



# Specialization of the Components of Project Management in the Implementation Stage of Information Technology Project Management

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### ABSTRACT

This study seeks to examine the standard components of project management in four knowledge areas of integration, scope, time and quality in IT management projects and with regard to infrastructures in different countries, to specialize those components for implementation in Iranian active IT corporations. Accordingly, using the Fuzzy Delphi Technique, the opinions of experts in this area were collected and a specialized conceptual model based on the mentioned standard components in association with IT management projects was developed. It was also found that, contrary to some industry projects, IT projects can be very diverse. Identification of relatively large weaknesses in the field of quality management in IT projects was the other finding of the present study. Moreover, it was found that most of the IT projects stop before being finished. Finally, the extracted conceptual model was implemented in three reputable IT corporations (the Iran (NOSA) Hardware and Software Corporation, the Hamkaran System Corporation and the Mesbah Energy Corporation, and findings were analyzed based on the Promethee II ranking model.

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### Introduction

The future success of many organizations depends on their ability to use IT; therefore, the demand for IT project managers continues to rise. Software companies present their new products to the market every day and technology is changing all the traditional ways of life and business; thus, if there is no proper management of IT projects, factors such as, lack of time and money, unrealistic expectations and many other factors, will lead to waste of the stakeholders' endeavors. Although, the project management has been established as a field of study for many years, IT project management is still in need of ideas and information beyond the general knowledge of project management. In recent years, the rate of investment in IT has significantly increased in Iran. In today's world, it can be seen that technology is considered as one of the most important tools of development in countries. Accordingly, conducting focused research in this area is considered essential for the technology development of any country. An accurate policy in the field of IT is only possible through a truthful understanding of the current technology state of the country in comparison with its past and other countries and this truthful understanding can only be achieved by continuing assessment of the technology states. In 2008, the number of people, who worked in IT-related jobs, reached to 4 million people for the first time in the United States where, the unemployment rate in those jobs was %23 (the lowest unemployment percentage). This was so, because companies needed skilled and talented workforce in their IT sections;

Therefore, it can be concluded that the IT-related jobs' security was at the top in that year in America (Ghasiri,2009).It is obvious that the quality of the country's IT projects can be increased by establishment of comprehensive standards in the field. Hence, the proper management, according to international

standards, can be considered as a requirement for successful implementation of IT projects.

Due to lack of physical objectivity and intangibility of different stages, the implementation of IT projects is generally riskier than other types of projects; therefore, considering the increasing number of IT projects failure, the important role of management in the success of these projects becomes obvious (Schwalbe, 2011 ).

#### Concepts and Definitions

**Project definition:** project is a temporary endeavor to create a product, provide a service or achieve a unique result. The temporary nature of project represents clear starting and ending points. The endpoint of a project occurs when the project's objectives are fully achieved or it is terminated due to failure to achieve the objectives or there is no more need to continue (Ghasiri,2009). Operation, on the other hand, is what is done in an organization to improve its business. At the ending point, when their objectives are achieved or they are terminated, the projects and operations are different from each other (Marchewka, 2009).

**Green IT:** the green IT strategy or green computing strategy includes the development and use of computer resources in an effective way to improve health, economy, social responsibility and environmental impacts in the community (Khoramirad, 2011).

**Project features:** projects are temporary and with a specific purpose. Both ownership and sources must be specified in a project. The most important features of any project are being temporary and having objectives and specified sources (Marchewka,2009).

**Project management:** project management is the application of knowledge, skills, tools and techniques in a project to achieve its predetermined objectives (Khanmohammadi and Jasbi,2005). One of the most critical decisions in project management is selecting the most skilled manager or leader of the team who plays a large role in project's activities. A project manager plays a leadership role and focuses on processes such as planning, organizing, and controlling. S/he must perform many administrative operations including, administrative reviews, tracking and reporting the project's status and many other daily responsibilities. In planning and implementation phases, a project manager should be able to establish and maintain relationships with people, identify requirements according to the needs, take into account the concerns and expectations of stakeholders and establish balance between the project's constraints including issues such as the scope, quality, timing, budget, resources and risks. Each project impacts on the limitations in a specific way on which, the project manager has to focus. The relationship between the limitations in a project is such that if one changes, at least one other factor will be also affected. For example, if the timing is pressed, it will be necessary to increase the budget to provide additional resources for the completion of the same amount of work in less time and if budget increase is not possible, the scope or the quality of the final product will decrease (Marchewka,2009).

