

A Method for Measuring the Project Management Maturity Level in the Power Industry

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Abstract: Background and Aim: Project management plays a vital role in business success. A company's strategic initiatives are often implemented through projects. This study aims to provide a method for measuring the level of project management maturity of companies in the power industry and according to the specific conditions of this industry. **Method:** First, five maturity levels have been considered according to the concept of continuous improvement and different maturity models. Then 51 processes were placed in 12 process areas and four stages of project completion. Each of these process domains was weighted using a fuzzy hierarchical analysis process. Using interviews and questionnaires in Tehran Regional Electricity Company, the level of project management maturity in each of the processes, process areas, and project completion stages was determined, as well as the overall maturity level of the organization according to the weights obtained. **Results:** After conducting the interview and completing the Tehran Regional Electricity Company questionnaire, the maturity level of each process, process areas, and project completion stages were obtained. The overall maturity level of the company, which was obtained through the weighted average maturity level of process domains, was 1.89. **Conclusion:** In the field of the project management process, the results showed that the field of project procurement management with 2.75 has the highest and the field of project risk management with 0.81 has the lowest level of maturity in the company. In the project completion stages, the planning step with 1.7 had the lowest, and the complete step with 2.64 had the highest level of maturity. The overall maturity level of the company was set at 1.89, which indicates that the company has reached the first level of maturity and is on the verge of achieving the second level of maturity.

Keywords: maturity level, project management, electricity

Introduction

In many cases, senior executives believe that they have provided all the resources needed for the projects but do not benefit from them as expected. On the other hand, many project managers believe that their biggest problem is the lack of sufficient support from senior managers in providing resources. The main root of these differences is the lack of institutionalization of project management processes in project-based organizations. (Sohrabi Dizaj, 2011). Due to the widespread release of high project failure rates and the associated exorbitant costs, most companies are turning to approaches to improve project management. This can be seen in the increased membership of project management associations such as the American Institute of Project Management (PMI). In addition, billions of dollars invested in projects and increasing attention to maturity models indicate an increase

in the value of project management in organizations. Due to the relationship between investments and time, cost, and resources of organizations, most companies are willing to pay special attention to the issues that improve their competitive position in the field of competition. Commercial value in organizations is considered. We now have to recognize the complex relationship between project management and its value as one of the organization's strategic assets (Judgev & Thomas, 2002).

Project management plays a vital role in business success. A company's strategic initiatives are often implemented through projects. Successful delivery of these projects allows the organization to respond quickly to changes, opportunities, and threats. For a project-oriented organization, the timely delivery of projects with the set budget and the desired quality will lead to customer satisfaction. For a customer-centric organization, effective project management improves business efficiency and marketing time, which adds to the organization's competitive advantage. All organizations seek to continually improve business systems and processes to maintain a competitive advantage (Jannahuddin, Chin, & Lee, 2010).

Over the past decade, maturity models have been introduced as one of the most tangible ways to assess project management maturity in a company. These models help organizations to compare their obvious capabilities at the level of organizational projects and programs with a specific and scientific standard. Maturity models are a framework and tool for describing how to improve the ability and level of the project process and can scientifically show the success and failure of project implementation and then identify and improve problems (Yang & Wang, 2009).

In the internal organizations of the country where projects are implemented, there is a need for a particular model for their evaluation that is comprehensive, following the characteristics and conditions of the country and industry. In the organizations present in the power industry, many projects are implemented to implement this industry's strategies and in the production, transmission, and distribution sectors. Given the large and important projects in this infrastructure industry, the successful implementation of its projects, in other words, project management, is essential. Lack of a uniform and defined form or standard to receive or rotate information between relevant units in the organization or consulting companies or contractors causes many problems. Despite many efforts and facing various challenges, in such a situation, due to the lack of adequate defined communication between project stakeholders and the project control unit and due to the periodicity and time of the project control process, insufficient information. From well-executed or poorly executed processes, in many cases, senior managers of the organization may not have access to the necessary project information at the desired time. Therefore, in this study, while studying different models of project management maturity, an appropriate methodology for measuring the level of project management maturity in the power industry has been presented and also process areas in this methodology with the opinion of experts and according to the characteristics of the organization and life. Moreover, the level of maturity in Tehran Regional Electricity Company should be determined.

Theoretical Foundations

Validity and reliability analysis

As stated in Chapter 3, in this study, Cronbach's alpha method was used to assess the reliability of the questionnaire. Reliability refers to the accuracy, reliability, stability, or repeatability of test results. In this method, alpha (reliability) is calculated as internal consistency, which forms the internal correlation between test questions.

