structured questionnaire through a comprehensive review of scientific literature and other research findings using 30 risk items and also analyzed the data using the SPSS program. Then, she ranked the data and assessment as the risk factors that had more probability and intensity, respectively. By examining the scientific literature and research findings, she concluded that: sabotage,

transportation problems, official corruption, terrorism, and lack of specialized knowledge are the most important critical risk factors in Iraq.

Chai and Kim (2018) found that financial investor companies in oil and gas projects have always been concerned about the probable price of oil and gas in the future. The lack of support for the implementation of these projects by oil and gas companies is affected by oil and gas prices. Using experimental data, they concluded that insurance companies could minimize losses.

Khalilzadeh et al. (2021) found that oil and gas projects in Iran, in addition to the risks in pmbok, are exposed to unknown risks such as sanctions conditions. The main risks were identified through document analysis, which was finally reduced to 17 hazards by expert reviews using the fuzzy Delphi method. The experts included 15 people with more than ten years of practical experience in oil and gas projects. The results of confirmatory factor analysis confirm all risks in terms of statistical population. The highest risk of oil and gas projects in Iran is the economic sanctions in the second stage of attracting foreign investment, and the lack of infrastructure has the most impact.

3. Methodology

The present study identifies and ranks the factors affecting investment risks in government development projects; the case study is oil projects in joint fields. This research used descriptive, correlation methods and used a questionnaire which is one of the most common methods for identifying risks, and considered the type and nature of research and data collection method. This applied research is fundamental in terms of the type of research and the purpose of its type of exploratory research and data collection method, it has mixed methods. Mixed research is the kind of research that is conducted by combining two methods in selecting a set of quantitative and qualitative research methods.

In this research, the statistical population included the experts available in the investment and development of joint oil field projects. This sample group includes 32 CEOs, project managers, financial managers of companies involved in the development of joint oil fields, and employees of the Investment and Business Office of the Ministry of Oil have been selected as available experts on joint oil field investment.

The methods of data collection in this study are as follows:

Library Studies; Library resources and articles have been used to collect information in the field of theoretical foundations and research literature.

Field researches; in this section, a questionnaire was used to collect data and information for analysis. The questionnaire of this research includes 62 questions. The objective of developing a questionnaire in this study is to discover the risk of each item. Although the set of questions is included in a questionnaire, it consists of three distinct categories of questions: 22 questions to determine market factors, 10 questions to determine technical factors, and 30 questions to determine institutional factors. The questions are designed using the existing literature in the development of joint oil field projects The 5-point Likert scale, which is one of the most common measurement scales, has been used to design these questions.

Table 2. Research Variables with Dimensions and Related Questions

Factors	Components	Number	Questions
Market	Commercial	6	1-2-3-4-5-6
	Supply	6	62-13-14-15-16-61
	Financial	12	7-8-17-18-19-20-21-22-29-30
Technical	Operation	2	35-16
	Construction	4	33-34-37-38
	Technological	2	31-32
Institutional	Political	12	9-10-11-12-53-54-55-56-57-58-59-60
	Management	12	23-24-39-40-41-42-47-48-49-50-51-52
	Provisions	6	25-26-27-28-43-44

Source: Research finding.

3.1 Data Analysis

In this research, the data collected through a questionnaire in each step first were entered into SPSS software, and the reliability of the questions was measured using the software. Then, in the next step, the frequency of risks was measured using Excel software. Statistical analyzes are made of two general types: descriptive and inferential statistics. In descriptive statistics, the general outline of the data is displayed by providing descriptive indicators as well as drawing figures. In the next step, data qualitative analysis was conducted by the risk assessment matrix. Then the expected monetary value method was used to quantify the data, to better understand the opportunities and threats.

A risk assessment matrix is a network for mapping the probability of occurrence of each risk and its impact on project objectives. Risks are prioritized according to their potential effects on achieving project objectives. The use of a search table or a risk assessment matrix is a general approach to prioritizing risks. Certain combinations of probability and impact that cause a risk to be rated high, moderate, or low are usually determined by the organization. Table 3 shows an example for defining impact scales for project objectives.