**Components of project management:** the components of project management are planning, timing, monitoring and controlling. Unlike many industrial projects, the nature of IT projects can be very diverse. Some of them include a small number of people and are limited to installation of the hardware and software available on the market while, others may include hundreds of people who create new software after analysis of the organizational processes. Software projects are more diverse than hardware ones. In general, due to the variety of IT projects and their novel issues, many people are challenged to find and create the best management process for these projects (Brans and Mareschal, 1984). Similar to any project, the IT product has a life cycle that means the information system passes through specific phases and stages during its existence. The most common IT product life cycle is named "System Development Life Cycle (SDLC)" indicating sequential phases or stages in an information system throughout its presence. Among the other models of IT life cycle, the waterfall life cycle, the spiral life cycle, the building life cycle and the prototype life cycle can be mentioned. The System Level Diagnostic Program (SLDP) shows the stages of system construction and reveals if the move from the old system to the new one has been done appropriately (Pilevari,2009).

**The Project Management Body of Knowledge (PMBOK) standard:** this standard is the essence of practical experiences of successful project managers. The PMBOK standard is not merely a theoretical argument; however, its implementation is difficult in practice. From this standard point of view, the process of project management is a group of integrated and related activities; therefore, the results of each of the areas of project management influence the other factors as well (Project Management Institute, 2013).

The PMBOK standard presents the concepts of project management in the form of a collection of interrelated processes. In fact, much of this standard is dedicated to the description of these processes and their interactions. In other words, the PMBOK standard describes that the project management consists of 5 processes and 9 knowledge areas and while these

processes and knowledge areas interacting, they cover 42 project management processes (Project Management Institute, 2013).

**Project objective goals:** in addition to the general objectives, a project has several objective goals that support its general objectives. These objective goals can be defined in terms of scope, timing, budget and quality standards.

**Tools:** tools support a project's processes and final products. Project management tools include tools and techniques to assess, develop and manage scope, timing and quality; thus, tools support the information systems. Some of the tools that are used in the IT management projects are described in Table (Ghasiri,2009).

**Knowledge areas of project management:** based on the PMBOK standard, knowledge consists of 9 areas that have been accepted as points for better management of the projects and support projects' processes and products (Marchewka,2009).

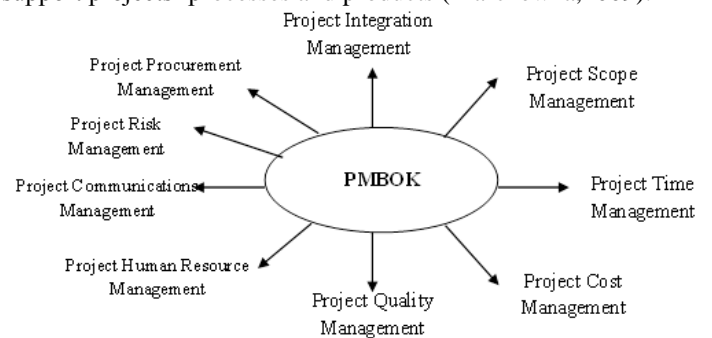


Figure 1. Project management knowledge areas

**Figure 1. Shows the project management knowledge areas**  
**Project Integration Management:** project integration management includes activities needed to identify, define, combine, collect and coordinate the various processes plus the project management actions within the process groups. Regarding projects, integration includes features such as union, integration, general ideas and comprehensive undertakings that are required to complete the project, manage the stakeholders' expectations and provide the necessities. The integration management ensures the decisions regarding resources and comparison between the available options and competitive goals. It is also a bridge between the areas of project management knowledge (Asoosheh, and Khakshour,2010). Since, the other 8 knowledge areas and all the project management processes are coordinated through the integration management, the PMBOK standard agrees to take it as one of the most important areas of knowledge (Asoosheh, and Khakshour,2010).

**Project scope management:** project scope management includes the processes required to ensure that the whole things essential for the successful completion of the projects are done well. The project scope management is mainly related to defining and controlling what is included in a project and what is not. The processes, tools and techniques used in the project scope management are different based on their application areas and usually are defined as part of the project life cycle. The approved detailed project scope statement, Work Breakdown Structure (WBS) and WBS dictionary are the basis of the project scope management. During a project life cycle, its scope is being monitored, verified and controlled. The completion of the project scope is determined based on the Project Management Professional (PMP) program (ICT Project Management in Theory and Practice, 2010).

