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Research Article

STRATEGY MANAGEMENT FOR SELECTION OF THE BEST METHOD FOR IMPLEMENTATION OF CONSTRUCTION PROJECTS (CASE STUDY: PROJECTS IN OIL COMPANY)

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ABSTRACT
Studies indicate that selection of the most suitable project delivery system can reduce the project costs to 12% and reduce the project end time to 30%. Diversity in project delivery methods in recent decades has revealed the gap in a suitable strategy to have an optimal selection among a variety of project delivery methods as one of the most strategic stages in construction management process. For this, scholars and experts specialized in contractual issues have proposed a variety of methods. As use of some of modern project delivery methods has been conventionalized, the present research has considered in-depth overview of researchers' works, that the results of research are proposed in a way that there is the possibility to use them in Iran. In summary, findings of the present research indicate that efforts for project delivery methods have been started with an emphasis on qualitative methods for selection of system at the late of the 1960s and resulted in quantitative methods in form of decision making tools in a multi-criteria space in recent years. In this regards, firstly a concise overview of a variety of project delivery systems, definitions for them, and major advantages and disadvantages of them will be proposed. Then, the existing views on the strategy for selection of the best project delivery method and the methods for this selection have been introduced, and ultimately two models have been proposed for this selection. The systems that must be compared for project delivery in Iran and the strategies for selection of an optimal system were determined via Delphi method, and ultimately a SAW model and AHP model were used for selection of such system. Efficiency of this method is represented through resolving a real problem. This is in a way that firstly the extent to which these strategies are important and priority of items for project delivery are specified by weighing the strategies and the degree of their proportion to each system for selection via SAW method and paired comparisons between strategies as well as paired comparisons between different project delivery systems regarding any strategy in AHP method.

Keywords: *The Project Delivery* Strategies; *Method SAW, Decision Making via AHP*

INTRODUCTION
Problem Statement
By increasing time and costs of civil projects in our country in a way that are overpaid or resulted in contract amendment as well as diversity of such projects in size, complexity, mechanism for finance and their distinctive characteristics, the necessity for a fundamental revision in management and implementation of the aforementioned projects is felt. This necessity derives from this fact that a substantial contribution of project problems such as increasing time and cost for not sustaining integration of project and weakness in state quarterback system in management of contractors and consultants has rooted in lack of linkage in design and construction processes, concentration of risk in quarterback system with low risk taking and reliance on state financial resources, that such problems can be resolved by invoking to one of strategic aspects in project management process, that is, the strategy for selection of an optimal method.
The aims that are pursued in this research include:
1-introduction of a variety of delivery methods and their sub-sets and overview of their advantages and disadvantages
2-detection of effective strategies in selection of the most suitable project delivery method

3-familiarity with the methods for selection of optimal project delivery method
4-suggestion of model for selection of system for doing civil projects based on the detected strategies

Research Questions

-what are advantages, disadvantages and characteristics of each of project delivery methods?
-what criteria and limitations affect selection of a project delivery method?
-what are the proposed models for selection of an optimal project delivery method and what characteristics these models have?
-what strategies are suitable for selection of an optimal project delivery method?

MATERIALS AND METHODS

Research Method

The present research has been conducted based on characteristics of qualitative research and the proposed model among the models under study, for which three data collection sources below have been used.
-library studies
- Unstructured interview
-asking experts' views through the questionnaire via Delphi method

Stages of Research

After library studies and detection of delivery systems and their advantages and disadvantages as well as the criteria for selection and the methods which have been used to date for selection of the most suitable project delivery system, experts' views were used to review the selection items and criteria and adapt them with the existing conditions in market. A simple model and a hierarchical analysis model were used for selection of delivery system. Ultimately, application of method via an example has been indicated. Optimal project delivery system is selected using simple additive weighting (SAE) and analytical hierarchy process (AHP) via software expert choice for a real project. These two methods are explained as follow.

Then, the results are compared. Further, the results are analyzed via analytical hierarchy process (AHP) so as to specify which delivery system will meet the employer's needs in a better way while just a group of strategies are important at an organization. To determine selection criteria, depth method by representation of a series of the criteria obtained from the previous research has been used. Oil companies' projects have been considered as the case study, that the employer must consider selection of optimal system strategy to execute such projects. The employer organization seeks proliferation in starting project and ending it with predicted cost. Further, this organization seeks to maximize quality of project like that of in international standards. Employer organization works out poor in sake of project management, in which experts do not involve. The employer has not had any financial problem in this project, seeking for transfer of risk in contract to the contractor, and seeking for introduction of minimum claims. The project does not enjoy a high complexity, thus the capability to define it has been high at the early stages for which it can meet the implementation costs in an acceptable limit.

Utilization of Methods SAW and AHP to Select Optimal Project Delivery System

Three fundamental issues below must be examined to prepare a framework for the system selection model:
-examination of accepted project delivery systems under the framework of the proposed model
-examination and detection of the criteria for selection of project delivery systems
-selection of the followed logic for selection of project delivery system

The accepted project delivery systems under framework of proposed model

A variety of systems to execute civil projects considering research limitation, that is, financing undertaken by the employer, include the factors below:

a- ln-House System

ln-house system can be useful for small projects in case the employer has special facilities and equipment, and also there is no barrier to execute the project via this method. Hence, this system is not used for medium and large projects. In Iran, this system due to its legal restrictions and proposed weaknesses is not used. Therefore,

with regard to lack of use of this method for execution of civil projects, this system is not embedded in the proposed model.

b- Design-Bid-Build System

In Iran, Design-Bid-Build system has been mentioned as the first system for execution of civil projects during long years, that to date most of governmental projects have been executed via this system, considered as the most important and most used system; further, this system has been mentioned as the most important systems for execution of civil projects in most of developed countries. Therefore, this system has been embedded in the proposed model.

c- Design-Build System

With regard to increasing demand throughout the world and advantages to use design-build system, there are numerous general approaches to use this system regarding formulation and notification of its criteria. The fundamental decision making in selection of project delivery system is centered at selection of a three-factor system and/or design-build system. Hence, it can say that the proposed model has mainly focused on evaluation of selection of this system, thus this system has been embedded in the model.

d- Construction Management System

This system is classified to two simple (agency) and risky (at risk) states. The simple (agency) state is not recognized as a separate system, but is a method for project management. This implies that the employer can consider chief executive officer as the consulter and consider assignment of some of employer's duties in both three-factor system and design-build system. Hence, it cannot propose construction management system as a separate system besides three-factor systems and build-design systems. Yet, type of this system with the risk in it under which the construction management company has worked out as a general contractor after design and undertaken the responsibility to execute the project can be considered as a separate system. However, construction management system (agency) is not considered as a separate system, it can examine one of the items in the proposed model as this factor has been recognized as the fourth factor on design-bid-build system.

e- Design Build Finance Operate Maintain *(DBFOM)*

This method is more likely used to hold great infrastructural projects, during which the contractor undertakes the responsibility for financing and executing the project, and engages in exploitation from the project to a certain time that has been determined based on a financial contract for repaying the costs and contractor's fee and profit. Hence, use of this method relies on political and economic factors in the countries. As a result, it cannot consider this method as one of the items in the proposed model.

Overview and Detection of the Criteria for Selection of Project Delivery Systems

There are numerous quantitative and qualitative criteria and factor which contribute in decision making and selection of a suitable project delivery system that their detection and determination play a major role in precise selection of system. 29 criteria were specified by analysis of most of criteria, that those criteria with more adjustment with technical and executive conditions were determined in three major indicators and 21 secondary indicators as shown in table below for representation in field study and pooling about effectiveness of criteria for selection as well as modification of countries' conditions.