Table 3. The Scales of the Impact of a Risk on the Main Objectives of the Project

Status defined for scales of the impact of a risk on the main objectives of the project (samples are provided for negative impacts only)					
Objectives of the project	**Very low 0.050**	**Low 0.10**	**Moderate 0.20**	**High 0.40**	**Very high 0.80**
Cost	Slight increase of cost	Increase less than 10% of the cost	10% to 20% increase in costs	20% to 40% increase in costs	More than 40% increase in costs
Time	Slight increase in time	Increase less than 5% of the time	5% to 10% increase in time	10% to 20% increase in time	Increase more than 20% of the time
Range	Not so noticeable reduction in range	Partial areas of the range are affected	Major areas of the range are affected	Reducing the range is unacceptable for a sponsor	The final product of the project is practically useless
Quality	Not so noticeable reduction of quality	Only favorite applications are affected	Quality reduction requires sponsor approval	Quality reduction is unacceptable for the sponsor	The final product of the project is practically useless

Source: Project Management Institute, PA, USA, 2017.

In this research, the mixed method has been used, because it is one of the most practical methods of risk assessment. Since this research is divided into quantitative and qualitative parts and the components of the two parts affect each other, this study is designed in two steps.

Step 1. Creating a Qualitative Structure

In this section, by weighting each component, a kind of comprehensive classification is conducted for each object, criterion (category), and sub-criterion (risk factor of each category). Each risk is ranked based on the probability of its occurrence and its impact on the target. The organization's thresholds for low, moderate, or high risks are displayed in the matrix, and it determines whether the degree of the risk impact on the goal is high, moderate, or low. 0.90 indicates the highest probability and has number 5 in the questionnaire, 0.70 indicates the high probability and the number 4 in the questionnaire and 0.50 indicates the moderate probability and number 3 of the questionnaire and 0.30 and 0.10 show 2 and 1 in the questionnaire, respectively.

The second level of the model is the three general risk classifications of oil and gas projects, which are market risk factors, technical risk factors, and institutional risk factors. Also, the third level, which is the sub-criteria level, is the commercial, supply, and financial criteria related to market risk factors, technological sub-criteria, construction and operations related to technical risk factors, and provisions, management, and political criteria related to institutional risk factors.

The risk assessment matrix has been used to determine the relationships between criteria and sub-criteria. To identify the most important risk, experts' opinions were collected on the probability of occurrence and impact of each risk. In the next step, the probability of each risk was multiplied by its impact. Each risk that had the most cumulative frequency from the experts' opinions was ranked from high to low. Accordingly, the risk of institutional factors with an average of 13.49 is the most important one, and the risk of technical factors with an average of 10.07 in the moderate degree of importance is the least important one.

Table 4. Ranking the Risk of the Main Research Criteria

Row	Risk	Degree of importance	Location in the matrix
1	C1	13.49	Red
2	C2	10.07	Yellow
3	C3	13.05	Red

Source: Research finding.

Table 5. Risk Assessment Matrix

Probability	Threat					Opportunity				
0.90	0.05	0.09	0.18	0.36	0.72	0.72	0.36	0.18	0.09	0.05
0.70	0.04	0.07	0.14	0.28	0.56	0.56	0.28	0.14	0.07	0.04
0.50	0.03	0.05	0.1	0.2	0.4	0.4	0.2	0.1	0.05	0.03
0.30	0.02	0.03	0.06	0.12	0.24	0.24	0.12	0.06	0.03	0.02
0.10	0.01	0.01	0.02	0.04	0.08	0.08	0.04	0.02	0.01	0.01
Impact	Very low	Low	Moderate	High	Very high	Very low	Low	Moderate	High	Very high

Source: Project Management Institute, PA, USA, 2017.

3.2 The Analysis and Ranking of the Risk of the Sub-Criteria of Market Risks

The experts' statements about the risk factors of joint oil field projects have been used to determine the frequency distribution function of the importance of market risks sub-criteria. In the distributed control form, respondents were asked to determine the risk of the identified items. Therefore, the respondents assigned a value of 1 to 5 to each item according to the importance of the risk. The 22 market factor items were categorized into 3 factors. A summary of the results related to the frequency of these 3 factors is given in Table 6. As it is shown, the business risk with the value of 14.09 includes most of the risk importance, and financial risk includes the least risk with the value of 12/07. The important point about business risks was that all market risks were at the red points of the matrix and required more attention from management.

Table 6. Ranking the Risk of Market Sub-Criteria

Row	Risk	Degree of importance	Location in the matrix
1	S1	14.09	Red
2	S2	13.15	Red
3	S3	12.17	Red

Source: Research finding.