**Project time management:** project time management includes the processes required to manage the timely completion of the project. The following main processes are offered in the preparation of a project plans:

1. Activity definition
2. Sequencing of activities
3. An estimate of activities' resources
4. An estimate of the duration of activities
5. Supplying schedule
6. Controlling the timing

Tasks related to the six processes of project time management are done at the beginning of the planning phase by the project management team. Some methodologies such as, the Critical Path Method (CPM) or the Critical Chain Project Management (CCPM) are better known and widely used. In the process of preparing the project timing, the output of the processes of activity definition, sequencing of activities, estimating activities' resources and duration of activities are used in combination with the scheduling tool.

**Project quality management:** project quality management includes the processes and activities that are implemented in an organization and specify responsibilities, objectives and qualitative policies to provide a project's requirements. The project quality management implements a quality management system in an appropriate way through procedures, policies and continuous process improvement activities. Quality is the degree of compliance in a set of requirements' inherent characteristics while, degree is a class of products and services with similar performances and different technical characteristics (United Nations Asian and Pacific Training Center, 2010).

#### **Literature Review**

In the field of IT project management, some studies have examined the application of different sets of standards; some have focused on the application of IT project management in a variety of projects such as, construction or contracting projects or in specific environments such as, municipalities or the public sectors and some researches have proposed models to define and combine these standards. One of the most prestigious studies in this field is the preparation of "Information Technology Project Management" by Professor Kathy Schwalbe. In this book, the PMBOK standard has been investigated in IT projects. The latest edition of this leading book was done in 2011 by her institute. In addition to the mentioned book, a number of master's theses have examined the possibility of implementing the PMBOK standard in a variety of Engineering, Procurement and Construction (EPC) projects in Iran. Moreover, in some studies and scientific papers conducted in Iran, the PMBOK standard has been compared with other project management standards such as International Organization for Standardization (ISO) standards, European Foundation for Quality Management (EFQM) model and Six Sigma. In Australia, Kersti Nogeste (2008) has compared IT project managements in the country's telecommunication organization based on two standards of PMBOK and Information Technology Infrastructure Library (ITIL). The Project Management Institute (PMI), in its fourth international conference in 2005, has implemented the ITIL standard using the PMBOK standard.

#### **The Current Study**

##### **Research Questions**

##### **The Main Research Question**

- 1) How can the concepts of the PMBOK standard be applied in the management of IT projects?

##### **The Secondary Research Questions**

- 1) How is it possible to apply the concepts of PMBOK standard in the IT project integration management?
- 2) How is it possible to apply the concepts of PMBOK standard in the IT project scope management?
- 3) How is it possible to apply the concepts of PMBOK standard in the IT project time management?
- 4) How is it possible to apply the concepts of PMBOK standard in the IT project quality management?

**Methodology:** The typical process of quantitative research contains a study for the selection of appropriate theory, making hypotheses, testing them and finally statistical analysis of the obtained data. In contrast, in the qualitative approach, no related theory may exist or it is possible that the researcher is not willing to confine himself to available theories. Thus, a qualitative approach can be used to build a new theory to explain a phenomenon or describe new patterns found in the data. In the quantitative approach, the data must be precisely specified; therefore, the original data are always numerical. However, in the qualitative approach, the quality and depth of the data are emphasized (Fisher and ); therefore, the data are essentially qualitative in nature. In such exploratory studies, which are mainly designed to construct new concepts, models and frameworks, the final results are not normally identified in advance (State of Arkansas, Office of Information Technology, 2003).

Using the Fuzzy Delphi technique, in the present study, it is tried to first, identify the factors related to success and failure of IT projects in Iran based on the PMBOK standard and then, offer new strategies to improve IT projects. Based on logical reasoning, this analysis tries to provide a novel model of IT project management in Iranian companies that adds to the collection of knowledge in this field. Therefore, methodologically speaking, this study can be considered as developmental and implementationally speaking, it can be reflected as action or modeling research.

**Data Collection:** In line with the specialization of the mentioned standard, reviews of library resources, documents, the latest scientific articles and books related to IT project management were conducted to gather the information needed for the theoretical foundation of the study. Moreover, in order to refine and finalize project management components for specialization in Iranian companies, the experts' viewpoints were considered and to review the basic components, the Delphi technique was used in line with the library method. It is worth mentioning that this specialization has been done in the implementation phase of IT management projects in Iranian companies and no similar model has been ever extracted from the conducted studies in the world. The Delphi panel members were selected based on non-probability sampling and a combination of objective, judgmental and chain methods. Accordingly, 10 people with one or more of the following features were selected by the researcher: faculty member in the field of IT, director or senior IT consultant, director or senior specialist in project management involved in the IT project management as well. Then the 10 selected participants introduced other specialists and the total number of experts reached to 24 people. Out these 24 experts, 3 were members of the panel with Bachelor degrees, 13 with master's degree, 1 was a professional doctor and 8 with Ph.D. degrees. The professional backgrounds of members of the panel are presented in the following table No.2.