Field Study

As the present research seeks to resolve the problem via method SAW and resolve the problem with the same input information used in method SAW via method AHP , thus the information such as criteria for selection and proportion of each system with the introduced criteria must be calculated to enter data into decision making matrix. Hence, a questionnaire corresponding to that one shown in appendix was provided and distributed among specialized experts for data collection. The field study aims to collect data for the purposes as follows:

1-detection of the criteria for selection of project delivery system in National Iranian Oil Company

2-determine proportion of each system with selection criteria

It should be noted that the questionnaires have been distributed among the employers, contractors and consulters and those one qualified with the characteristics below so as to validate the proposed models in this research:

1-at least bachelor degree at one of fields of studies pertaining to the civil projects
2-at least 10 years experience at construction and management in civil projects
3-sufficient familiarity with modern project delivery systems

RESULTS AND DISCUSSION

Findings of Field Study

Detection of Selection Criteria

Detection of selection criteria has been one of the aims of field study. After representing 21 selected criteria from previous research that have been shown in table for the respondents at Arvandan Oil and Gas projects, 13 criteria were selected. Determination of weight of each criterion in project to resolve problem via method SAW

These weights are estimated by employer project management group for any special project after necessary examination and collection of experts' views via Delphi method. After calculating weights of criteria in the project, they should have been de-scaled as there are different measurement units for criteria. In table below, the criteria selected by experts together with their weights have been represented.

The criteria for selection of optimal project delivery system ↓	**Rank of priority**	**The score for weight of criteria in the project**	**De-scaled score**
Trust on certainty with the final project cost	1	100	0/122
Timely end of project	2	90	0/110
Reducing project completion time	3	80	0/097
Accelerate the start of the project	4	80	0/097
Project management capability and knowledge required by the employer Needing to capability and knowledge of project management by employer	5	70	0/085
Needing to flexibility at construction period	6	70	0/085
Implementation of project with high quality	7	60	0/073
Transfer of maximum risk to the contractor	8	60	0/073
Least involvement by employer	9	50	0/061
The project can defined thoroughly	10	50	0/061
It is the first time that the project is implemented	11	40	0/049
Complexity and level of technology used in the project is under standard level	12	40	0/049
There are qualified contractors to implement project	13	30	0/037
		820	

The criteria for selection of optimal delivery project system in Oil Company together with ranking their criteria and de-scaled weights

Determination of the Weights at Any System Proportion to the Criterion for Resolving Problem via Method SAW

Determination of the weights at any system proportion to a criterion has been targeted in distribution of questionnaire. As mentioned above, score of any system in implementation of project with criterion in addition to having the criteria must be specified to select a suitable project delivery system. Hence, it has

been asked in pooling forms to determine the score for proportion of each project delivery system ranging from 1 to 7, that is, 7 represents maximum proportion and 1 represents minimum proportion. In table below, the selection criteria together with the mean for proportion of each system with selection criterion has been represented.

The Proposed SAW Model to Select Project Delivery System

Depiction of decision making matrix is one of the requirements in SAW model. For this, decision making matrix is depicted and used corresponding to table. After filling the required information in matrix in the table, the matrix for selection of project delivery system in Oil Company is represented in table below:

Table 1: Final matrix for selection of an optimal delivery system at Arvandan Oil and Gas projects via SAW method

A variety of project delivery systems ←		**Design-Bid-Build system D.B.B**	**design-build system D.B**	**Construction Management system C.M**
The criteria for selection of optimal project delivery system ↓	weight of criterion in project	Degree of proportion of each system with the selection criterion corresponding to table		
Certainty in timely project completion	0/110	4	6	5
Reducing project completion time	0/097	3	5	2
Definite project costs	0/122	4	6	5
Implementation of project with high quality	0/073	5	4	6
Proliferation in starting project implementation	0/097	3	6	4
Needing to flexibility at construction period	0/085	6	2	5
Needing to capability and knowledge of project management by employer	0/085	5	6	5
Transfer of maximum risk to the contractor	0/073	4	6	4
Minimization of claims	0/061	2	5	4
A duplicate of the project :	-	5	6	5
-the project should have been designed and implemented several times	0/049	5	5	5
-it is the first time that the project is implemented				
Complexity of project and required technology level for construction:	0/049	5	5	5
-low	-	4	5	5
-high				
Definition for the project	0/061	5	6	5
-project must be defined thoroughly	-	5	4	5
-project must not be defined thoroughly				
The qualified contractor who is familiar with new project delivery systems:	0/037	5	6	5
-accessible	-	5	4	5
-inaccessible				
Total score at any system		4/26	5/41	4/79

Abbreviations as shown in table below for primary and secondary indicators have been used to enter the information of paired comparisons in software Expert Choice.
It is observed that construction management system was determined as the most suitable project delivery system via SWA method, and then design-build system was determined with the second rank, and ultimately the least priority was given to design-bid-build system.

Table 2: Abbreviations of indicators for use in software Expert Choice

Row	Indicator	Abbreviations
1	Aims and characteristics of employer organization	A1
1-1	Certainty in timely project completion	A1-1
2-1	Reducing project completion time	A1-2
3-1	Definite project costs	A1-3
4-1	Implementation of project with high quality	A1-4
5-1	Proliferation in starting project implementation	A1-5
6-1	Needing to flexibility at construction period	A1-6
7-1	Needing to capability and knowledge of project management by employer	A1-7
8-1	Transfer of maximum risk to the contractor	A1-8
9-1	Minimization of claims	A1-9
2	Characteristics of project	A2
1-2	A duplicate of the project	A2-1
2-2	Complexity of project and required technology level for construction	A2-2
3-2	Definition of project	A2-3
3	Requirements and limitations of construction industry in country	A3
1-3	The qualified contractor who is familiar with new project delivery systems	A3-1

After doing paired comparisons and reviewing their maladjustment, the priority of major indicators for selection of optimal project delivery system was obtained, shown in figure 4-1.

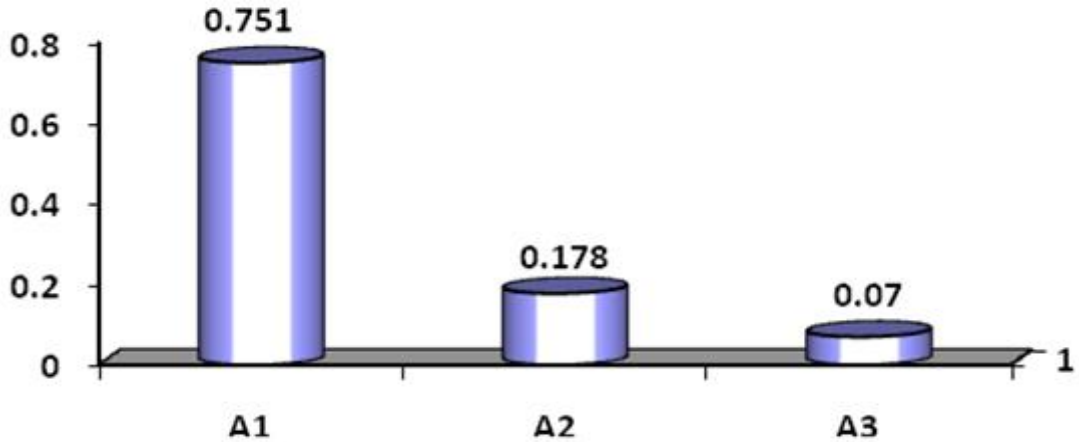

Figure 1: The priority of major indicators for selection of optimal project delivery system

Priority of secondary indicators has been obtained at any major indicator corresponding to the diagrams:

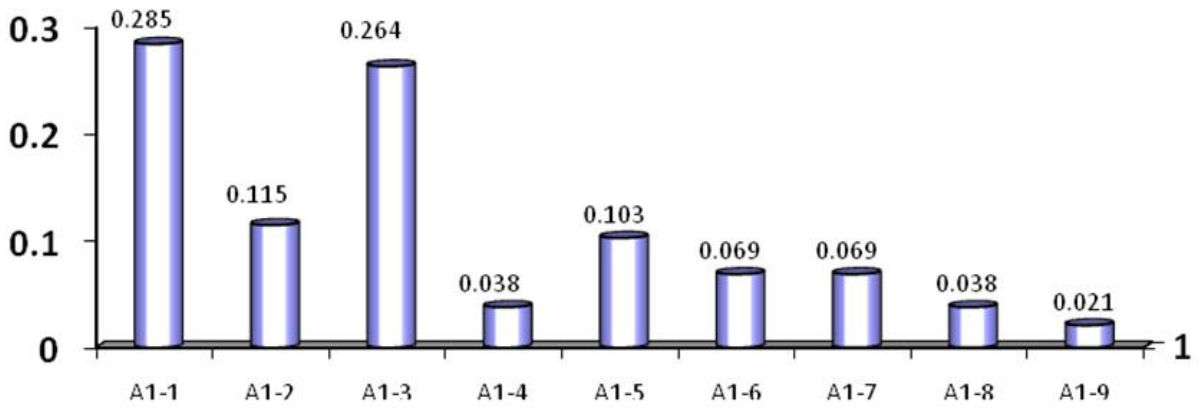

Figure 2: The priority of secondary indicators for selection of optimal project delivery system concerning major indicator of "aims and characteristics of employer organization"

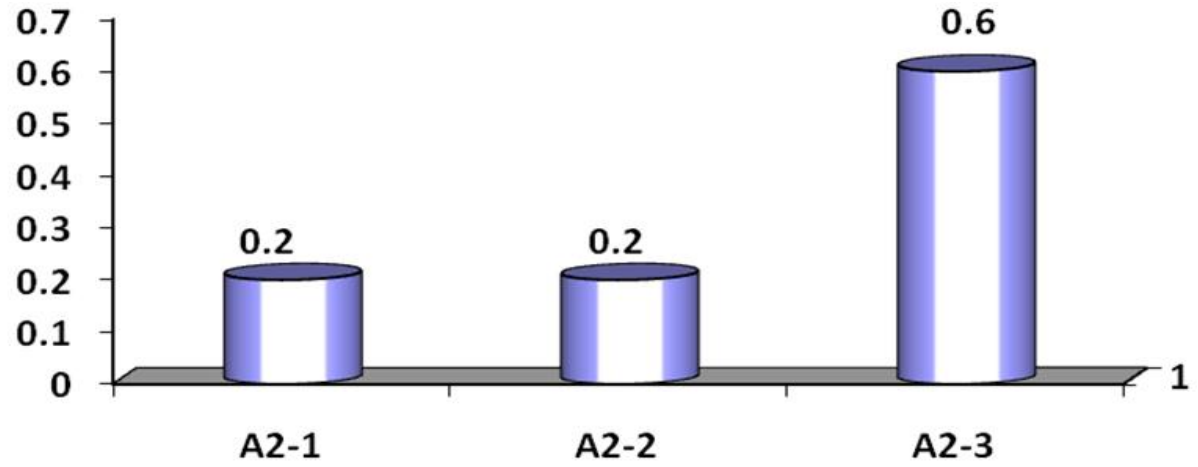

Figure 3: The priority of secondary indicators for selection of optimal project delivery system concerning major indicator of "characteristics of project"

After indicating the priority of indicators, it will be the turn for indicating the priority of items (delivery systems) at any major and secondary indicator. These priorities have been displayed in diagrams.

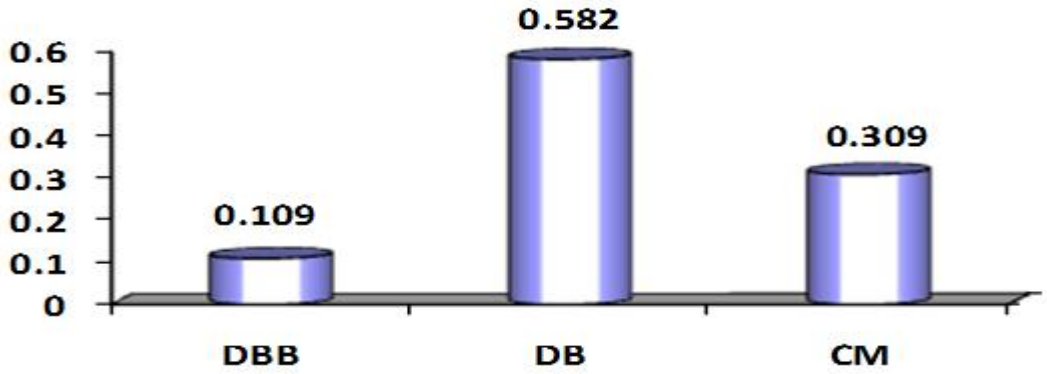

Figure 4: The priority of secondary indicators for selection of optimal project delivery system concerning major indicator of "Certainty in timely project completion"

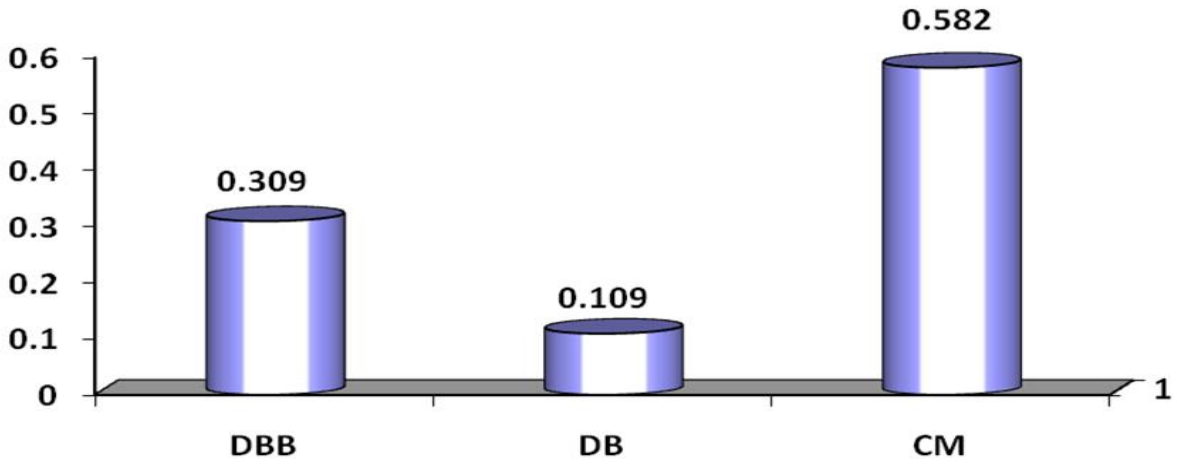

Figure 5: The priority of secondary indicators for selection of optimal project delivery system concerning major indicator of "Reducing project completion time"

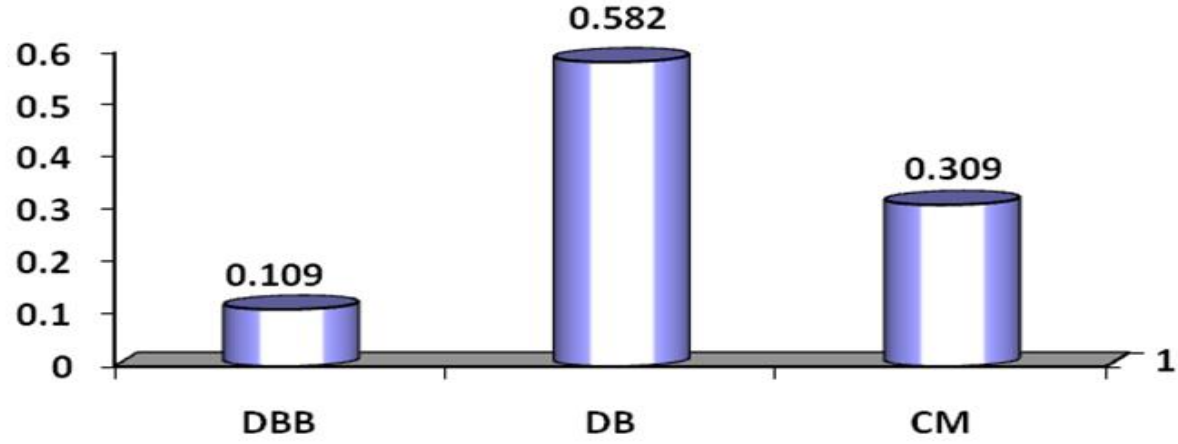

Figure 6: The priority of secondary indicators for selection of optimal project delivery system concerning major indicator of "definite project costs"