3.3 The Analysis and Ranking of the Risk of Technical Risks Sub-Criteria

This section describes the results of the frequency of the importance of the risk of technical sub-criteria. As it is shown, 10 items of technical factor were classified into 3 factors. A summary of the results related to the frequency of these 3 factors is given in Table 7. As can be seen, operational risk requires more attention than construction and technological risk. Also, technology risk is the least important one among the technical risks.

Table 7. Ranking the Risk of Technical Sub-Criteria

Row	Risk	Degree of importance	Location in the matrix
1	S4	7.11	Yellow
2	S5	6.40	Yellow
3	S6	13.93	Red

Source: Research finding.

3.4 The Analysis and Ranking of the Risk of Institutional Risks Sub-Criteria

This section describes the results of the frequency of the importance of the risk of institutional sub-criteria. As it is shown, 30 items of the institutional factor were classified into 3 factors. A summary of the results related to the frequency of these 3 factors is given in Table 8. As can be seen, the political risk with the value of 14.64 is the most important investment risk in the joint field project and is more important than management and provisions risk in terms of the political position of Iran and the economic war situation we are involved in, but this does not mean that we shouldn't consider the management and provisions risk. The provisions and management risks are at the red points of the risk matrix with the values of 13.96 and 11.92, respectively.

Table 8. Ranking the Risk of Institutional Sub-Criteria

Row	Risk	Degree of importance	Location in the matrix
1	S7	13.96	Red
2	S8	11.92	Red
3	S9	14.64	Red

Source: Research finding.

Step 2. Creating a Quantitative Structure

This section describes the results of the frequency of the impact on the probability of occurrence of each risk for all items of the questionnaire. In this section, 62 items were categorized into 32 risks, which were questioned and assessed by experts according to the results of their probability of occurrence and their impact. The results are presented separately in Table 9.

Table 9. Probability Results on the Impact of the Risk Assessment Matrix

P*I	Average	Q-number	P*I	Average	Q-number	P*I	Average	Q-number
10.83556	3.533333 3.066667	Q45 Q46	13.42667	3.8 3.533333	Q23 Q24	16.24	3.866667 4.2	Q1 Q2
12.06222	3.933333 3.066667	Q47 Q48	13.22667	4.133333 3.2	Q25 Q26	13.19111	3.733333 3.533333	Q3 Q4
9.186667	3.533333 2.6	Q49 Q50	16.17778	4.333333 3.733333	Q27 Q28	12.84889	3.933333 3.266667	Q5 Q6
13.86667	4 3.466667	Q51 Q52	11.48889	3.666667 3.133333	Q29 Q30	11.78667	3.466667 3.4	Q7 Q8
7.653333	2.8 2.733333	Q53 Q54	7.106667	2.6 2.733333	Q31 Q32	16.46667	4.3 3.8	Q9 Q10
15.54667	4.4 3.533333	Q55 Q56	10.70222	3.733333 2.866667	Q33 Q34	18.35556	4.666667 3.933333	Q11 Q12
19.04	4.533333 4.2	Q57 Q58	13.93333	3.666667 3.8	Q35 Q36	12.32444	3.933333 3.133333	Q13 Q14
10.8	3.6 3	Q59 Q60	8.493333	3.266667 2.6	Q37 Q38	14.88	4.133333 3.6	Q15 Q16
12.24889	3.533333 3.466667	Q61 Q62	13.89778	3.933333 3.533333	Q39 Q40	11.52	3.6 3.2	Q17 Q18
			9.066667	3.4 2.666667	Q41 Q42	14.69333	3.866667 3.8	Q19 Q20
			12.48	3.6 3.466667	Q43 Q44	12.69333	3.733333 3.4	Q21 Q22

Source: Research finding.

As can be seen, sanctions have had the most negative impact on the growth of investment in joint oil fields, and political change and foreign conflicts in the second rank have the most risk. Domestic political changes and price fluctuations and the lack of government financial transparency in the third to fifth ranks include the largest share of domestic factors in the negative rate of investment in joint fields. The weak performance of the contractor, weak banking system, budget overruns, and non-progress of the financial plan according to previous planning, bureaucracy, management changes in the sixth to tenth ranks are the most important investment risks in the joint oil field project. Inappropriate budget allocation, lack of a proper mechanism for attracting domestic investment, bank interest rate fluctuations, legal fluctuations, the financial inability of the private sector, instability of laws and regulations, lack of human resources strategy, and finally, the type of contracts used in national projects include the ranks eleventh to eighteen major risks associated with the joint oil field project.