As previously explained, 51 questions were given to the respondents in the form of a Likert scale questionnaire from 0 to 5 to express their opinion about the level of maturity of each process. Finally, the reliability of the questionnaire was 0.954, which is outstanding and indicates that the reliability of the questionnaire is at a high level.

The questionnaire was designed using reliable sources in project management processes and was approved by project management specialists and some managers and experts and was used in the present study.

The maturity level of project steps

Also, based on the stages of the project and the completion of the process cycle, the level of maturity was determined for each stage of planning, implementation, control, and completion. In order to obtain the level of maturity of each stage of project completion, the average level of maturity of the processes that were in one stage of the project was considered the level of maturity of that stage. As shown in the figure, the level of maturity of the company's processes in the planning stage with 1.7 and then execution with 1.76 is less than the control stage with 1.88 and the end with 2.64. Therefore, the company should pay more attention to improving the planning and implementation processes.

Project

Projects come in many forms. Important projects from significant industries can be mentioned, such as: building a ship, Design, and construction of a new car, construction of a building or factory, construction of a water and sewage system for a city or village. They require significant effort and special teams and often require the cooperation of various organizations. On the other hand, most of the projects we deal with are smaller: engineering can all be a project by building projects to create new facilities, rehearsing a program, or changing the way an organization manages. In the social environment, some projects can be mentioned: furniture, organizing changes in the traffic culture of the community, and going on vacation can all be a kind of project (Mokhtari Zanjani, 2008).

The Project Management Knowledge Body Guide defines a project as a temporary effort to create a unique product or service. On the other hand, British Standard 6079 (BS6079) defines a project as Coordination with specific start and end points, accepted by an individual or organization to introduce specific goals within the parameters of time, cost and performance "(Van Der Merwe, 2002).

Despite the definitions provided by the portal, we were faced with the question, what is the difference between a project and daily operations? We can point to its "uniqueness.

Project Management

Project management is a specialized part of management, like other functional strategies, that is used to accomplish a series of business goals, strategies, and tasks within a given schedule and budget. The nature of project management to support implementing a competitive organizational strategy to deliver a desirable output (such as batch launch time, high quality, low-cost products. According to the Shenhar project leadership framework, project management Alignments include project strategy, organization, process, tools of standards, and culture (2006, Srivannaboon & Milosevic).

The Project Management Knowledge Body Guide defines project management as applying knowledge, skills, tools, and techniques to project activities to meet the needs and expectations of stakeholders in a project.

Also, British Standard 6079 (BS6079) defines project management as: "Planning, monitoring and controlling the whole existence of a project and motivating all those involved to achieve the project objectives on time, at cost, quality and performance. Designated "(Merwe, 2002).

Strategic management by projects

Strategic management is formulating and executing strategies to create a sustainable competitive advantage for the company. The strategic plan shows the strategic direction and guides resources to carry out an organization's vision, mission, and goal with a sustainable competitive advantage. A complete strategic plan is meaningless without practical implementation (White & Patton, 2000).

The ability of the organization to align resources and activities with strategic goals can lead to success and survival in business. Projects are often seen as part of designing and implementing organized future strategies. It is essential to do the thing right rather than do the right thing. This means that choosing projects according to business goals is more important than doing the right thing (Naaranoja, Haapalainen, & Lonka, 2007).

Some of the goals of implementing strategy through projects are:

Introduce a systematic process of transformation from strategy formulation to strategy implementation

Shorten the time to formulate a strategy to execute a strategy

Increase efficiency in implementing business strategy

Integrating project goals and business strategy goals

Simultaneous control of changes in the strategy formulation and implementation process (Hauce & Kovac, 2000).

The concept of process

As stated, project management is the application of knowledge, skills, tools, and techniques related to project activities to meet project requirements. This application of knowledge requires effective management of appropriate processes (Project Management Institute (PMI, 2008). Organizational processes can align and converge all organizational activities towards business goals. Organizational processes can provide the right resources and the necessary context for applying new technologies. Appropriate and integrated processes help the organization's human resources work towards greater organizational convergence and the processes. Efficient is the motivation for using new technologies in the organization; in practice, the organization is moving towards maturity despite appropriate and efficient processes (Ghods Farah Sirous, & Bardiar, 2010).

A process is a set of related actions and activities performed to achieve a product, resulting in a predetermined service. Each process with its inputs, tools, and techniques can be used.