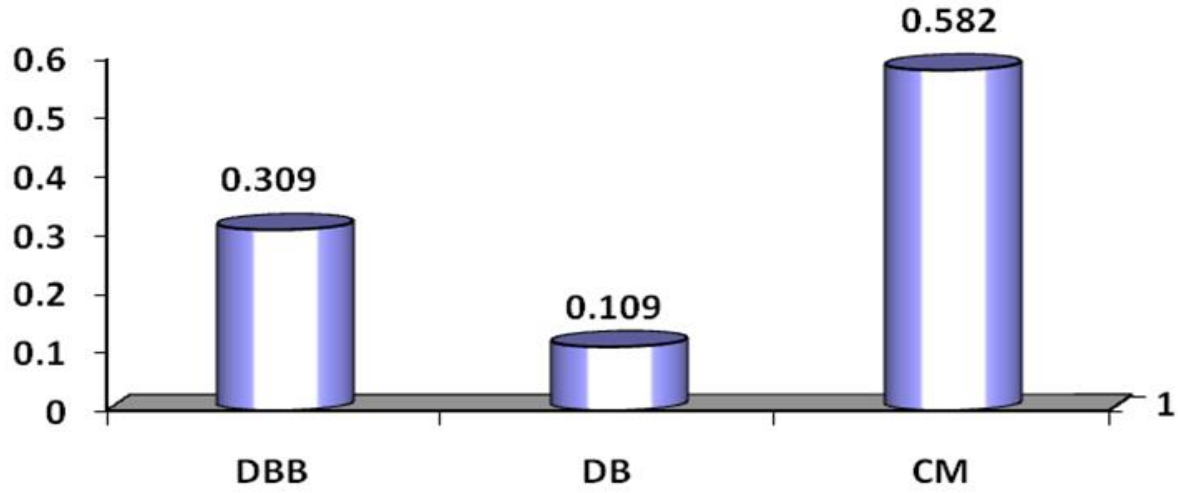

Figure 7: The priority of optimal project delivery system concerning secondary indicator of "Implementation of project with high quality"

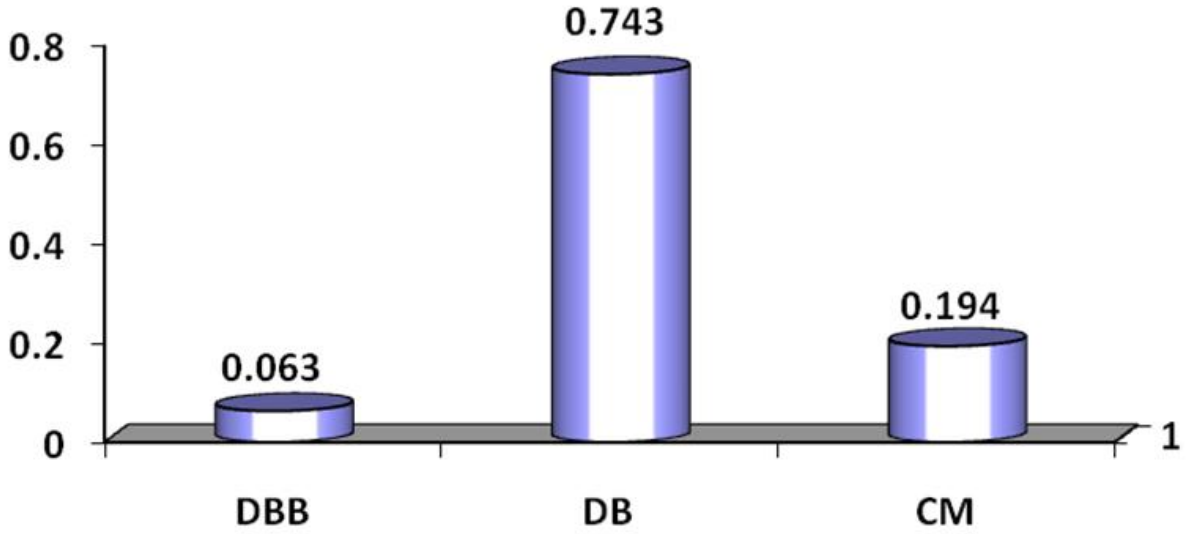

Figure 8: The priority of optimal project delivery system concerning secondary indicator of "Proliferation in starting project implementation"

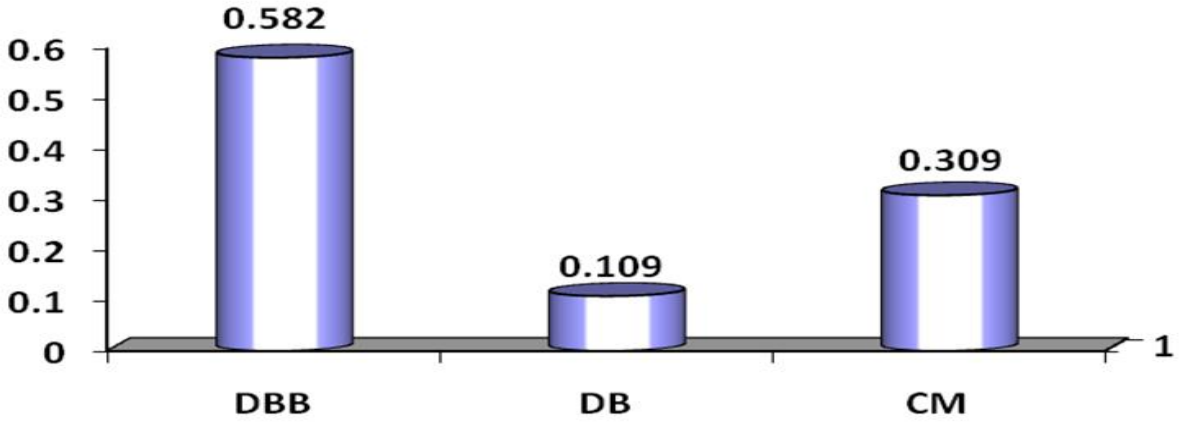

Figure 9: The priority of optimal project delivery system concerning secondary indicator of "needing to flexibility at construction period"

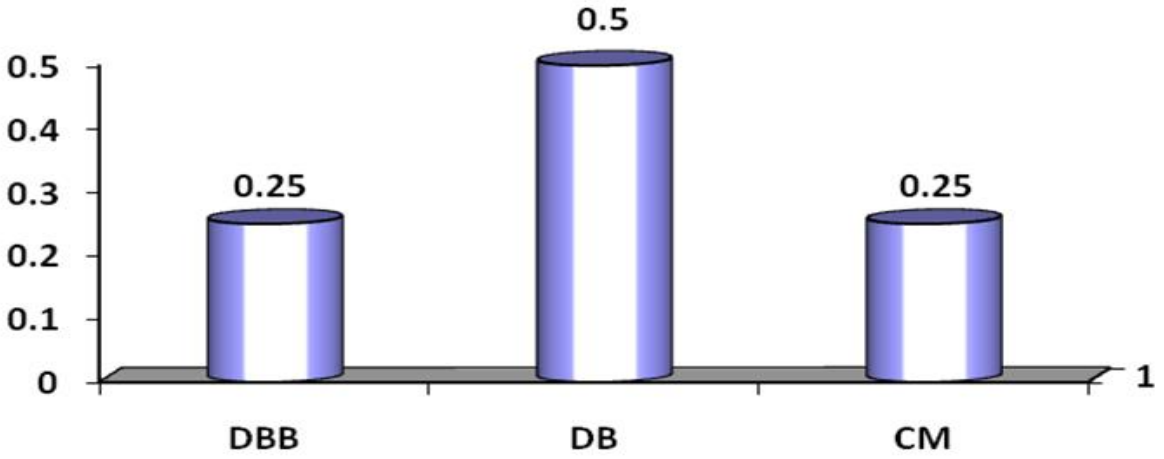

Figure 10: The priority of optimal project delivery system concerning secondary indicator of "needing to capability and knowledge of project management by employer"