4. Expected Monetary Value

This section quantitatively measures the risk of joint oil field projects using the expected monetary value method. Therefore, the distribution function of each risk factor must be determined first. After determining the distribution function, the appropriate amount of demand or risk is determined for each factor. By the quantification of the risks involved, it helps stakeholders to better understand the risks and make better decisions. Therefore, in this study, we tried to compare two types of joint oil field contracts, which are almost equal in terms of area, with the decision tree method, which is a method derived from the expected monetary value method. The present scenario includes a contract for the buyback of the North Azadegan joint oil field and a contract for participation in the production of the Sepehr and Jafir fields for 20 years. Both fields produce an average of 70,000 to 75,000 barrels per day. Therefore, they are almost equal in terms of revenue, and costs between 2.5 to 2.6 billion dollars are planned for these two projects.

Experts' opinions on the probability of occurrence of each risk have been used to draw the decision tree. Then, documentary data were used to compare the two scenarios of using partnership contracts in the development of joint oil fields and buyback contracts. In the following, the expected monetary value of each project is compared. Here, a decision is made as to whether 2.6 million dollars of capital should be spent on the development of the North Azadegan oil field through buyback or whether 2.5 billion dollars should be spent on the development of Sepehr and Jafir fields using the production sharing agreements. For this decision, risk (which is uncertain and therefore represents a node of chance) must be considered. For instance, weak risk leads to 26.280 billion dollars of revenue from investing in buyback contracts and 27.612 billion dollars of revenue from the partnership contracts of the National Iranian Oil Company. The reason for this issue can be the capacity of the company to accept the risk in the type of contract. The end of each branch represents the net effect of returns minus costs. For each decision branch, all the effects are aggregated to determine the total expected monetary value of each decision. Keep in mind that all investment costs are taken into account.

In the scenario of a buyback contract with the threat of non-investment, 0.668 % of the income, which is about one billion dollars, is for the employer country, and with the investment opportunity of 0.332 %, the income is about 26.280 billion dollars. In contrast, in the scenario of a production sharing agreement, with the threat of non-investment, we will earn about 0.668 % or half a billion dollars. Also, with 0.332 % of the investment opportunity, the revenue of the National Oil Company will be about 27.612 billion dollars.

From the risk calculations of the three market, technical, and institutional factors in Figure 1, it is shown that with an equal share of risk, the production sharing agreement has a higher expected monetary value equal to 7.228 billion dollars. This option also contains the lowest risk because the worst-case scenario has been avoided with a loss of 2 billion dollars.