**Table 1. Some tools used in project management**

Knowledge area	Tools and techniques		
Integration management	<ul style="list-style-type: none"> <li>✓ Stakeholder analysis</li> <li>✓ Project scheme</li> <li>✓ Project management software</li> </ul>	<ul style="list-style-type: none"> <li>✓ Change Control Board</li> <li>✓ Project review meetings</li> </ul>	<ul style="list-style-type: none"> <li>✓ Work permit system</li> <li>✓ Project leadership</li> </ul>
Scope management	<ul style="list-style-type: none"> <li>✓ Net present value</li> <li>✓ Return on Investment</li> <li>✓ Refunds</li> </ul>	<ul style="list-style-type: none"> <li>✓ Project charter</li> <li>✓ Work breakdown structure</li> <li>✓ weighted scoring models</li> </ul>	<ul style="list-style-type: none"> <li>✓ Needs analysis</li> <li>✓ Control range</li> <li>✓ Statement of Scope</li> </ul>
Quality management	<ul style="list-style-type: none"> <li>✓ Six Sigma</li> <li>✓ Quality control charts</li> </ul>	<ul style="list-style-type: none"> <li>✓ Pareto charts</li> <li>✓ Fishbone diagram</li> </ul>	<ul style="list-style-type: none"> <li>✓ Quality audits</li> <li>✓ Quality procedures</li> </ul>

**Table 2. Members of the panel work experiences**

Work type	Number	Experience (year)		
		Most	Least	Average
Faculty member of universities or research institutes in the field of IT	10	19	2	7
Director of IT research projects	21	25	1	10.7
Executive of IT research projects	14	25	1	11
Organizations' counselor in the field of IT	17	12	2	7
Policy council member in the field of IT	15	20	1	8.8

**Table 3. The obtained components from the Fuzzy Delphi technique in the project integration management**

Project integration management		
1	The impact on IT project management	For the IT project management, work statement or project charter should be provided in the initial phase.
2		Expression of business justification, as one of the early processes in project management, is required.
3		If a project is done for a foreigner client, the contract must be submitted to the project manager in the initial phase.
4		Identification and consideration of organization's environmental factors and process assets play an important role in the initial stage of IT management projects.
5		The most reliable technique for the integration management in the initial phase can be the polling of experts.
6		Providing a detailed list of organization's environmental factors and process assets can influence the planning phase of project management.
7		The use of experts' views is influential in the planning phase of management.
8		In the implementation phase, it is important to conduct processes of guidance and management of project activities to achieve the project objectives.
9		In the monitoring and controlling phases, it is important to conduct monitoring and controlling processes to monitor, review and adjust the project activities and ensure their compliance with the project management programs.
10		In the monitoring and controlling phases, it is important to check all change requests and either approve or reject them in order to carry out an integrated monitoring of the changes.
11		In the ending phase, it is important to conduct processes of project completion and delivery of the items.
1	The components applicability in Iran	For the IT project management, work statement or project charter should be provided in the initial phase.
2		Expression of business justification, as one of the early processes in project management, is required.
3		If a project is done for a foreigner client, the contract must be submitted to the project manager in the initial phase.
4		Identification and consideration of organization's environmental factors and process assets play an important role in the initial stage of IT management projects.
5		The most reliable technique for the integration management in the initial phase can be the polling of experts.
6		Providing a detailed list of organization's environmental factors and process assets can influence the planning phase of project management.
7		The use of experts' views is influential in the planning phase of management.
8		In the implementation phase, it is important to conduct processes of guidance and management of project activities to achieve the project objectives.
9		In the monitoring and controlling phases, it is important to conduct monitoring and controlling processes to monitor, review and adjust the project activities and ensure their compliance with the project management programs.
10		In the ending phase, it is important to conduct processes of project completion and delivery of the items.