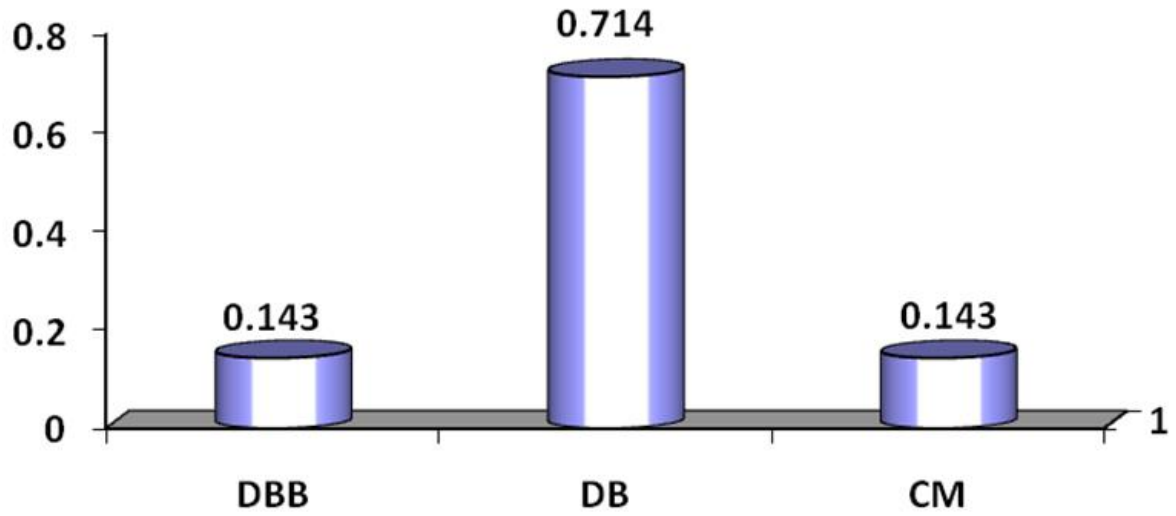

Figure 11: The priority of optimal project delivery system concerning secondary indicator of "Transfer of maximum risk to the contractor"

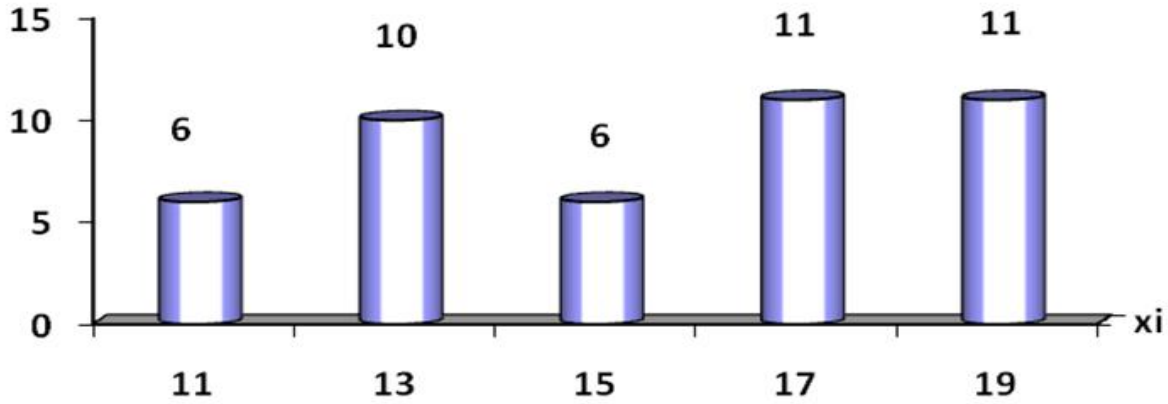

Figure 12: The priority of optimal project delivery system concerning secondary indicator of "Minimization of claims"

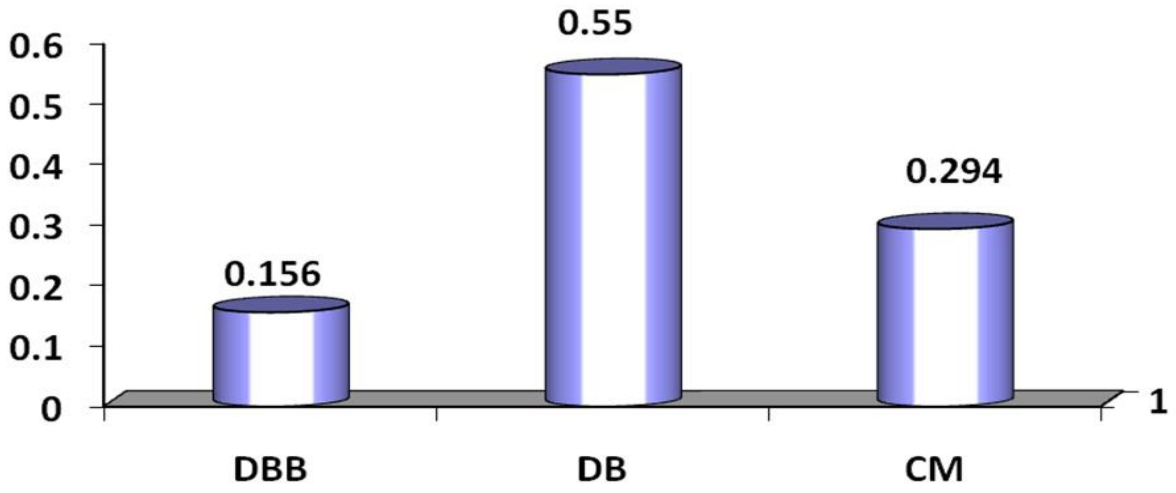

Figure 13: The priority of optimal project delivery system concerning major indicator of "Aims and characteristics of employer organization"

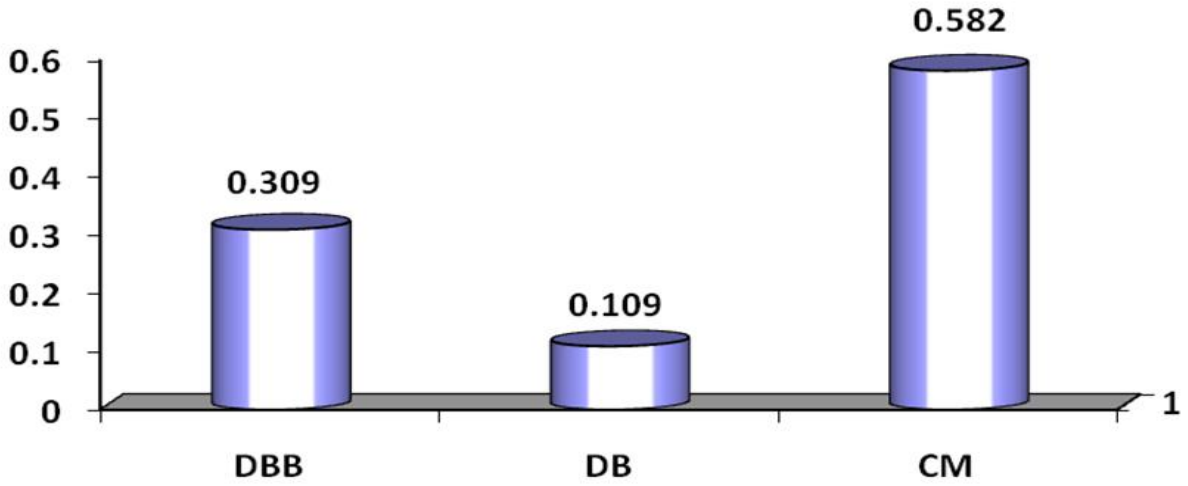

Figure 14: The priority of optimal project delivery system concerning secondary indicator of "duplicate of the project"