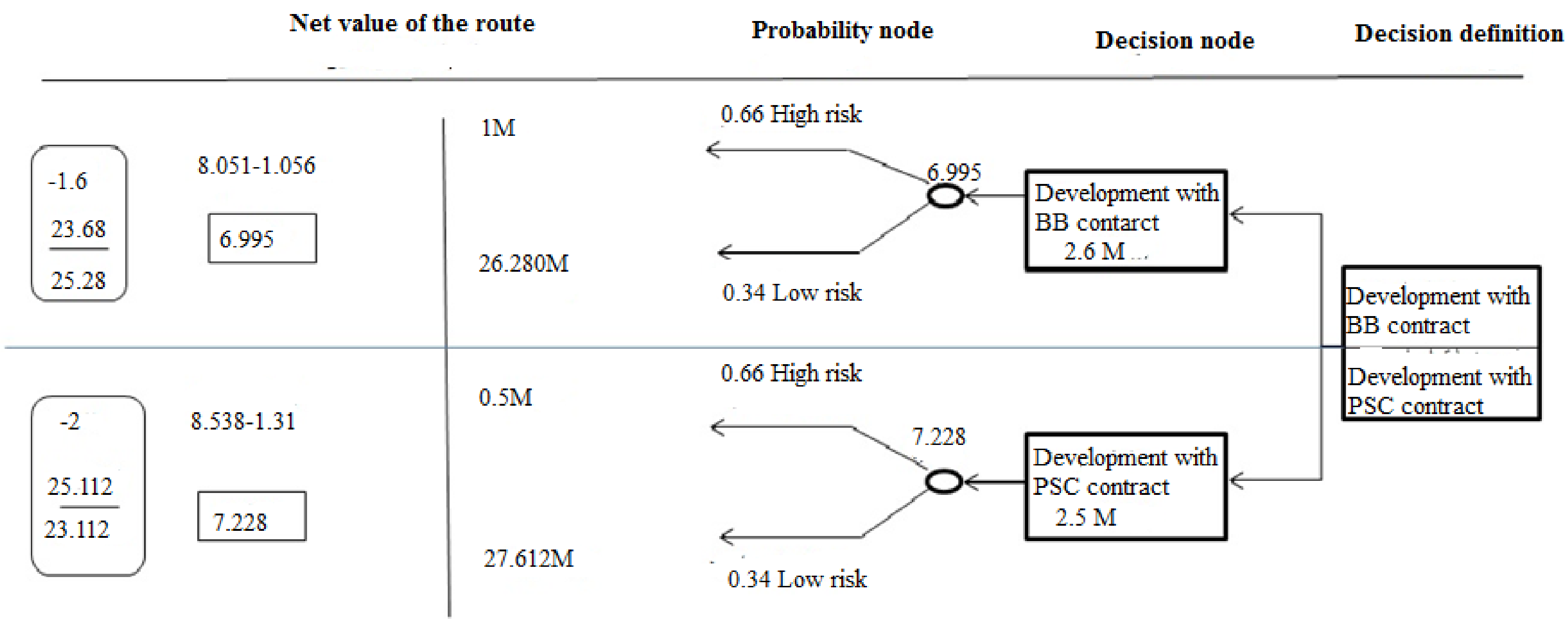

Figure 1. Decision Tree of Research Objectives
Source: Research finding.

5. Decision Tree Simulation for Market Factors

According to the calculations of market risk factors in Figure 2, it is shown that with the equal share of risk, the production sharing agreement has more expected monetary value that is equal to 6.514 billion dollars. This option also includes the lowest risk because the worst-case scenario has been avoided with a loss of 2 billion dollars. It should be noted that risk 0.686 is considered as a high-risk threat, and also risk 0.314 is considered as a low-risk threat.

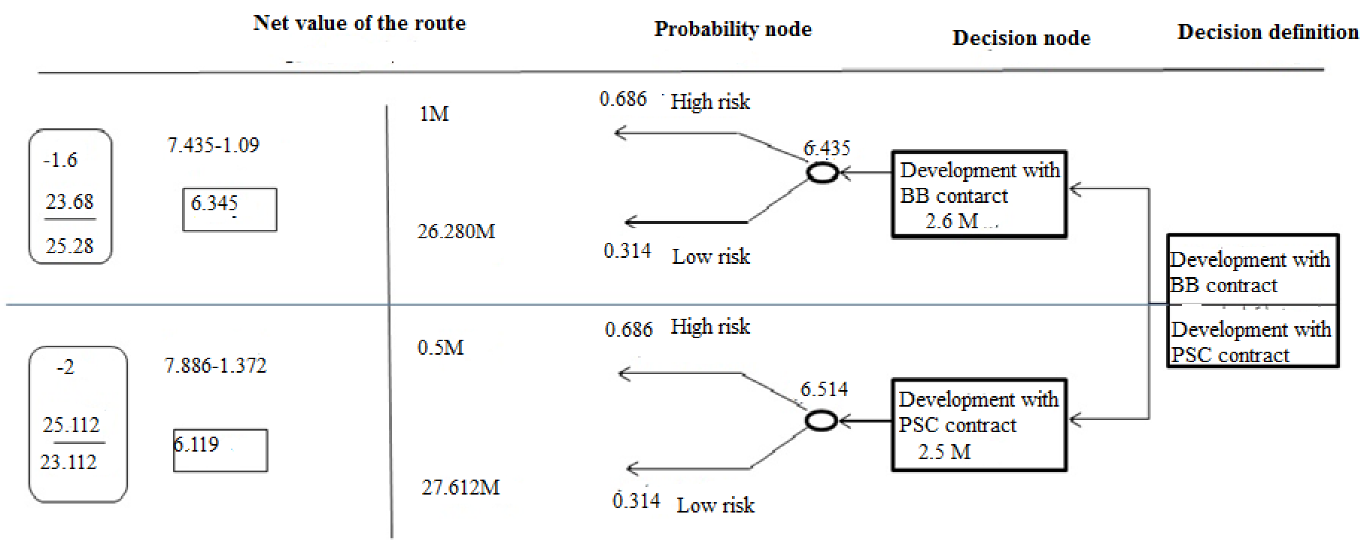

Figure 2. Decision Tree of Market Risk Factors
Source: Research finding.

