

Critical Competencies in Project-Based Organizations: An Interpretive Structural Modelling approach

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Abstract

The capabilities of project managers determine the success of the projects. Nowadays, the standards of project management competence in the most advanced societies in the world are widely accepted. Several published articles and books in this area, and the increasing attention of organizations to the desirability of project management, also indicate its increasing importance. Developing a model for assessing the identification of project management based on the behavioral and professional principles in order to select, evaluate and enhance the human resources of the project will have a significant impact on the professional development and professional excellence of this specialized field in project-based organizations (PBOs). Over the years, knowledge of skills and knowledge for project success has been one of the most fundamental issues. In this study, the interpretive structural modeling (ISM) method is used, and then the competencies are ranked according to the given privileges. The findings of this study indicate that all of the competencies of a project manager are significantly related to achieving project performance in terms of leadership, organization, production management, technicality, and so on. Knowledge and experience of project management, leadership, knowledge and practical experience, industry knowledge and experience, and cognitive and individual effectiveness are among the most influential factors that have a significant impact on competency.

Keywords

Project Management, Project Manager's Competency Standards, Project-Based Organizations (PBOs), Criteria, ISM Methodology

1. Introduction

The competency of doing a job is far beyond being able to do it. Competency is a term beneficial, but for different people, it induces different concepts. Competence includes knowledge, skills, attitudes, and behaviors that are related to better job performance (Bundy, 2004). A project manager would not be worthy of knowing the project management knowledge but rather being able to use it in addition to knowledge and also be able to handle the issues of human, social and behavioral issues. In most definitions of competency, all of these dimensions exist, and the only significant difference is in the type of vocabulary used. By definition, competency is a set of knowledge, encountering practices, skills, and other personal characteristics that affects a significant portion of a person's job (for example, one or more responsibilities), is associated with performance in that job, can be measured according to entirely accepted standards, can develop and improve through education, and it can be broken into competency dimensions (Nicholas and Steyn, 2017).

The use of knowledge correctly results in proper performance, which is different from the experience, because someone may have done something wrong over the years. The ability to select the most suitable project manager shows organizational maturity in project management and is still a challenge for organizations (Kerzner and Kerzner, 2017). Since the projects are undertaken as a tool for achieving the strategic goals of organizations, project managers