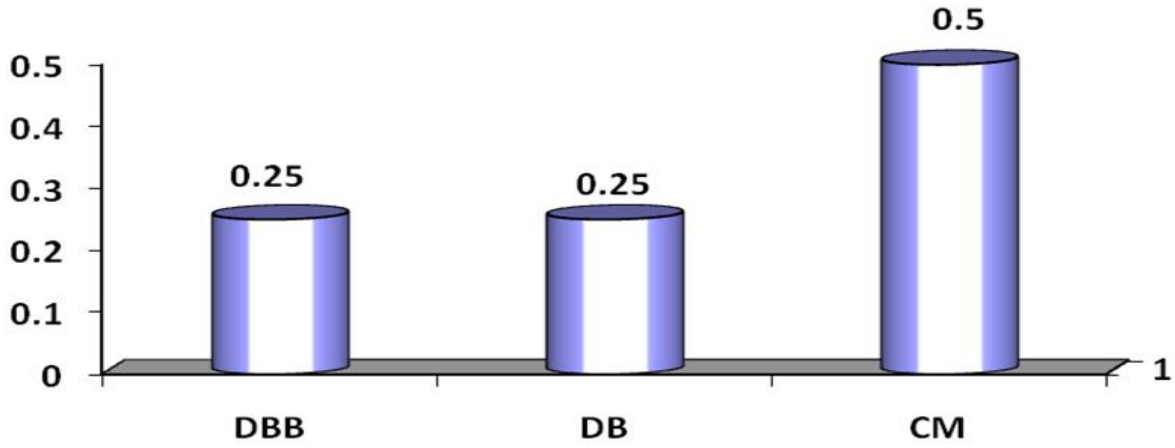

Figure 15: The priority of optimal project delivery system concerning secondary indicator of "Complexity of project and required technology level for construction"

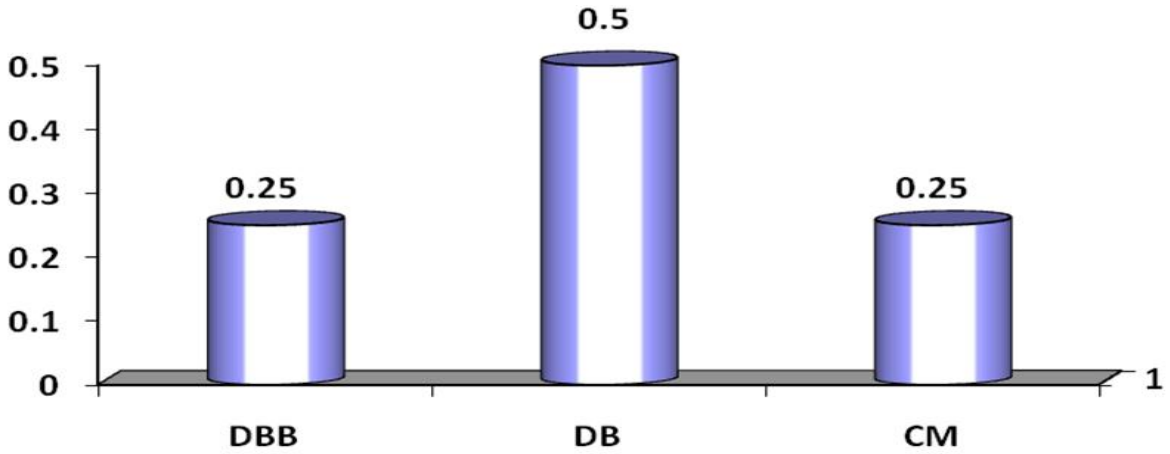

Figure 16: The priority of optimal project delivery system concerning secondary indicator of "definition of project"

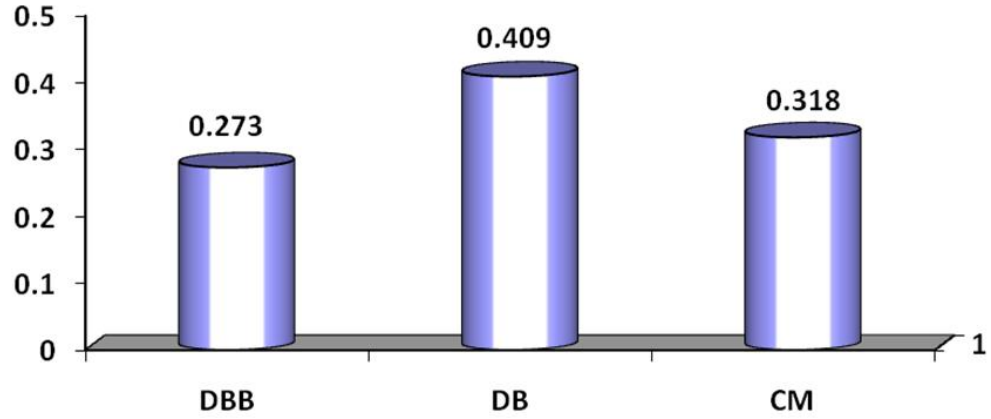

Figure 17: The priority of optimal project delivery system concerning secondary indicator of "characteristics of project"

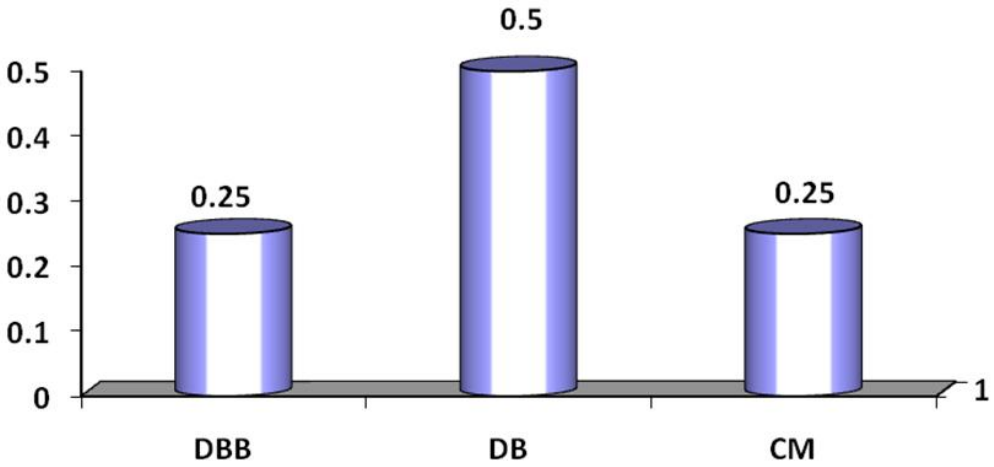

Figure 18: The priority of optimal project delivery system concerning major indicator of "Requirements and limitations of construction industry in country" and secondary indicator of "The qualified contractor who is familiar with new project delivery systems"

To sum up, by asking the experts' views and doing paired comparisons by the decision maker group, ultimate prioritization of systems to implement oil company projects was represented as follow in figure below.