6. Simulation of Decision Tree for Technical Factors

Experts' opinions on the probability of occurrence of each risk have been used to draw the decision tree. Then, using the documentary data, the two scenarios of using sharing contracts in the development of joint oil fields and buyback contracts were compared. Later, the expected monetary value for each technical component was calculated. In this component, the highest demand or high-risk threat is 0.60, and the lowest demand rate or low risk is 0.40. According to the calculations of technical risk factors in Figure 3, it is shown that with an equal share of risk, the production sharing agreement has more expected monetary value that is equal to 8.884 billion dollars. This option also includes the lowest risk because the worst-case scenario has been avoided with a loss of 2 billion dollars.

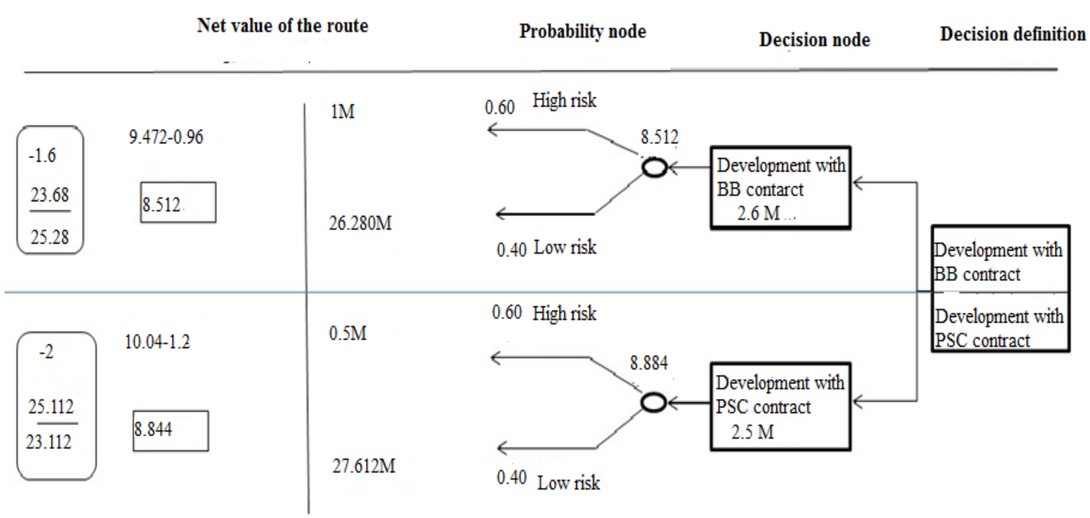

Figure 3. Decision Tree of Technical Factors
Source: Research finding.

7. Decision Tree Simulation for Institutional Factors

Experts' opinions on the probability of occurrence of each risk have been used to draw the decision tree. Then, using the documentary data, the two scenarios of using sharing contracts in the development of joint oil fields and buyback contracts were compared. Later, the expected monetary value for each technical component was calculated. In this component, the highest demand or high-risk threat is 0.672, and the lowest demand rate or low risk is 0.328. According to the calculations of technical risk factors in Figure 4, it is shown that with an equal share of risk, the production sharing agreement has more expected monetary value that is equal to 6.891 billion dollars. This option also includes the lowest risk because the worst-case scenario has been avoided with a loss of 2 billion dollars.

