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Identifying the Causes of Delay in Projects of Phase 15 and Phase 16 of South Pars Gas Field Using TOPSIS Method

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ABSTRACT

Many factors can influence oil and gas projects' implementation. These factors may be related to employers, advisers, contractors or environmental reasons. This research has been done with the aim of investigating the reasons of delay in phases 15 and 16 of South Pars Gas Field. These reasons have been ranked by using TOPSIS method which is a multi-criteria one. After studying 46 managers of project, chief executives and involved experts, 22 indicators were designed or by comparing similar studies in other countries and Iran relating to mentioned reasons and considering professors' ideas, existing indicators have been adjusted. By calculating weight using Entropy Shannon, in next stage we have ranked the choices by using TOPSIS. Current study shows that environmental factors, (political), employers, contractors and project advisors have their own effect in length of delay in projects. Based on this study, some suggestions were proposed to involved groups in project and we can be hopeful that using these suggestions can decrease the length of delay.

KEY WORDS: Project management, project's delay, oil and gas projects, MCDM

INTRODUCTION

Development of gas industry in Iran has started an accelerated growth in recent years. Iran has great gas resources and gas will be one of the main sources of energy supply in the coming decades. Hence, an attempt should made in order to obtain an appropriate position in the gas market of the region and the world and compete with other competitors in this field. Iran has many common gas sources with neighboring countries, one of the most important of which is South Pars. Expansion of this gas field and not staying behind Qatar in exploiting this valuable sources are of great importance. Gas can be exported or be used as an alternative to oil and its derivatives. Development of South Pars Gas Field, which is one of the top priorities gas industry, can be considered a milestone in the history of Iran gas industry.

South Pars Gas Field (North Dome in Qatar) is world's greatest gas field which is located in the Persian Gulf and Iran and Qatar's territorial waters. This shared gas field between Iran and Qatar is known ad North Dome in Qatar. Since the beginning of the exploitation of this field, Iran and Qatar have always had a competition for supremacy in the exploitation of hydrocarbon resources of this shared gas field.

In the fall of 2012, Iran was daily harvesting 300 million cubic meters of reserves of this field, 70 million cubic meters less than its partner. With regard to the financing of $ 7 billion annually in the past 3 years for this gas field and duration of projects implementation in the past decade which has been more than 7 years, it is necessary conduct scientific studies on the reasons for delays in implementation of projects of Phase 15 and Phase 16 of South Pars Gas Field.

Today, a major part of the capital of each country, especially developing countries, is allocated to infrastructure and developmental projects and one of the key factors for economic growth and development of any society is the success in implantation of developmental projects. Slowness and lack of progress in the implementation of urban and developmental projects will not make for a sustainable management and this indicates that there are fundamental problems and barriers to the implementation of project, known as crisis of developmental projects.

The main problem that most projects are faced with is the delay in accomplishing different phases of the project and ultimately its completion. Delay is an action or event which makes longer the time referred to in the

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contract for performing a specific operation. This mostly occurs as longer duration of an activity or postponement of the date of commencement (Schumacher, 1995).

If the operation of the projects is delayed, it not only wastes the national capital but also makes the project unjustifiable both technically and economically (Vatankhah, 2003). Hence, studying the causes of delays in projects and resolving the existing problems will provide us with valuable experience and knowledge which can be applied in future projects. These valuable experiences are considered as implicit knowledge of projects and needs a powerful management.

1- Concepts and literature review:

Delays in projects could be associated with the increase in the specified cost. Many governmental industries or relevant organizations have their own set performance targets for evaluating the common progress of production time in different levels of a project. This helps the reduction of production period based on realistic principles that do not have any effect on other priorities.

Project is a temporary endeavor undertaken to provide a promised unique product or service and delay is an action or event which makes longer the schedule of a project. In other words, delay is the gap between the preplanned time of a project and its real duration.

Delay in the implementation of developmental projects causes capital stagnation and postponement of return on investment, increased current expenses of the project, reduced purchasing power of the project budget due to the increase in inflation rate, idleness of resources and non-use them in other projects, loss of necessity in time-dependent projects, and conflicts between different parties involved in a project due to additional costs and dissatisfaction of people, customers, and beneficiaries.