The resulting outputs are identified (Project Management Institute (PMI, 2008). Prasad processes as a set of seven tasks, including Tasks, Teams, Techniques, Technology, Time (Time), defines tools that are precisely arranged to convert a set of inputs into a specific set of outputs (goods or services) (Prasad, 2019).

Project managers and their teams must carefully consider each process and its inputs and outputs. Project management is a total commitment in which each product and project process is appropriately aligned with other processes to create coordination. Actions taken during a process typically affect that process and other related processes. A change of scope, for example, generally affects the cost of the project but may not affect the communication program or product quality. These high-level process exchanges require a balance between project requirements and objectives (Project Management Institute (PMI, 2008).

The emergence of maturity models

The concept of process maturity was born out of the total quality management movement, where the application of statistical process control (SPC) techniques showed that the improvement of any technical process leads to two things: reducing the inherent instability of the process and improving its average performance (Fengyong & Renhui, 2007)).

Thus, the quality movement first sought to stabilize the process and bring it under statistical control. Then it is time to try to improve the capabilities of the process.

The concept of maturity and maturity of project management

1. According to the advanced Oxford dictionary, maturity is defined as follows: Reasonable quality of thinking and behavior, adult manner.

2. In the case of a person, animal, or plant) a state in which he is fully grown and developed.

3. (In the case of a business) is when the money you have invested is ready to be paid (Supic 2005). Elsewhere, the literal meaning of puberty is "full development with ideal conditions" (KAYA & IYIGUN, 2001).

Webster's Glossary defines the word "rising" as maturity when it reaches its whole natural state with maximum development. If we apply the concept of maturity to the organization, it refers to a situation in which the organization has reached a perfect state in achieving its goals. In this case, the maturity of the project means that the organization implements its projects in a perfect condition (Davodian, Salhshour. & Mahdavi Adeli, 2011) (Khameneh, 2008)

Maturity is also concerned with understanding and determining why success occurs and ways to correct or prevent joint problems. The term maturity refers to the capabilities developed over time to create reproducible project management success (KAYA & IYIGUN, 2010).

Therefore, project management maturity is when an organization applies project management techniques and uses them appropriately and maturely. A mature organization is an organization with a broad ability to manage projects based on standard and defined project management processes that can be tailored to meet the specific needs of each project (Supic)

1. Description of maturity levels 2. Model processes that are subject to evaluation 3. Evaluation tools to identify the level of organizational maturity. Model for how to develop and maintain maturity level

Other components in the models include capabilities, evidence of objectives, interrelationships, a network of prerequisites, etc. (Supic, 2005).

Krinia describes the maturity model in three ways: 1. A list summarizes the most important tasks that the organization should perform concerning that particular issue. 2- A map that shows the required activities based on tasks and the logical sequence to achieve the goals. 3- Measuring tools and measuring the accuracy of process performance, which is used to evaluate how activities and processes are performed and how to implement them (Davoudian Salahshour, & Mahdavi Adeli, 2011). Of course, in addition to project management, there are other models of maturity in technology, knowledge management system health, risk management, etc.

Introducing some models of project management maturity

- **Capability Maturity Model (CMM)**

The emergence of maturity models of project management is a relatively new phenomenon that can generally be traced to the maturity model of capability presented by the Institute of Software Engineering (SEI) at Carnegie Mellon University Grant, 2016) & (Pennypacker, 2006).

This model, the first maturity model presented, introduces 5 introductory levels, repetition level, defined level, managed level, an optimal level as maturity levels. These maturity levels define a sequential scale for assessing an organization's software capability.

- **Capacity Maturity Model (CMM)**

20802. Integrated Capability Maturity Model (CMMI) Software Engineering Institute (SEI) Considering the principle of project management that the quality of a system with a product is strongly influenced by the quality of the process used to produce and maintain it, CMMI models Which contain the same principle. The main focus of this model is on engineering guidelines, software engineering, product integration and process development, and supplier organization. Using the model has two approaches, the staged approach has 5 levels of maturity, and the continuous approach has 6 levels of capability. Maturity levels in the staged approach are elementary, managed, determined, quantitatively, and optimally managed. Capability levels in the continuous approach include incomplete, done, managed, determined, quantified, and optimized levels (Software Engineering Institute, Carnegie Mellon Uni, 2006)

Maturity levels in the Capacity Maturity Model Integration (CMMI)

3802. Berkeley Model 17 The Berkeley Project Management Maturity Model is a 5-level model. Each level breaks the project management activities and processes into 9 areas of knowledge and 5 phases of project management. One of the advantages of using the Berkeley model is that it includes all the organizations that run the project management processes and activities and does not belong to a specific area or organization. The Berkeley model allows an organization to identify its strengths and weaknesses and achieve a higher level of maturity by focusing on its weaknesses (Kwak & Ibbs, 2010).