**Table 4. The obtained components from the Fuzzy Delphi technique in the project scope management**

<b>Project scope management</b>		
1	The impact on IT project management	Preparation of documentation requirements (business requirements, business objectives, stakeholders' requirements, etc.) plays an important role in the planning phase.
22		The use of interviews, Delphi technique, facilitator workshops and other methods of documentation requirements preparation are important in the planning phase.
3		Preparation of project scope statement (description of product range, criteria of product acceptance, project deliverables, and project constraints) is important in the planning phase.
4		Providing WBS is important in the planning phase.
5		In the implementation phase, it is important to define the scope of the project and describe constraints, assumptions and previous data through WBS.
6		In the monitoring and controlling phases, it is important to do activities related to acceptance of the deliverables such as looking over the items in front of the supporters and customers.
7		In the monitoring and controlling phases, it is important to ensure that all approved change requests as well as all corrective and preventive actions have been done appropriately.
8		Selection of appropriate project based on reasonable and realistic approaches is important in the initial phase of the project.
9		Careful study and thorough knowledge about the project charter is very important before the official initiation of the project.
10		Presentation of strategic planning to advance the project is important in the planning phase.
1	The components applicability in Iran	Preparation of documentation requirements (business requirements, business objectives, stakeholders' requirements, etc.) plays an important role in the planning phase.
2		The use of interviews, Delphi technique, facilitator workshops and other methods of documentation requirements preparation are important in the planning phase.
33		Preparation of project scope statement (description of product range, criteria of product acceptance, project deliverables, and project constraints) is important in the planning phase.
4		Providing WBS is important in the planning phase.
55		In the implementation phase, it is important to define the scope of the project and describe constraints, assumptions and previous data through WBS.
6		In the monitoring and controlling phases, it is important to do activities related to acceptance of the deliverables such as looking over the items in front of the supporters and customers.
7		In the monitoring and controlling phases, it is important to ensure that all approved change requests as well as all corrective and preventive actions have been done appropriately.
8		Careful study and thorough knowledge about the project charter is very important before the official initiation of the project.
9		Presentation of strategic planning to advance the project is important in the planning phase.
10		The use of suitable software is important in the implementation phase.

**Table 5. The obtained components from the Fuzzy Delphi technique in the project time management**

<b>Project time management</b>		
1	The impact on IT project management	It is important to define activities to identify specific actions to produce deliverables in the project planning phase.
2		Identification and documentation of project activities in the planning phase are important.
3		Estimation of activities resources (estimation of type and quantity of raw materials, labor, equipment or required supplies, etc.) is important in the planning phase.
4		Estimation of activities duration (estimation of time required to perform each activity based on predetermined resources) is important in the planning phase.
5		Compilation of schedule (listing the activities, their properties, relationships, durations, resources and constraints) is important in the planning phase.
6		Monitoring the status of the project and ensuring its current status, reviewing project's progress and updating its activities are important in the monitoring and controlling phases.
7		Auditing progress of the project in terms of time is important in the implementation phase.
8		The use of suitable software is important in the implementation phase.
9		Controlling the timing changes in the monitoring and controlling phases is important.
1	The components applicability in Iran	It is important to define activities to identify specific actions to produce deliverables in the project planning phase.
2		Identification and documentation of project activities in the planning phase are important.
3		Estimation of activities resources (estimation of type and quantity of raw materials, labor, equipment or required supplies, etc.) is important in the planning phase.
4		Estimation of activities duration (estimation of time required to perform each activity based on predetermined resources) is important in the planning phase.
5		Monitoring the status of the project and ensuring its current status, reviewing project's progress and updating its activities are important in the monitoring and controlling phases.
6		The use of suitable software is important in the implementation phase.
7		Controlling the timing changes in the monitoring and controlling phases is important.

**Table 6. The obtained components from the Fuzzy Delphi technique in the project quality management**

Project quality management		
1	The impact on IT project management	It is important to perform quality planning to recognize quality requirements and the project and product standards and document the approval procedure in the planning phase.
2		Performing quality assurance processes to audit quality requirements and results of quality control is important in the implementation phase.
3		Performing quality control processes to evaluate the performance of required changes is important in the monitoring and controlling phases.
1	The components applicability in Iran	Analysis of the needs and expectations of stakeholders in the initial phase of the project.

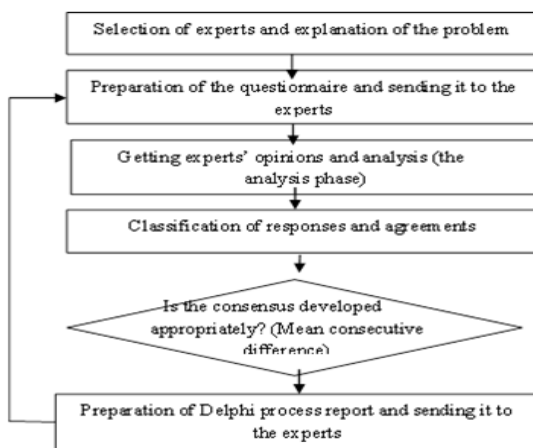
**The population and samples:** the population of this study was 24 top experienced professionals in implementation of IT projects. No sampling method was used in the current investigation and all 24 participants were selected based on previously described characteristics.