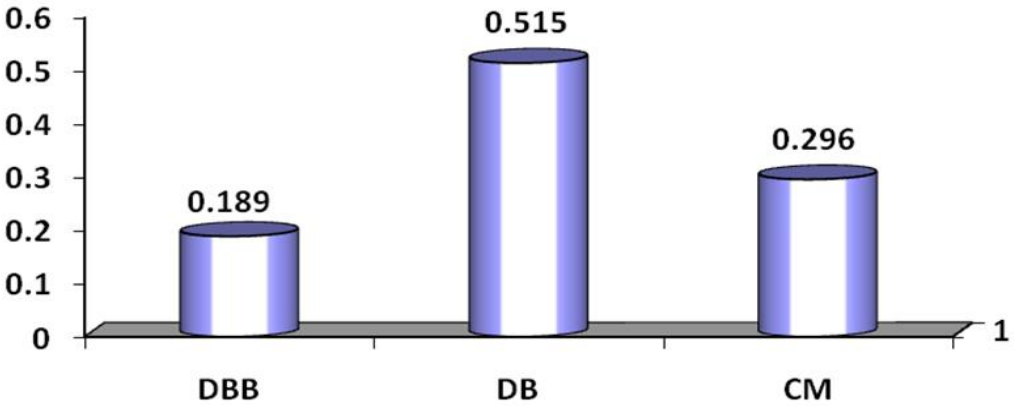

Figure 19: The priority of project delivery system at oil companies

It can observe that Design-Build system has been recognized as the most suitable delivery system via AHP method based on SAW method, then the second rank has been given to Construction Management system, and ultimately the last rank has been given to Design-Bid-Build system.

Sensitivity Analysis

To date, delivery systems and indicators have been weighed and prioritized based on paired comparisons among experts. Yet, environmental conditions have been mentioned as the effective parameters in experts' views and decisions, through which the experts' views and decisions might be different under different environmental conditions, changing the priority of indicators and final priority of systems for performing the project.

For this, sensitivity analysis was used to have comprehensive research. Sensitivity analysis in sake of aim indicates sensitivity of items regarding all the criteria. Yet, it can measure sensitivity analysis to a special indicator. To analyze sensitivity, importance of indicators must be changed and the change must be observed in importance of items.

Therefore, the importance of indicators must be changed and the changes in priority of items must be observed at any stage of change. As priority of indicators in concerning selection of optimal project delivery system via sensitivity analysis cannot be predicted in future, it is better to reach importance of each indicator to the highest limit at a stage, that is, it must transform this factor to the only decision making factor for selection of the optimal delivery method and it must specify the order of items. Since a hierarchy in four levels has been defined in the present project and importance of the first and second major indicators including aims and characteristics of organization and characteristics of project is so high, sensitivity analysis on their indicators seems essential.

Therefore, the analysis is made on three major indicators at the first stage and on 9 secondary indicators as the sub-set of aims and characteristics of employer organization and on 3 secondary indicators as the sub-set of characteristics of project via tools of sensitivity analysis including software Expert Choice. Results of these analyses have been represented in tables below. In figure below, a sample of the diagrams for sensitivity analysis representing output of software before and after applying the changes has been represented.

With regard to table below, it can deduce that the only effective indicator in decision making includes: the requirements and restrictions in construction industry in country that is corresponding to the secondary indicator of qualified contractor who is familiar with new project delivery systems. However, design-build system is the most suitable system to implement the projects; design-bid-build system finds a value corresponding to the value of design-build method. This problem can be due to involvement by numerous contractors who are familiar to design-bid-build system.

Table 3: Relative weight of project delivery systems considering each of major indicators

Major indicator affecting decision making	Changing the importance of indicators	Percent of relative weight of each delivery system considering just one of indicators		
		CM	DB	DBB
A1	Increasing this indicator to 100% and the rest to 0%	29/1	55/8	15/1
A2	Increasing this indicator to 100% and the rest to 0%	31/7	41/7	26/7
A3	Increasing this indicator to 100% and the rest to 0%	25	50	25

With regard to table above, it can perceive that desirability of design-build system decreases to implement the project by removing the major indicator of aims and characteristics of employer organization under which design-bid-build system will be the most suitable system.

Table 4: Relative weight of project delivery systems under not considering each of major indicators

Major indicator affecting decision making	Changing the importance of indicators	Percent of relative weight of each delivery system considering just one of indicators		
		CM	DB	DBB
A1	decreasing this indicator to 0% and increasing the rest	31/9	8/5	59/6
A2	decreasing this indicator to 0% and increasing the rest	28/7	55/3	16/0
A3	decreasing this indicator to 0% and increasing the rest	29/6	53/1	17/3

Table 5: Relative weight of project delivery systems under considering each of secondary indicators as the sub-set of major indicator of aims and characteristics of employer organization

Secondary indicator affecting decision making	Changing the importance of indicators	Percent of relative weight of each delivery system considering just one of indicators		
		CM	DB	DBB
A1-1	Increasing this indicator to 100% and the rest to 0%	30/9	58/2	10/9
A1-2	Increasing this indicator to 100% and the rest to 0%	26/3	65/9	7/9
A1-3	Increasing this indicator to 100% and the rest to 0%	30/9	58/2	10/9
A1-4	Increasing this indicator to 100% and the rest to 0%	58/1	11	30/9
A1-5	Increasing this indicator to 100% and the rest to 0%	19/4	74/3	6/3
A1-6	Increasing this indicator to 100% and the rest to 0%	30/9	11	58/1
A1-7	Increasing this indicator to 100% and the rest to 0%	25	50	25
A1-8	Increasing this indicator to 100% and the rest to 0%	14/3	71/4	14/3
A1-9	Increasing this indicator to 100% and the rest to 0%	26/3	65/9	7/9

According to table, it can observe that desirability of delivery management system increases by increasing importance of secondary indicator of "delivery of project with high quality", and then the second priority is given to design-bid-build system. This might have been acquired from employers' trust on high quality of project delivery in construction management system. In addition, quality of delivery in design-build system is assumed at the least possible state from point of view of experts.

Concerning "flexibility of project during construction", it can observe that design-bid-build system meet this need in a best way, and then the second priority is given to construction management system. This indicates that employers must take this point into account that they will have the least influence on changing the project under selection of design-build system. Tables indicate that if complexity of project and required technology level for construction is high or the capability for giving a definition be less, it will be better to use construction management system.

Table 6: Relative weight of project delivery systems under not considering each of secondary indicators as the sub-set of major indicator of aims and characteristics of employer organization

Secondary indicator affecting decision making	Changing the importance of indicators	Percent of relative weight of each delivery system considering just one of indicators		
		CM	DB	DBB
A1-1	decreasing this indicator to 0% and increasing the rest	28/4	54/8	16/8
A1-2	decreasing this indicator to 0% and increasing the rest	29/4	54/5	16/1
A1-3	decreasing this indicator to 0% and increasing the rest	28/4	54/9	16/6
A1-4	decreasing this indicator to 0% and increasing the rest	27/9	57/5	14/5
A1-5	decreasing this indicator to 0% and increasing the rest	30/2	53/7	16/1
A1-6	decreasing this indicator to 0% and increasing the rest	28/9	59/1	12/0
A1-7	decreasing this indicator to 0% and increasing the rest	29/4	56/2	14/4
A1-8	decreasing this indicator to 0% and increasing the rest	29/7	55/2	15/2
A1-9	decreasing this indicator to 0% and increasing the rest	29/1	55/6	15/3

Table 7: Relative weight of project delivery systems under considering each of secondary indicators as the sub-set of major indicator of aim characteristics of project

Secondary indicator affecting decision making	Changing the importance of indicators	Percent of relative weight of each delivery system considering just one of indicators		
		CM	DB	DBB
A2-1	Increasing this indicator to 100% and the rest to 0%	33/3	33/3	33/3
A2-2	Increasing this indicator to 100% and the rest to 0%	50	25	25
A2-3	Increasing this indicator to 100% and the rest to 0%	25	50	25

Table 8: Relative weight of project delivery systems under not considering each of secondary indicators as the sub-set of major indicator of characteristics of project

Secondary indicator affecting decision making	Changing the importance of indicators	Percent of relative weight of each delivery system considering just one of indicators		
		CM	DB	DBB
A2-1	decreasing this indicator to 0% and increasing the rest	31/2	43/7	25
A2-2	decreasing this indicator to 0% and increasing the rest	27/1	45/8	27/1
A2-3	decreasing this indicator to 0% and increasing the rest	41/7	29/2	29/2

Dynamic sensitivity for nodes below: Goal: PDSS>A1(L: .751)