In order to increase (enhance) the performance of duration of projects implementation, it is very important to identify and determine the factors affecting the duration of projects and causing delays. Delay is one of the most common phenomena in Iran's developmental projects. This phenomenon has been observed in simple construction projects to large ones such as projects related to petrochemical industries, construction of dams, and nuclear power plants during the past decades. This subject has attracted the attention of many researcher and they divide the causes of delays in projects into two sets of justified and unjustified factors. Justified factors usually refer to natural events which are less likely to be predictable and unjustified factors are due to weaknesses in managerial and executive structures.

2-1- Project management:

Project management is a process which plans, organizes, guides, and controls a project to be carried out through the best possible way and achieve the best possible results (Mervit, 1999). Multiple factors may contribute to the management of a project based on the nature of that project. The projects that are managed by two factors have an integrated approach (design and implementation). Projects such as hydroelectric plants, water treatment plants, and sewage where the type and details of equipment (that are often purchased from abroad) are not specified before the purchase tender and non-compliance with the design and also as the guaranteed capacities by the equipment manufacturers is very important, implementation time and work interference are such that it is not possible to conduct them in design and implementation method by three factors (Bakhshaei, 1999).

The main reasons for delays and failures of the project:

Delays in projects are undeniable because of their complexity. Previous studies show that most major construction projects in the world face an increase in duration by about 50%. Also, because of the direct relationship between time and cost of the project, increased duration of a project often leads to increased costs. Studying the causes of delays in construction projects and finding strategies for reducing them is being considered as a very serious issue around the world.

On the other hand, it is very important for many project to be operated very quickly and delay in their completion causes heavy damages to the objectives. Common causes of project delays can be classified into two categories of uncontrollable factors (non-scheduled) and controllable factors (anticipatable) (technical factors). However, identifying and studying the controllable and technical factors is more important.

Analysis of the causes of delays in the projects (programs) of construction:

Delays in construction are of common problems in civil engineering projects. Delay is defined as an activity which develops the time required to execute or complete a work. Poor management can cause delay in a project and affects its productivity (efficiency). Many efforts have been made in various countries to investigate the causes of delays in projects. Unknown conditions of soil, poor monitoring of location, slow process of decision-making like all project teams, initial fluctuations of the customer, required changes during the project, and insufficient

experience of contractor are 6 major causes of delays in building and civil engineering projects. Materials, equipment, and delays related to works have been identified as the main causes of delays in contractor performance.

The order (commandment) of fluctuation, slow decision-making, and problems with cash flow are considered as causes of delays from customer. The contractor can cause delays in a projects through financial difficulties, materials management problems, problems of scheduling and planning, inadequate inspection of location, equipment management problems, and inability of individuals. Incomplete drawing, slow response from the consultants, change orders, the subject of recent orders, and poor communication are classified as causes of delay by advisors. Inclement weather and natural disasters are regarded as increasing factors responsible for delays in projects.

2-2- A review of previous studies:

Any study, in addition to being based on previous research, can be an introduction and basis for future studies. The stronger and higher the link a study with previous studies and theories, the higher its contribution to the expansion of human knowledge (Houman, 1999; 3). Considering the above-mentioned concepts, a summary of the most important studies that are directly or indirectly related to the subject of the present study will be presented.

Since the developmental projects are of great importance in the economic and budgeting system of our country, a large amount of the country's annual budget is spent on the implementation or completion of construction projects. However, delays in national developmental projects is one of the most common problems in the implementation of these projects. Hence, it is necessary to identify and analyze the causes of delays seems. In the present study, it has been tried to identify important factors contributing to the delay in the implementation of developmental projects by analyzing the comments and views of experts, managers, and contractors involved in the implementation of development projects in order to use the results in the process of planning and budgeting the projects and executive organizations. The findings indicate that the employer's financial problems due to the weakness in the executive and planning system of the country, appropriation strategy, weakness of executive organizations in planning, implementing, and controlling the developmental projects, problems caused by sanctions such unpredictable and sever inflation rate and sometimes scarcity of some items, education level and expertise of the executive director, and shortage of skilled and experienced contractors and human resources are of effective factors causing delays in governmental developmental projects. We hope that the results of the present study be helpful in resolving the existing barriers, accelerating the implementation and operation of projects, maximizing the productivity, and saving in financial and human resources (Noori, 2009).