**Administrative process of the study:** according to the Fuzzy Delphi technique, a list of mentioned project management components in the PMBOK standard was given to the experts to determine their importance in Iranian companies. The experts were also asked to offer their ideas about components not included in the list. Then, the specialized comments were taken three times. The Delphi technique ended optimally after the third round and consensus was achieved.

**Definitions of linguistic variables:** the linguistic variables are the basis of Fuzzy logic. The values of these variables are words instead of numbers. Although, the words are inherently less accurate than the numbers, they are closer to human understanding. In this study, the qualitative variables are defined as trapezoidal fuzzy numbers: low (4, 2, 00), medium (3, 4, 6, 7) and high (6, 8, 10, 10).

The used questionnaires in the present study have been designed in line with the Fuzzy Delphi technique to extract the specialized components of IT project management in Iran. Doing so, for each of the four knowledge areas of integration, scope, quality and time, separate questionnaires were designed; therefore, the experts could respond with more precision and express their comments with more convenience. According to the study's framework and each of the components, the Cronach's alpha coefficient was used (by SPSS) to determine the reliability of the questionnaire. The obtained Cronach's alpha coefficient was 0.94. For determination of the validity of the questionnaire, the experts' comments were considered.

**The process of achieving the conceptual model of the study:** The conceptual model used in the current study is to assess the most influential components in IT project management based on the conditions and infrastructures in Iran. Figure No.2 shows the Fuzzy Delphi implementation algorithm



Based on the proposed components and defined linguistic variables, after distribution of the questionnaire among the experts, the data were collected. Then, the mean value of the relationship between the examined components and their effects on IT project management and also their applicability in Iran was calculated based on the following formulae (Ching-Hsue and Yin, 2003).

$$A^{(i)} = (a_1^{(i)}, a_2^{(i)}, a_3^{(i)}, a_4^{(i)}), \quad i = 1, 2, \dots, n \quad (1)$$

$$A_m = (a_{m1}, a_{m2}, a_{m3}, a_{m4}) = \left( \frac{1}{n} \sum a_1^{(i)}, \frac{1}{n} \sum a_2^{(i)}, \frac{1}{n} \sum a_3^{(i)}, \frac{1}{n} \sum a_4^{(i)} \right) \quad (2)$$

In the above formulae, the  $A^{(i)}$  is the  $i^{th}$  expert's view and the  $A_m$  is the average experts' views. Then, using the following formula, the difference between each expert's view and the average experts' views was calculated and if the difference was above 0.2, the second stage questionnaire would be distributed. This process continued until the difference became less than 0.2 (Ching-Hsue and Yin, 2003).

$$(a_{m1} - a_1^{(i)}, a_{m2} - a_2^{(i)}, a_{m3} - a_3^{(i)}, a_{m4} - a_4^{(i)}) =$$

$$\left( \frac{1}{n} \sum a_1^{(i)} - a_1^{(i)}, \frac{1}{n} \sum a_2^{(i)} - a_2^{(i)}, \frac{1}{n} \sum a_3^{(i)} - a_3^{(i)}, \frac{1}{n} \sum a_4^{(i)} - a_4^{(i)} \right) \quad (3)$$

All the mean differences in the second and third rounds of questionnaire distribution were less than 0.2; therefore, all the expected components were confirmed and the process of questionnaire distribution was stopped. On the subject of the project integration management, the results indicated that the processes of "identification and consideration of organization's environmental factors" and "process assets" had similar mean ranges concerning "The impact on IT project management" and "The components applicability in Iran". In other words, these two components are subsets of each other. Moreover, the process of "providing a detailed list of organization's environmental factors" and "process assets" showed similar mean ranges. Accordingly, these two components can be merged with each other to aggregate and summarize the data. It must be noted that, two components of "conducting processes of guidance and management of project activities to achieve the project objectives" and "monitoring and controlling processes to monitor, review and adjust the project activities and ensure compliance of management programs with the project" can be merged as well. However, the important point of difference between this case and other cases is in differences in the implementation phases of "conducting processes of guidance and management of project activities to achieve the project objectives" and "conducting monitoring and controlling processes to monitor, review and adjust the project activities and ensure compliance of management programs with the project".