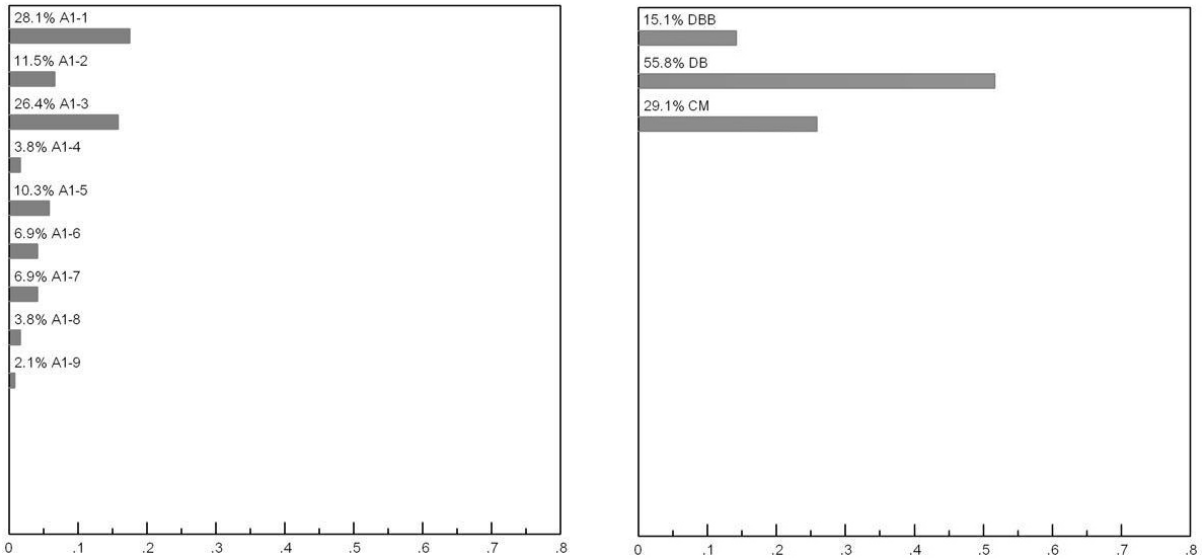

Figure 20: Sensitivity analysis of software Expert Choice before changing

Dynamic sensitivity for nodes below: Goal: PDSS>A1(L: .751)

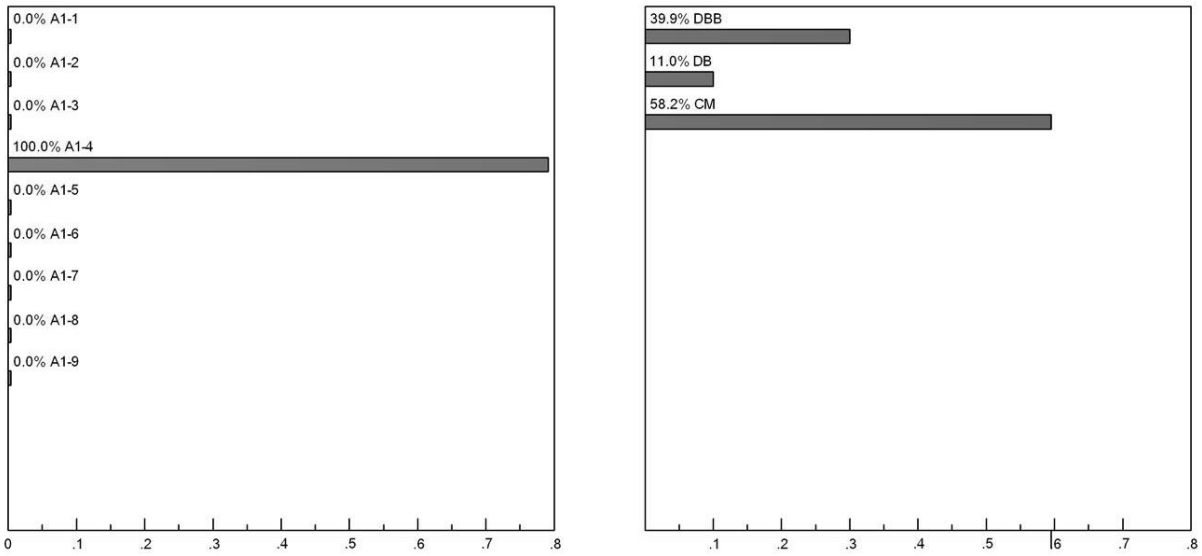

Figure 21: Sensitivity analysis of output of software Expert Choice after changing (increasing importance of secondary indicator of project delivery with high quality to 100% and decreasing effect of other secondary indicators to 0%)

Conclusion

Failure of success of a project in access to its predetermined aims highly relies on the project delivery method. A variety of project delivery methods specify roles and responsibilities of different factors contributing in the project. In addition, project delivery methods specify the framework for project delivery based on sequence and different stages of design, procurement and delivery of project. Since characteristics of any project differ from another project and aims and needs of employers, environmental conditions and the requirements for project delivery are not the same in all projects, it is not logical to execute all the civil projects via a method. Further, the studies have indicated that selection of a suitable delivery method for project and proper use of it can decrease the costs of project to 12% and reduce the

delivery time to 30%. This requires the employers to seek the most suitable project delivery method at any project so as to achieve the pre-determined aims. Hence, it can say that one of the important decisions that must be made at the early stages of a project lies on overview of different items for project delivery and selection of the most suitable one. Concurrent with increase in diversity of project delivery methods and complicatedness in selection process of project delivery method, necessity for development of a systematic decision making process for selection of an optimal delivery method at any new project has been felt by the employers. Through overview of the related works, it can observe that different researchers have proposed different models, stages and tools to achieve an optimal project delivery method. These models can be classified to two groups: 1-process or qualitative models, 2-non-proccess or quantitative models.

Results from Research

1-it must admit that finding any project delivery system does not imply removal of previous delivery systems, that no system is spontaneously good or bad. To implement different projects, it can employ differ project delivery systems based on size and nature of projects, for which it requires to know what system under which conditions can provide the benefits of employer.

2-one of the most important decisions in project management process lies on selection of an optimal system at the early stages of project to implement it. Favorable function and success of a project will come to realize when the adopted decisions are considered in favor of project delivery regarding the proper criteria.

Use of multi-criteria decision making methods to select an optimal system due to facilitation and simplification of problem in different responses enjoys advantages than other models. Multi-criteria decision making methods have been classified to numerous classifications, that different researchers have used the sub-set of scoring especially via models AHP and SAW.

3-Analytic hierarchy method (AHP) due to enjoying superior advantages especially paired comparisons seems more accurate. Yet, due to complicatedness of projects, paired comparisons without software are rarely possible. Yet use of SAW method is simple under diversity of criteria, that users have a more understanding from this method. In addition, it can use this method in manual. Hence, it required to use SAW method to resolve the problem for selection of project delivery system in manual, and control the responses via hierarchical analysis method.

4-in this research, after resolving the problem for selection of optimal project delivery system via SAW and AHP methods to understand sensitivity of items on aim of problem, software Expert choice has been used. Results of this analysis can be used to select a delivery system without any need to resolve problem or when the employer puts an emphasis on one of several effective factors in decision making.

-however, selection of project delivery system requires numerous information on effective criteria for selection of system and degree of their priority and proportion; it can guess a suitable item when such information might not be often accessible. For instance, with regard to sensitivity analysis in this research, it can say that it is better to use construction management method when a project is complicated and the required technology level is high.

Suggestions

1-results of civil projects implemented via modern executive systems such as construction management must be collected and analyzed. Then, it can use such information to select an optimal system for future projects via neural network.

-however an attempt has been made in proposed models to consider independent selection criteria, contrast between such criteria is not rejected. Hence, it can propose several approaches to consider such contrasts in the model in future research.

-as the experts' view in the proposed models is definite, it can centralize the experts' views with uncertainty in future research

-with regard to increasing expansion of use of internet in project management and increasing the Web Based Decision Supporting Systems, it is suggested designing a Web Based Decision Supporting Systems for the employers in country for selection of an optimal project delivery system.

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