Previous studies and experiences show that selection of the most appropriate system for implementation of a project can reduce the cost by 12% and time by 30%. Therefore, it can be stated that the selection of an appropriate system for implementation of a project is one of the most important strategic decisions which can greatly affect the progress and productivity of that project. It has been attempted to view the effect of sanctions and the shocks caused by them on developmental projects of the country as a delay. Shock caused by sanctions on foreign currency income, which includes at least 60 percent of the state's foreign exchange earnings, causes irreversible losses to the budget of developmental projects as some of the running costs could not be reduced (Odhe, 2002).

According to studies, the following items, respectively, have been mentioned as the most important causes on delays in projects in Ghana:

- Lack of proper financing of projects and delays in payments
- Weakness in setting the contracts
- Weakness in providing the materials
- Inflation rate
- Financial problems of contractors

In this paper, employer has been also mentioned as the most important cause of delay in projects. In addition, inflation has been referred to as an independent factor in the present paper, while it has been less taken into account in other studies. Paying a special attention to the financing of projects, continuous training of managers, using the modern practices of materials management, and addressing the issue of inflation can be mentioned as proper solutions (Shakeri, 2012).

Various surveys have been carried out in Egypt based on different criteria such as the groups involved in a project, the extent of projects, and type of industry.

According to the poll carried out in the field of construction in Egypt, the most important factors causing delay, orderly, are as follows:

- Liquidity problems of contractors
- Changes in the scope of projects and interventions made by the employer
- Improper financing of projects by contractors (Mohamed *et al*., 2013).

The main causes of delays in project in Australia are as follows:

- Financial difficulties (from the perspective of employers)
- Contractual relations (from the perspective of contractors)
- Project management problems (from the perspective of consultants)

In studying the results of causes of delays in projects in developing countries, there are few studied in which contractors refer to non-financial issues as the main causes of delay. As it can be seen, in this study, contractual relations has been as the most important cause of delay by contractors (Orangi *et al*., 2011).

In another part of the same study, causes of delays in projects have been classified in 8 categories as follows:

- Employer (payments for works done, employer's involvements, slow decision-making, and duration of contracts)
- Contractor (workshop management, improper methods of implementation, planning mistakes, mistakes in implementation, and low experience)
- Consultant (contract management, preparation and verification of the plan, quality control, and longtime of waiting for approval tests)
- Materials (quality of materials and shortage of materials)
- Equipment and labor (labor supply, labor productivity, and equipment availability)
- Contracts (changed commands, conflicts and errors in the tender documents)
- Contractual relations (talks and negotiations, inappropriate organizational structure of projects, and weak communication between departments)
- External factors (weather conditions, changes in regulations, problems with neighbors, unforeseen circumstances)

Another study has been conducted in Victoria, Australia about the costs of developmental projects of pipelines aimed at proper development of knowledge management based on logical protocols projects, planning, control, and preventive measures against delays in project completion. The methods used in this study included review of literature, targeted interviews with the managers of construction projects, and study based on extraction of knowledge from some the pipelines projects. This research contains the key findings on the fundamental causes of delays and approaches to the management of developmental projects (Yang & Kao, 2009).

In a study conducted by Hyunjoo *et al*. (2007) in the U.S., causes of delays in developmental projects were investigated. Construction projects involve many elements related to work, cost, materials, time, and other resources.

Shakeri *et al*. (2012) studied the conventional problems causing delay in the implementation of developmental projects and the main indicators for assessing the success of the projects completed at the specified or without unauthorized delay. They used a questionnaire for collecting the subjective judgments and evaluation of experts and professionals about the causes of delays in projects and their importance. As the conventional method for the implementation of projects in Iran is three-factor method, a population made up employers, consultants, and contractors was selected and the obtained results are as follows:

Factors causing delays by employers:

1- Payments, adjustments, and other costs: Since the funding of projects in developing countries is usually done by measures taken by the employer and due to some issues such as large number of projects, budget constraints, and administrative bureaucracy, there are many problems in payments to the contractors.
2- Involvements of the employer: This problem occurs when the projects are implemented by three-factor method.
3- Delay in decision-making
4- Pressures imposed by the employer for completion of the project in a shorter and unplanned time.
5- Administrative bureaucracy in the employer's organization
6- Type of contracts for assignment of projects: This is related to the strategic decisions of the project
7- Method of tendering and selection of contractors: This may result in the selection of incompetent and inexperienced contractors
8- Making changes in the scope of works

Factors causing delays by contractors:

1- Minor contractors
2- Incompetency and low experience of contractors
3- Weakness in management of workshop
4- The executive practices used: Non-application of a proper method can cause major problems and executive errors. On the other hand, an appropriate execution method can directly the implementation speed.
5- Poor planning

6- Implementation errors and mistakes
7- Financial power of the contractor

Factors causing delays by consultants:

1- Lack of complete awareness of the terms of contract
2- Delay in approving the plans
3- Quality control and monitoring the works
4- Waiting for confirmation of the results and research
5- Problems in planning and design
6- Incorrect estimation of errors: This would lead to problems such as delays, claims, and disputes.

Factors causing delays by materials:

1- Quality of materials
2- Shortage of materials
3- Delay in supply of materials
4- Changes in the type and feature of materials during construction

Factors causing delays by labor:

1- Supply of human resources
2- Efficiency of human resources
3- Expertise and skill of human resources

Factors causing delays by equipment and machinery:

1- Lack of access to machines and problems in providing spare parts: Economic sanctions have greatly affected this item.
2- Efficiency of existing machines

Factors causing delays by contractual relations:

1- Negotiations and major disputes
2- Poor relations between the groups involved in the project
3- Errors and ambiguities in the contract

Factors causing delays by external factors:

1- Inflation and rising prices
2- Changes in regulations or standards
3- Problems with neighbors and local residents
4- Political issues
5- Economic, social, and cultural status of the region

Finally, after collecting the questionnaires, the factors causing delay in projects from the perspective of employers, contractors, and consultants were ranked and then an overall ranking of the causes of delays was provided. The results showed that most important cause of delays in developmental projects is lack of proper financing of the projects.

Fallahnejad (2013) studied the causes of delay in Iran gas pipeline project. According to Iran's strategic development plan, Iran should have the capacity of transmitting over 1300 million cubic meters of gas per day. In order to achieve this goal, the length of gas pipeline should be doubled after 15 years. However, this experience has shown that there are significant delays in the pipeline projects. This study aimed to identify and rank the causes of delays in such projects in Iran. In this study, 24 gas pipeline projects were reviewed and then the causes of delay determined by 10 experts in different majors. A list of 43 items was obtained and then they were ranked. The results showed that 10 major causes of delay in gas pipeline projects in Iran include imported materials, unrealistic duration of project, issues related to the customer, confiscation of land, changes in orders, contractor selection procedures, payments to contractors, authorization, the suppliers, and the contractor Fund. In order to discover the common causes of delays in gas pipeline projects, 24 project carried out by NIGC from 2004 to 2011 were studied. Some documents of these projects such as contracts, correspondences, progress reports, meetings statements, and contractor's report on delays were reviewed. It was not possible to study more than 24 projects, because projects with such magnitude are usually conducted several times a year and also there are not sufficient documents and reports delays in the projected conducted before 2004. According to the review of previous studies and documents of projects, a relatively complete list of causes of delay was obtained. To make sure about the validity of this list, 10 limited interviews were conducted with project managers, internal procurement managers, international procurement managers, contract managers, financial managers, and legal experts. Based on the results of interviews, some modifications were made on the list and final list including 43 causes of delay was prepared. In order to rank these 43 causes of delay, the importance of each item should be determined. For this purpose, a questionnaire-based evaluation was conducted. A questionnaire was developed and sent to the executive experts and management team

members who were involved in gas pipeline projects. The questionnaire was developed in two parts; the first part contained 43 causes of delay and the second part was a space allocated for the respondents to express their opinion about the frequency of each of the items and their impact on the project (Fallahnejad, 2013).