According to the experts' views, the component of "conducting processes of guidance and management of project activities to achieve the project objectives" must be implemented in the implementation phase while, the component of "conducting monitoring and controlling processes to monitor, review and adjust the project activities and ensure compliance of management programs with the project" is to be implemented in the monitoring and controlling phase of the project; therefore, these two components cannot be merged with each other.

Regarding the components applicability in Iran, it can be concluded that this indicators is mostly related to the component of "Expression of business justification, as one of the early processes in project management" while, the component of "checking all change requests and either approve or reject them in order to carry out an integrated monitoring of the changes" showed the lowest relationship with this indicator and can be eliminated.

For example, regarding the proposed component of "polling the experts in the initial phase of planning", the experts concluded that its relationship with the indicator of "The impact on IT project management" is 6 out of 10 in the most pessimistic situation and 9 in the most optimistic situation. Therefore, considering an average value of 7.5-8.5, it can be stated that this component is highly related to the indicator of "The impact on IT project management". The same situation existed for the component of "conducting processes of guidance and management of project activities to achieve the project objectives" in the implementation phase. Comparing the components, the least relationships were found between the project quality management and the mentioned components and the fuzzy numbers indicated a weak quality management in IT projects conducted in Iran. This weakness was observed in both indicators of "The impact on IT project management" and "The components applicability in Iran". These poor results may be due to lack of knowledge, familiarity, practical experience and professional skilled experts in the assessment of IT projects quality management in Iran. Correspondingly, data obtained from the questionnaires in each of the knowledge areas of scope, time and quality were analyzed and as far as the descriptions of project and PMBOK standard components were not altered, the components were merged and those with the least association with the two indicators of "The impact on IT project management" and "The components applicability in Iran" were eliminated. Finally, based on the experts' views, the following conceptual model in four areas of project management knowledge was obtained.

The answer to the main question of the study is presented in all tables (3, 4, 5 and 6) while, the answers to the secondary questions are presented in tables No.3, No.4, No.5, and No.6 respectively.

#### **Answer to the first secondary research question**

##### **Implementation (case studies)**

After reviewing and specialization of components of the PMBOK standard commensurate with IT projects in Iran, the processes of validation and implementation of the conceptual model was examined in 3 Iranian IT corporations.

In order to assess the validity of the designed conceptual model, 12 questions were designed and given to 22 experts in the field of IT project management. The questions were about the components of the PMBOK standard in four management knowledge areas of integration, scope, time and quality. The final results indicated an overall %60 consensus of the experts; therefore, the designed conceptual model received appropriate validity for being used in IT project management in Iran. Then

the weights of each component and subcomponents were calculated through the group method as the main criteria for assessing their impacts and applicability in Iran. Finally, the extracted conceptual model was implemented in three reputable IT corporations (the Iran (NOSA) Hardware and Software Corporation, the Hamkaran System Corporation and the Mesbah Energy Corporation) and findings were analyzed based on the Promettee II ranking model.

The implementation process in the above-mentioned IT corporations included the following 9 steps:

- 1) Calculation of the weights of the components,
- 2) Development of a decision matrix,
- 3) Determination of a threshold value for each component,
- 4) Calculation of the difference between the components and threshold values,
- 5) Application of the preference function with zero,
- 6) Application of the preference function with one,
- 7) Creation of a weighted matrix,
- 8) Formation of a collective utility function,
- 9) Classification of the components.

After implementation of the project in the mentioned corporations and based on the PMBOK standard concepts, some recommendations were also provided.

#### **Conclusions and Recommendations**

##### **Conclusions**

The nature of IT projects and their concepts are similar to other projects. Based on the definition of the project, the IT projects are temporary in nature and have specific beginning and ending points. These projects have defined deliverables and are affected by constraints such as budget; however, subtle differences exist in IT projects' products. Often, the methods of product life cycle with traditional project management processes are merged to create dynamic processes for project management. Unlike some industrial projects, IT projects can be very diverse. In both software and hardware dimensions, the IT projects have great complexity and variety. In general, due to the variety of IT projects and their novel issues, many people are challenged to find and create the best management process for these projects. For that reason, the use of modern management techniques and management knowledge are very important in these projects.

One of the most important factors in the success of IT projects is the organization and its senior director's commitment to use IT. In an organization, When the IT use is limited to buying some computers and minor equipment and setting up network or when the senior manager does not have enough understanding of the importance and impact of IT on the business, the successful implementation of big standards such as, the PMBOK cannot be expected. Accordingly, an organization's commitment to use IT along with a supportive senior manager can play important roles in the successful implementation of IT projects.