PMI Solution Model

The PM Solution model uses nine PMBOK knowledge areas in the CMM model. This model is based on a two-dimensional framework with 5 distinct levels of maturity in one dimension and evaluates organizations in the other dimensions in 9 areas of project management knowledge. Each level of maturity indicates the individual capabilities of the organization based on the characteristics of each level. Maturity levels are called elementary processes, structured processes and standards, organizational standards and institutionalized processes, managed processes, and optimized processes.

- **KerZner model**

The KerZner project management maturity model is based on a 5-step structure, each stage representing a higher level of organizational maturity and development in project management. In this model, the levels of maturity levels are examined in different chapters, and a questionnaire is presented to meet the requirements of each level, based on which the organization finds its current status and makes the necessary plans to improve its position. Maturity levels in this model are shared literature, shared processes, unified methodology, modeling, and continuous improvement (KerZner, 2015).

- **P3M3 Model**

This model, which is based on the process maturity framework proposed in the Capacity Maturity Model (CMM), presents project-related activities, programs, and portfolios in the form of key process areas that play a role in achieving successful project results. . P3M3 identifies activities related to independent projects and programs, as well as activities that lead to building an infrastructure of adequate models in project and program management within the organization. Given that the basic basis of this model is the capability maturity model, it uses the same 5 levels to define maturity: elementary processes, reproducible processes, defined processes, managed processes, and optimized processes (OGC 2016).

- **Organizational Project Management Maturity Model (OPM3)**

Organizational project management Systematic management of projects, programs, and portfolios to achieve macro-strategic goals. The concept of organizational project management is based on the belief that there is a correlation between the organization's capabilities in project management, program management, and portfolio management and its effectiveness in implementing the strategy. The extent to which an organization engages in this type of project management is interpreted as the organizational maturity of the project management of that organization (Project Management Institute, 2006).

OPM3, provided by the Project Management Institute, consists of knowledge, evaluation, and improvement. The element describes the knowledge of organizational project management and the organizational maturity of project management. Also, the best solutions and how to use the model are part of the knowledge element of the OPM3 model. It should be noted that the OPM3 model follows a standard called Project Management Knowledge Range (PMBOK).

The evaluation element provides methods, processes, and procedures that an organization can use to assess maturity. Evaluation is done in two ways: self-evaluation and comprehensive evaluation. Self-assessment is used to identify the best solutions, and comprehensive evaluation is used to identify the competencies associated with the best solutions.

Improvement Element: For many users, evaluation results include a list of capabilities that are not yet fully developed in the organization. OPM3 guides how they should be arranged in order of importance and thus forms the basis of subsequent improvement plans (Institute of Project Management, 2006).

Method

The type of research is applied, and its method is survey. First, we use library studies to collect basic information and review the literature, and then through field studies, the status of organizational maturity of project management in Tehran Regional Electricity Company is examined. The statistical population of the research is the experts and design managers of Tehran Regional Electricity Company. In order to evaluate the model and adapt the above model to the conditions of the power industry, an interview and a questionnaire were used to collect information. After studying different maturity models in this research, the OPM3 model has been used as a model.

Given that the OPM3 model has continuous improvement on the agenda, we also considered five maturity levels from the introductory level to the optimized level according to different maturity models. As the OPM3 model uses the PMBOK standard in its structure, we also based the process areas of this standard on our model and using this standard and the maturity model of petrochemical projects, and according to the characteristics of the power industry and the opinion of experts, We added another one. The importance of each process domain was determined using the fuzzy AHP method. Project management processes were identified within the framework of project management process areas and according to the project progress stages. In this study, interviews and questionnaires were used to obtain the level of maturity of each of these processes among the data collection tools. The questionnaires were filled out by 12 design and development experts of Tehran Regional Electricity Company to obtain the level of maturity in this company. By determining the maturity level of each process, the maturity level of process areas, project development stages, and finally, the desired organization were determined.

Findings

Weights of each process domain

After the pairwise comparison questionnaire of project management maturity indicators in the power industry was completed by experts, Chang development method was used to determine the weight of each indicator. Linguistic variables have been used to collect experts' opinions regarding the pairwise comparison of criteria, as described in Table 3-3. It is worth mentioning that because of the opinion of all those who filled in the questionnaire and the same woman was considered, a geometric average was used to obtain the average opinion of the respondents.