2- Research methodology:

In today's world, most of issues that managers should decide about them have different dimensions and are developed by various criteria. In other words, most decisions of managers are influenced by different conflicting qualitative and quantitative factors and managers should try to choose the best possible option. Making mistakes and uncertainty in decision-making leads will cost the managers an arm and a leg. The more the power and authority of managers, the heavier the cost of their wrong decisions (Ghodsipour, 2002).

It is obvious that solving the issues of multi-criteria decision making is complicated and cannot be done easily. Especially, when most of the desired criteria are in contrast with each other, increasing the desirability of one can reduce that of another. Hence, some methods known as Multi-Criteria Decision making (MCDM) and Multiple Attribute Decision Making (MADM) have been developed which can be helpful in resolving the above-mentioned issues (Noori & Tabatabaeiyan, 2006). MADM offers various techniques for different stages of decision making. In these methods, several options compared with each other based on different criteria and then the best choice or an order to the best choices will be selected. Based on mathematical reasoning, MADM practices select the best choice of decision making among the existing ones and determine their priority (Hwang & Kwang, 1981). Nowadays, MADM practices are widely used in various fields, which is due high ability and capability of these practices in modeling the real issues and also their simplicity and understandability for most of users. Although the mathematical techniques and methods for planning and decision-making provide us with optimum results, they make sense under certain conditions and assumptions. This group of techniques require precise and evident basic information and data.

The technique used in the present study was optimization using the existing information. Any study should have a plan to go through in order to achieve the desired objectives. The research plan of the present study is shown in Figure1.