Another finding of the present study was the identification of relatively huge weaknesses in IT projects quality management. Some IT systems with vital missions have created many sufferers and quality problems in many business systems have resulted in major financial losses. Accordingly, having sufficient knowledge about the quality management and acceptance of the fact that the final responsibility for verifying the quality of a product is on the customer can help to improve IT projects management in Iran.

Failure of many IT projects in the field of time management is one of the fundamental problems found in this study. Most of the IT projects stop before being finished or linger more than the scheduled time. This may be due to either project's internal

changes that are to some extent predictable or environmental/ external changes that are unpredictable. However, in the current investigation, the identified reasons behind failure of IT projects time management were inability to estimate the timing of activities and inappropriate use of resources, WBS techniques and time management software.

The process assets and environmental factors were discussed and the importance of their recognition and consideration as fundamental issues in the success of IT project management based on the PMBOK standards was highlighted. Perhaps, one of the most difficult components of the PMBOK standard for specialization in Iran is providing a detailed list of an organization's process assets and environmental factors. Compilation of such a list requires detailed and documented information such as, formal and informal programs, policies and procedures, learned lessons and previous information, completed timings, risk and earned value data, etc. Unfortunately, access to such information is not possible in the majority of Iranian companies. The environmental factors include external and internal elements such as, industry or government standards, infrastructures, market conditions, business information banks and communication channels within an organization that affect the success of a project.

#### Recommendations

✓ It is recommended to use suitable software to help projects management.

✓ In the present study, the components of the PMBOK standard in four management knowledge areas of integration, scope, timing and quality were reviewed and specialized for Iranian IT projects; therefore, it is recommended to conduct similar investigations in order to include the other 5 knowledge areas presented in the PMBOK standard.

✓ It is recommended to conduct studies on the assessment of organizations' willingness to use the PMBOK standard in their IT project management.

✓ It is also recommended to assess other project management standards such as ITIL. The ITIL is a management standard and a collection of successful experiences, best thoughts, patterns and management techniques that specifies the workflow process of an organization. Applying the ITIL standard is very common these days and practicing its rules is a part of each software company's principles. The ITIL standard was created in England; however, it is being used in many countries including Iran. Accordingly, it is recommended to analyze the ITIL standard's complicated issues in future studies or compare it with the PMBOK standards.

#### References

[1] K. Ghasiri, Information Technology Project Management, Dibagaradn cultural institute publication, Tehran, 2009.

[2] A. Asoosheh, P. Khakshour, Information Technology Project Management, Scientific and Cultural publications, 2010.

[3] J.T. Marchewka, Information Technology Project Management, Transl. Jalili, Third ed., 2009.

[4] N. Khoramirad, PMP and Project Management Standard Exams Guide, PMBOK, 2011.

[5] M. Golabchi, Information Technology Approach to Project Management, 2009.

[6] A. Adel, Faraji, Fuzzy Managmnet Science, Iran Center of Managmnet and Productivity, 2010.

[7] N. Jafari, Gh. Montazar, Using Fuzzy Delphi method to determine the country's tax policies, Economic Journal, Vol. 8, 2008.

[8] S. Khanmohammadi, J. Jasbi, Application of Fuzzy Delphi method to select a set of power system alarms based on the estimation of risk model to prioritize, Twenty-fifth International Conference on Electricity.

[9] N. Pilevari, explanation and presentation of the agility evaluation pattern in supply chains based on expert systems, Ph.D. dissertation, Islamic Azad University, Science and Research branch, Iran, 2009.

[10] M. Fisher, P. Forest, Scope-cost-time integrated model with work breakdown structure, 2009.

[11] State of Arkansas, Office of Information Technology, Best Practices for Managing State Information Technology Projects, 2003.

[12] Ch. Ching-Hsue, L. Yin, Evaluating the Best Main Battle Tank Using Fuzzy Decision Theory with Linguistic Criteria Evaluation, European Journal of Operational Research, 2003, Vol.142, p.147.

[13] J. P. Brans, B. Mareschal, P.H. Vincke, "PROMETHEE: Anew family of outranking methods in multi criteria analysis", 1984. In J. P. Brans, editor, Operational Research' 84, pages 477-490. North- Holland, Amsterdam.

[14] J. P. Brans, B. Mareschal, "PROMETHEE-GAIA'. A Methodology Of Aid Decision of Presence Multiple Criteria, Ellipses, Paris, France, 2002.

[15] Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK® Guide), Fifth Edition, 2013.

[16] K. Schwalbe, Information technology project management. Revised 8e, 2011.

[17] ICT Project Management in Theory and Practice, United Nations Asian and Pacific Training Center for Information and Communication Technology for Development, 2010.