After experts completed 9 AHP questionnaires, geometric mean was used to obtain their average opinion, and the mean pairwise comparison numbers were in the stages of weight determination. The results after the completion of the steps are as follows: the weights extracted from the FAHP method.

Table 1. Weight of each process domain

Indicators for measuring the level of maturity of project management in Iranian organizations	Weight
Project strategy management	0.10869
Project integration management	0.1
Project communication management	0.092652
Project human resource management	0.092391
Project scope management	0.08913
Project quality management	0.084783
Project time management	0.081522
Project cost management	0.079348
Project safety management	0.076087
Project risk management	0.067391
Project financing management	0.065217
Project Procurement Management	0.059873

Validity and reliability analysis

As stated in Chapter 3, in this study, Cronbach's alpha method was used to assess the reliability of the questionnaire. Reliability refers to accuracy, reliability, stability, or repeatability of test results. In this method (alpha calculation), reliability is operated as internal consistency, which forms the degree of internal correlation between test questions.

As previously explained, 51 questions were given to the respondents in the form of a Likert scale questionnaire from 0 to 5 to express their opinion about the level of maturity of each process. Finally, the reliability of the 954 questionnaires. It was found that the value is very good and indicates that the reliability of the questionnaire is at a high level.

The maturity level of project steps

Also, based on the stages of the project and the completion of the process cycle, the level of maturity was determined for each stage of planning, implementation, control, and completion. In order to obtain the level of maturity of each stage of project completion, the average level of maturity of the processes that were in one stage of the project was considered the level of maturity of that stage. As shown in the figure, the level of maturity of the company's processes in the planning stage with 1.7 and then execution with 1.76 is less than the control stage with 1.88 and the end with 2.64. Therefore, the company should pay more attention to improving the planning and implementation processes.

Conclusion

Discussion and analysis of results

Over the past decade, maturity models have been introduced as one of the most tangible ways to assess project management maturity in a company. These models help organizations to compare their obvious capabilities at the level of organizational projects and programs with a specific and scientific standard. Maturity models show why some projects have been successful, and others have failed during academic and organizational efforts. Universities and companies always question the success rate of projects and consider the return on investment of projects. As mentioned in previous chapters, organizations can use maturity models to assess the level of their project management and, after identifying weaknesses, try to improve them. To determine the current status of project management and implementation, according to the conditions of the power industry, a maturity model has been designed in this regard, and the maturity level of Tehran Regional Electricity Company has been measured in different dimensions. We now discuss the level of maturity in each dimension.

In terms of project management process areas, the results showed that the project procurement management area with a maturity level of 2.57 and then the project strategy management area with a maturity level of 2.53 are in a better process maturity status. The results show that these process domains have reached the second level of maturity and are on the way to achieving the third level of maturity. Considering that in this research, each process's maturity level in these areas has been determined, the necessary planning can be done to improve each of these processes. Achieving the second level of maturity, the structured level means that project management processes exist in these process areas, and there are also criteria for measuring these processes in the organization. The closer this level of maturity is to the third level of maturity, the measurement of processes will be according to organizational standards and criteria and other projects.

In the process area of risk management, the project, which has reached the maturity level of 0.81, shows that this area is a process where the processes of risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, and monitoring. It involves risk control, it has not yet reached the basic level of maturity, which means that there are no project management processes in this area yet. The process area of human resource management with a maturity level of 1.15 indicates that there are project management processes in this area, but there are no defined activities and standards, and project managers are not accountable according to process standards.

In the dimension of project implementation, according to the average level of maturity of the processes in each stage of project completion, the level of maturity was determined. In the planning, implementation, and control stages, the maturity level is close to each other, and the processes in it are at a lower level in terms of the degree of maturity than the project completion stage. The level of maturity of the planning stage is 1.71, which indicates that the processes of this organization in the planning bath are weaker and should be considered to improve the level of maturity in all these strategies. As shown in the table, the most significant number of processes are in this bath, and if the level of maturity is upgraded in this bath, the overall maturity of the company will increase. The project completion step, in which only 3 processes are included, has a maturity level of 64.2 and higher than the other steps of the project completion cycle.

The general level of maturity of project management was determined according to the weighted average level of maturity of process areas. According to the experts and using the fuzzy hierarchical analysis process

method for each of the process areas, a weight was obtained, and the level of maturity of project management in Tehran Regional Electricity Company was determined. The level of maturity of project management in Tehran Regional Electricity Company was 1.89, which shows that this company has reached the first level of maturity and is on the way to achieving the second level of maturity. The overall level of maturity of the organization can be the basis for comparing the maturity of project management in different organizations.

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