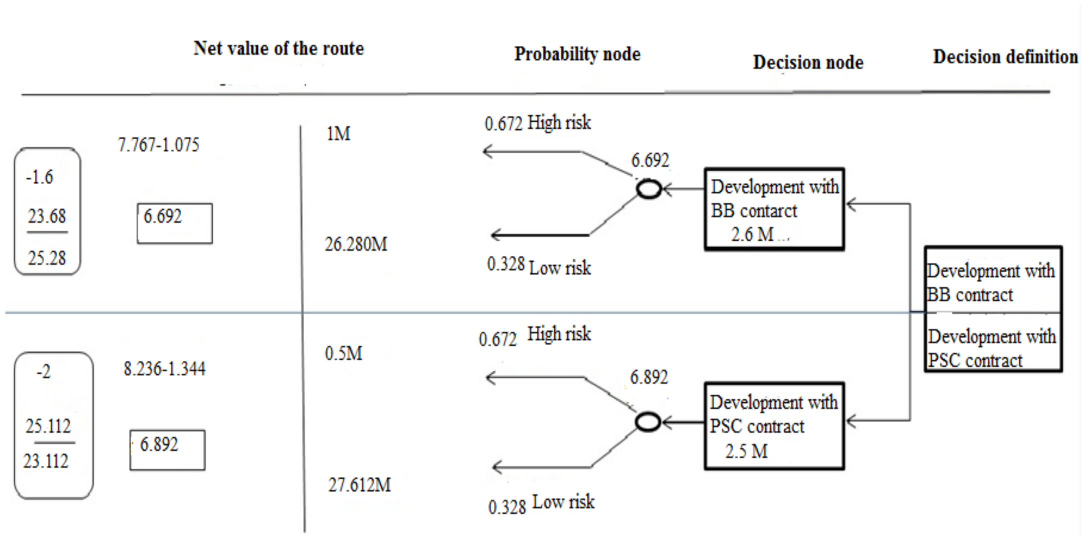

Figure 4. Decision Tree of Institutional Factors
Source: Research finding.

This decision node shows how to choose one of the various investment strategies (shown as decision nodes) when the project contains uncertain elements (shown by chance). Therefore, it can be concluded that in all conditions, the expected value of the production sharing agreement transfers less risk to the employer.

8. Conclusion

Iraq has already begun to develop its oil and gas reserves after years of war and sanctions and the arrived of large oil companies has given this opportunity to try to surpasses Iran with its amount of oil and gas production. So, the investment risk in government construction projects is one of the most important measures which must be considered to attract capital for the development of infrastructure and construction projects in Iran.

In this research, three general categories were used to assess the risk of joint oil field projects. According to the type of factors related to these three general categories, each has different levels of risk on the risk of joint oil fields. According to Figure 5, the market factor has the highest amount of risk compared to the other two general categories. As can be seen, the share of institutional risk is 36.84% and is placed relatively a short distance from the market factors with a risk share of 35.64%. On the other hand, the technical factor with a risk share of 27.50% of the total risk of joint field projects has the lowest potential toward the risk.

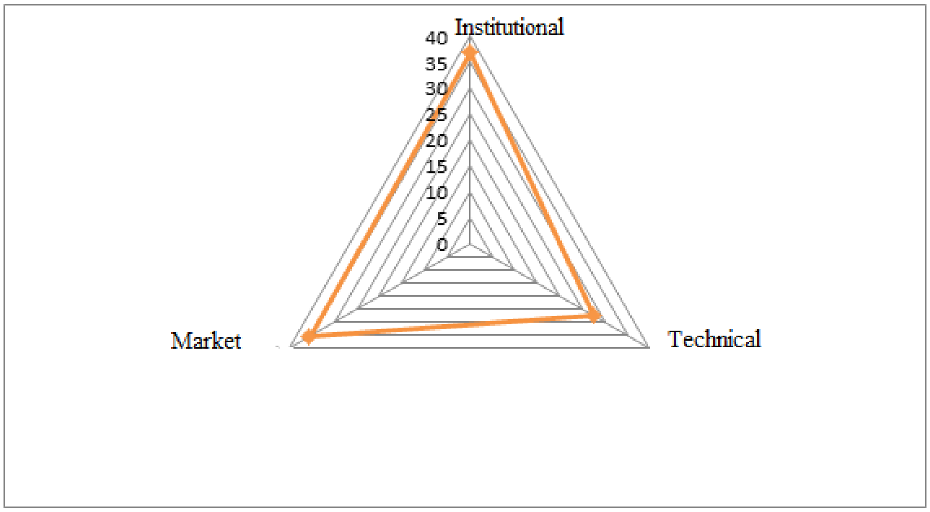

Figure 5. Radar Chart of the Overall Risk Level of Joint Oil Field Projects
Source: Research finding.