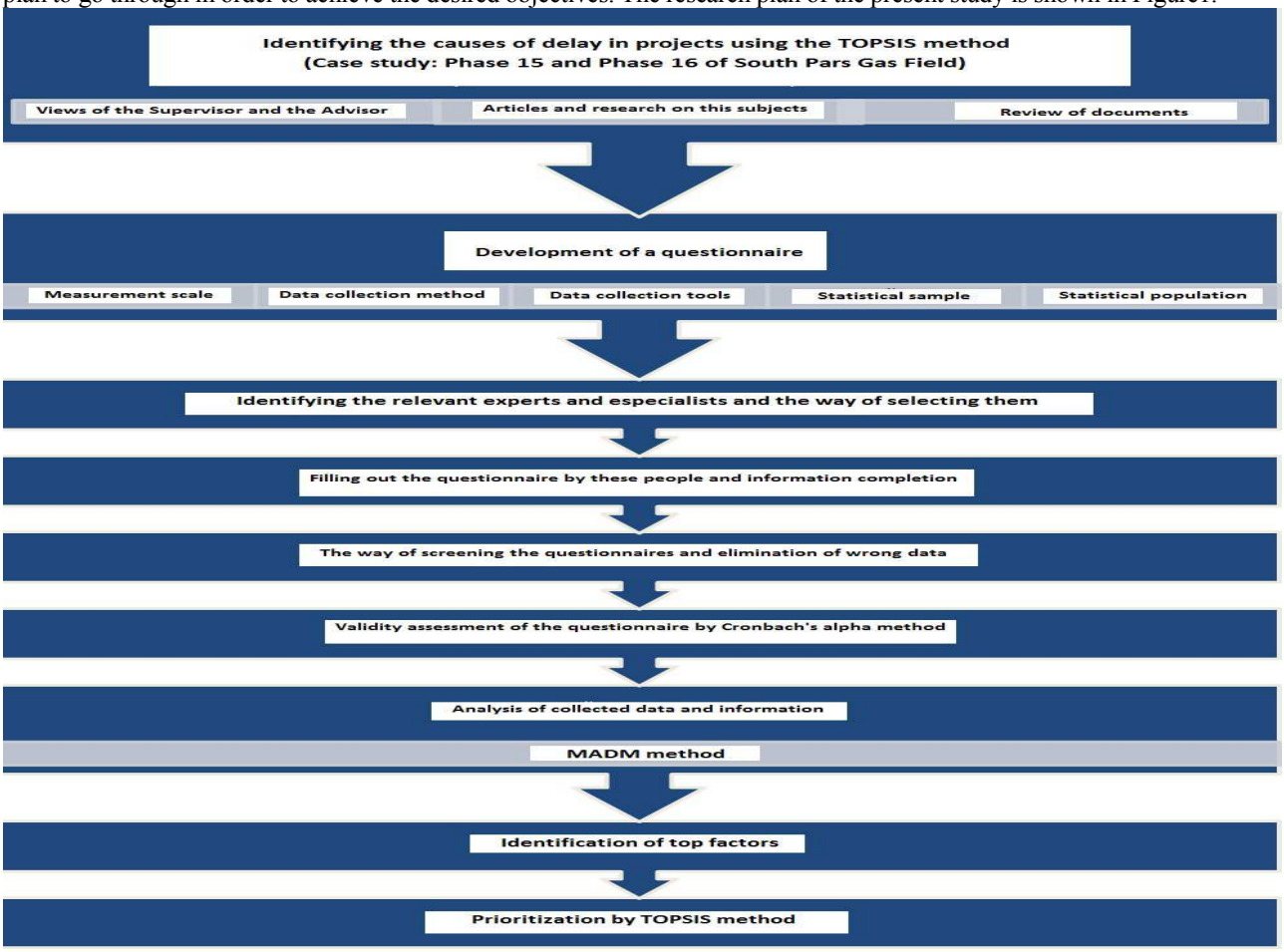

Figure 1: Research plan in an overall view

In the present study, the following tools were used for collecting the required data and information:

1- Reviewing the documents: For direct observation of behavior, the researcher should describe the features of behavioral unit or the observed unit. According to Figure 1-3, the researcher in this study used library resources, articles published on the Internet, and the existing documents on databases for collecting information for literature review.

2- Interview: This data collection tool provides the possibility of establishing direct contact with the respondent. In addition, in-depth evaluation of the perceptions, attitudes, interests, and aspirations of the subjects can be possible through interview. Interview is a tool that allows us to study the complex issues, follow up the answers and find the causes, and make sure that the subject has correctly understood the questions. In the present study, after the interview with the experts who were selected randomly, some questions were asked about criteria and comments about criteria.

3- Questionnaire: Questionnaire is one of the most common tools of research and a direct method for obtaining the required data. A questionnaire includes a series of questions (items) that the respondents answer them and these answers analyze the desired data of research. Knowledge, interests, attitudes, and beliefs of subjects can be evaluated through the items of a questionnaire. In addition, answers to the items of a questionnaire reveals the experiences of respondents and what they are doing at present. Once the relevant research documents and previous studied were reviewed, the final questionnaire was developed by considering the comments and views of academics and exploring the digital or library documents and articles. The criteria included in the final questionnaire are as follows:

- Ambiguity in contracts
- Economic instability
- Delay in delivery of equipment to the contractor by the employer
- Delay in the selection of contract type by the employer and consultant for assignment of projects
- Changes in the government and managements
- Changes in the design (increased scope of the project)
- Inflation and increased price of materials
- Involvements of the employer and changes he/she makes in the project scope
- Lack of a timetable for the implementation of activities by the contractor
- Lack of proper financing of projects and delay in payments
- Lack of time management in implementation of projects
- Lack of access to project financing resources because of sanctions and political problems
- Incompetency and low experience of contractors
- Poor management of the workshop and insufficient experience of contractors
- Shortage of skilled manpower
- Pressures imposed by the employer for completion of the project in a shorter and unplanned time
- Poor management of project by the contractor and lack of enough specialists in the contractor team
- Problems with neighbors and local residents
- The extent of impact on the selection of project executor (contractor and consultant)
- The extent of impact on the selection of contract type
- The role of factors affecting site selection for projects
- The role of factors affecting the design and construction of projects

4- Analysis of data and findings:

Determining the weight of criteria using the Shannon entropy:

First step: Conversion of the values of decision-making matrix xij into unscaled values of pij to be used in the Shannon entropy technique.

Xij, m, and n, respectively, denote the quantitative value of important criteria for decision-making choices, number of decision-making choices, and number of important criteria.

$$p_{ij} = xij \; / \sum xij \; ; \quad 0 \leq p_{ij} \leq 1 \; \& \; i = 1,2,...m \quad \& \quad j = 1,2,..., \quad n$$

Firstly, the columns of the matrix should be normalized (Equation 1) and then calculate Equation 2 for each column. The weight of each criteria can be obtained from Equation 3. Finally, weight vector should be normalized by Equation 4.