Risk is defined in two dimensions: uncertainty and impact on objectives. Common terms to describe these two dimensions are probability and impact. The assessment of the importance of each risk will make sense by considering both of them. Therefore, it is obvious that examining these two dimensions is one of the most important steps in measuring the risk of joint oil field projects, and managers can make a disciplined plan for the next risk measures by considering the importance of risk in the overall risk "impact". The impact of each risk is a percentage of the overall risk that must be measured and the sum of the impact of all factors is equal to one, among which political, commercial, and provision factors have the most impact and managers must pay more attention to these factors.

Another dimension that needs to be considered here is the probability of any risk occurring. The probability of occurrence of any risk factor is separate from the overall risk of joint oil field projects. This issue indicates that the examination of the probability of occurrence of any factor should be conducted without considering the importance of that factor in the risk of joint oil field projects. In the situations that one factor may have the greatest impact on the total risk of joint oil field projects; the same factor may have the lowest probability of occurrence. It should be considered that in many cases, these two concepts are misused.

Figure 6 shows the probability of the occurrence of risk factors for joint oil field projects. As can be seen, the operation factor has the most probability in the technical risk.

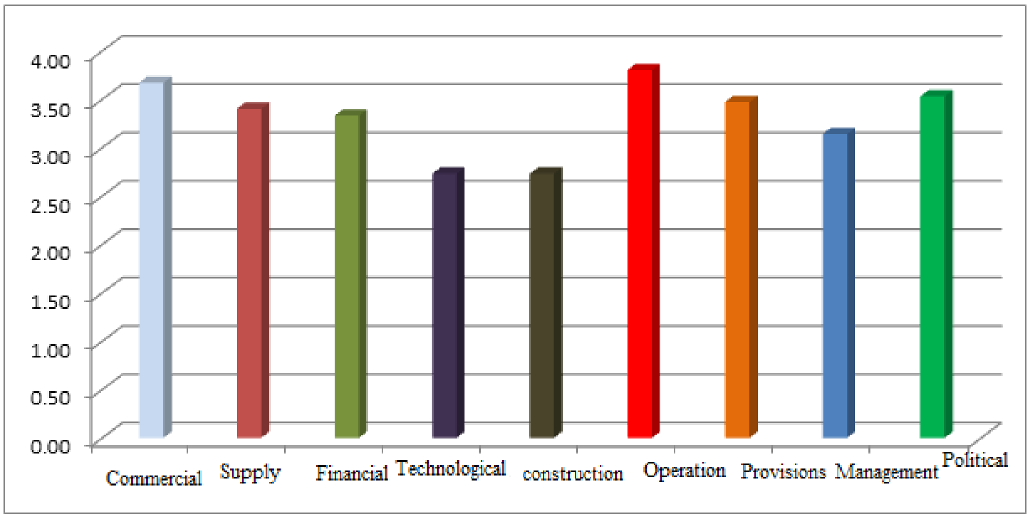

Figure 6. Probability of Occurrence of Any Risk
Source: Research finding.

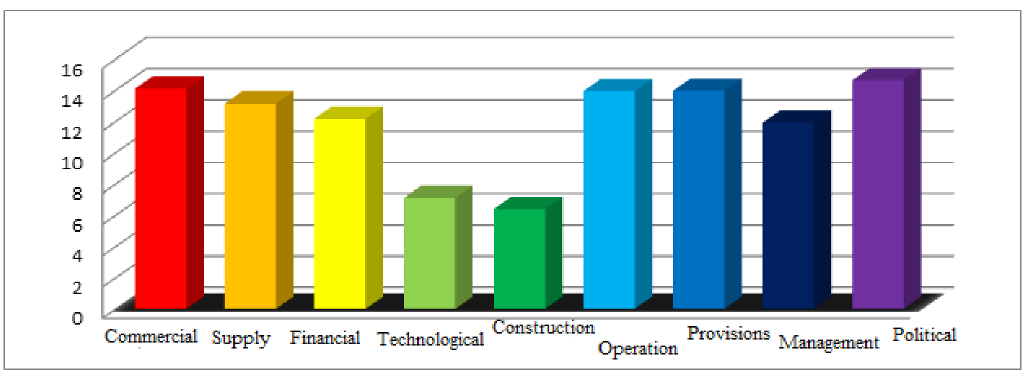

Figure 7. The Importance of Each of the Risk Factors
Source: Research finding.

However, in terms of the total risk of each of the 9 risk factors for joint oil field projects, as can be seen in Figure 7, the political, provision, and commercial factors have the highest risk among joint oil field projects. This issue should be considered in the planning and determination of executive priorities of such projects.

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