Table 1: The primary matrix extracted from polls

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1	5.34	5.66	5.47	4.57	3.77	4.25	5.77	4.65	5.68	5.69	5.84	5.68	5.20	5.40	4.66	3.35	5.19	3.14	4.38	4.28	3.40	4.41
2	5.03	5.51	5.28	4.40	3.77	3.32	5.62	4.70	5.65	5.47	5.75	5.61	5.52	5.69	4.76	3.42	5.35	2.27	4.27	4.16	3.45	4.01
3	4.39	4.98	4.67	4.01	3.66	3.24	5.27	4.39	5.17	5.20	5.34	4.58	4.64	4.96	4.31	3.39	4.99	2.80	4.50	4.33	3.54	4.37
4	4.31	5.05	4.78	3.84	3.63	3.23	5.25	4.47	5.02	5.01	5.21	4.47	5.16	5.19	4.56	3.20	5.05	2.47	3.88	3.73	2.99	3.81
5	4.98	5.64	5.55	4.00	3.73	3.95	5.96	4.67	5.55	5.63	5.42	5.32	5.21	5.51	5.21	3.66	5.81	2.43	4.22	4.35	3.48	4.81
6	4.77	5.57	5.45	3.95	3.71	4.09	5.73	4.61	5.69	5.39	5.61	5.51	5.49	5.99	5.35	3.69	5.79	2.44	4.81	4.49	3.61	4.97

Table 2: Calculation of Wij values

W_1	0.045703	W_{12}	0.045355
W_2	0.045471	W_{13}	0.045463
W_3	0.045447	W_{14}	0.045453
W_4	0.045517	W_{15}	0.045417
W_5	0.045517	W_{16}	0.045476
W_6	0.04527	W_{17}	0.045452
W_7	0.04548	W_{18}	0.04529
W_8	0.04551	W_{19}	0.045444
W_9	0.045477	W_{20}	0.04546
W_{10}	0.045486	W_{21}	0.045455
W_{11}	0.04549	W_{22}	0.045364

$$W_j = dj / \sum dj$$

Steps of TOPSIS method calculations:

After calculation of weights by Shannon's entropy, the choices should be ranked by TOPSIS method. To this end, the following steps should be done:

- Calculation of the Euclidean distance of each choice with its positive ideal choice (A*) and the worst choice (A^-).

$$S_i^* = \sqrt{\sum_{j=1}^{n} (V_{ij} - V_j^*)^2} \; ; \mathrm{i} = 1,2,...,\mathrm{m}$$

$$\mathrm{S_i^-} = \sqrt{\sum_{j=1}^{n} (V_{ij} - V_j^-)^2} \; ; \; \mathrm{i} = 1,2,...,\mathrm{m}$$

Table 3: Calculation of V_j

Ideal distance	Positive	Negative	Ideal distance	Positive	Negative
V_1	0.0205	0.0166	V_{12}	0.0201	0.0158
V_2	0.0194	0.0171	V_{13}	0.0197	0.0165
V_3	0.0198	0.0166	V_{14}	0.0203	0.0168
V_4	0.0205	0.0172	V_{15}	0.0206	0.0166
V_5	0.0189	0.0182	V_{16}	0.0198	0.0172
V_6	0.0212	0.0161	V_{17}	0.0179	0.0179
V_7	0.0198	0.0174	V_{18}	0.0222	0.0160
V_8	0.0191	0.0178	V_{19}	0.0205	0.0166
V_9	0.0193	0.0171	V_{20}	0.0197	0.0164
V_{10}	0.0196	0.0172	V_{21}	0.0196	0.0162
V_{11}	0.0196	0.0175	V_{22}	0.0208	0.0160

- Calculation of the relative proximity of i-th choice (A_i) to the ideal choice.

$$C_i^* = \frac{S_i^-}{S_i^* + S_i^-}; \quad 0 < \mathrm{C_i^*} < 1 \;\&\; \mathrm{i} = 1,2,...,\mathrm{m}$$

The closer the A_i to the ideal positive choice (A*), the more close the value of C_i^* to 1.

Table 4: Relative proximity of each choice to its ideal choice

CL_1	CL_2	CL_3	CL_4	CL_5	CL_6
0.865	0.468	0.237	0.966	0.701	0.801

- Prioritization of choices in a descending order of C_i^*

Table 5: Prioritization of choices in a descending order

Project	Score
U.G	0.966
Industrial building	0.865
General civil	0.801
Aslk Catcher	0.701
Process	0.468
Non-industrial building	0.237

5- Conclusion and recommendations:

As mentioned before, the present study aimed to identify the causes of delay in projects of Phase 15 and Phase 16 of South Pars Gas field and ranking them by TOPSIS model. The followings are recommendations for each of the groups involved in these projects:

Recommendations to the employers:

1- Selection of an optimal system for implementation of developmental projects.
2- Organizations should be obliged to observe the laws related to encouraging the consultants and contractors in order to expedite the executive processes and faster completion of projects.
3- Administrative agencies should avoid signing contracts prior to the allocation of total project credit.
4- The employer had better to assign the consultants to completely and carefully do the technical studies and projects design.
5- Estimation of the real and feasible time for doing the works according to the requirements and specifications of the project, local and temporal conditions, and financial resources and also scheduling and determining the duration of contract based on time and way of funding.
6- It is recommended that the authorities recognize and consider the importance and conditions of projects in allocation of funds based on realities and without any expediency.
7- Non-technical and political issues should not be gotten involved in allocation of funds to projects.
8- Timely declaration of the real adjustment indices.
9- About actualizing the adjustment indices, it is recommended that the guild of constructors to be appropriately and reasonably be involved in calculation of adjustment indices.

Recommendations to consulting engineers:

1- Considering the problems before construction
2- Appropriate and optimum design
3- The use of new technologies and ideas to reduce cost and time and increase quality

Recommendations to contractors:

1- The use of project management knowledge to reduce cost and time and increase quality
2- The use of value engineering knowledge
3- Application of management and documentation in developmental projects

Strategies for coping with economic shocks to construction projects due to sanctions:
Strategies to mitigate the effects of sanctions on developmental projects:

Economic sanctions have always been an integral part of America's policies since World War II and it has been getting more intense since the end of the Cold War. The following items are recommended to be taken into account for coping with economic sanctions and pressures:

1- All possible scenarios should be predicted in evaluating the sanctions
2- The government should adopt controlling policies to prevent hoarding the goods
3- In order to provide appropriate contexts for coping with sanctions, the government should take pressure off producers by controlling the inflation rate
4- Investment in sectors that bring advantages to Iran such as the use of motivated forced, promotion of national morale, the use of devices and weapons produced inside Iran
5- Regionalism is a highly recommended scenario for dealing with sanctions

After calculating the weight of criteria by Shannon entropy and prioritization of options based on calculated weights, the results were presented in the following table.

Number	Criteria	Result
1	Ambiguity in contracts	0.045703
2	Changes in the government and managements	0.045517
3	Delay in the selection of contract type by the employer and consultant for assignment of projects	0.045517
4	Involvements of the employer and changes he/she makes in the project scope	0.04551
5	Lack of time management in implementation of projects	0.04549

Number	Criteria	Result
6	Lack of proper financing of projects and delay in payments	0.045486
7	Inflation and increased price of materials	0.04548
8	Lack of a timetable for the implementation of activities by the contractor	0.045477
9	Pressures imposed by the employer for completion of the project in a shorter and unplanned time	0.045476
10	Economic instability	0.045471
11	Incompetency and low experience of contractors	0.045463
12	The extent of impact on the selection of contract type	0.04546
13	The role of factors affecting site selection for projects	0.045455
14	Poor management of the workshop and insufficient experience of contractors	0.045453
15	Poor management of project by the contractor and lack of enough specialists in the contractor team	0.045452
16	Delay in delivery of equipment to the contractor by the employer	0.045447
17	The extent of impact on the selection of project executor	0.045444
18	Shortage of skilled manpower	0.045417
19	The role of factors affecting the design and construction of projects	0.04546
20	Lack of access to project financing resources because of sanctions and political problems	0.045355
21	Problems with neighbors and local residents	0.04529
22	Changes in the design (increased scope of the project)	0.04527

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