are also responsible for taking on leadership roles (Müller and Turner, 2010, Jahantigh et al., 2018). Giraldo González et al. (2013) indicate numerous studies show that project manager competencies are vital to project success. The success of the project is to achieve the objectives of the project by following the requirements and conditions agreed with the project stakeholders. It almost includes time, cost and quality (Mokhtari et al., 2012). One of the most important and influential factors in the success of the project is the adoption of an appropriate approach to the selection, appointment, maintenance, and promotion of managers and staff and, in general, the human resources of the project (Almasi and Malmir, 2015). Now it has to be examined how the competency of the axis is realized. Competence refers to a set of knowledge, values, personal attitudes, relevant skills, and experiences that are needed to succeed in a specific activity. Any person must have the competency to succeed in a job, or, in other words, qualify for it. Generally, competence is a collection of knowledge, value, skills, capabilities, and other behavioral characteristics that can be measurable and related to individual performance (Moein et al., 2015). One of the most important areas of competence that has a great impact on the success of projects is project management competencies (Jahantigh et al., 2017). Therefore, the development of project management competency standards is considered as one of the basic needs of PBOs. These standards define the key dimensions of a project manager's suitability that affects the efficiency and effectiveness of project management and is, in fact, a tool for measuring and enhancing the level of ability of those who want to be involved in project management. Improving project performance is a common concern in almost all organizations. Studies show that the project manager's skills are critical to the success of the project (Giraldo González et al., 2013). On the other hand, and in a similar way, the capabilities of project management have a major impact on project performance, and thus affect the performance of the entire organization (Crawford, 2005). Advanced and expert tools for project management are not enough to improve project performance, and the development of project management skills is also necessary. It should be noted that despite studies, the relationship between the project manager and organizational success requires more studies (Berssaneti and Carvalho, 2015). According to the PMBOK Manual, Fifth Edition (Project Management Institute, 2013), the project manager is responsible for achieving goals, and the success of the project depends on the skills of the project managers. Selection of project managers is a major challenge for organizations (Ahsan et al., 2013) as well as a major success factor for projects (Sadeghi et al., 2014). The ability to select the most suitable project manager demonstrates organizational maturity in project management, besides being a challenge for organizations (Kerzner and Kerzner, 2017). It should be noted that different organizations and different types of projects require the different authority of the project managers (Chipulu et al., 2013) and (Takey and de Carvalho, 2015). Accordingly, growing interest from experts and organizations to identify the key competencies required in any unique situation to select a successful project manager (Giraldo González et al., 2013). On the other hand, according to the project conditions, the project manager may need to learn some competencies in order to be successful in the project (Takey and de Carvalho, 2015). In order to identify the competencies and point out the guidelines for developing the necessary competencies to manage projects, various project management institutions have created guidelines, frameworks, or standards. Some examples of these institutions are: the Project Management Institute (PMI), who created the Project Management Competency Development (PMCD), the International Project Management Association (IPMA), who created the Individual Competence Baseline for Project Programmer and Portfolio Management (ICB), the Association for Project Management (APM), who developed the APM Competence Framework (ACF), and the Australian Institute of Project Management (AIPM) who developed the Professional Competency Standards for Project Management ([PCSPM] AIPM, 2010a, 2010b; APM, 2015; IPMA, 2015; PMI, 2007). Despite the existence of these guidelines, some skepticism has been created by the absence of a definitive empirical basis for their preparation (Chipulu et al., 2013). In this paper, the concept of competence is an assimilation of the concepts identified by PMI (2007), IPMA (2015), AIPM (2010a), and APM (2015). Thus, competences are defined here as knowledge, personal attitude, and the ability or relevant experience that allows performing one or more activities to realize an expected level of performance. Consequently, the concept of core competencies can be defined as a set of competences considered essential for a person to be accepted as appropriate for the field of project management. The key competencies are usually required for project management (AIPM, 2010a, 2010b, APM, 2015, IPMA, 2015, PMI, 2007). The guidelines developed by these institutes and project management associations provide a comprehensive view of the core competencies that the project manager must effectively target. The facilitation of understanding the competencies listed by suitability models is presented in Table 1. The analysis of the scales of the three models (PMCD, ICB, PCSPM) is presented in this table, which shows a similarity between their structure and the methodological approach between them (Takey and de Carvalho, 2015).

Also, after investigating articles for analyzing literature review, some criteria to assess the competency in project management were found. One of them is soft skills, which contain leadership (Müller et al., 2012, Müller and Turner, 2007, Müller and Turner, 2010), communication (Henderson, 2008, Monteiro de Carvalho, 2013), emotional intelligence (Clarke, 2010, Lee et al., 2013), change management (Crawford and Nahmias, 2010, Harison and

Boonstra, 2009), resiliency (Babajani et al., 2019), M-learning (Moein et al., 2015) and knowledge (Chipulu et al., 2013, Palacios-Marques et al., 2013). Finally, Boyatzis (1982) presents a competency model that indicates that the relevant managers from all areas and sectors, not just project managers, share a set of common characteristics, including leadership, human resource management, direction, expertise, focus on people, and an ability to manage actions and objectives. In this article summary of identified competencies in table 2 were investigated.

Table 1: Comparative Analysis of Project Management Competences Framework

Proposed Competency Model	PMCD Project Manager Competency Development Framework (PMI, 2007)	ICB IPMA Competence Baseline (IPMA,2015)	APM Competency Framework (APM, 2015)
Behavioral: Qualifications related to personal and social capacities of a project manager	Individual competencies: 6 Individual competencies and the group one needs.	Person competencies: 10 personal and social competencies that a person needs.	Among the 27 competencies created, is a combination of behavioral, managerial, and defined-concept skills. For example, leadership is one of the competencies of APM.
Technical or Specific: It is related to the activity that the Project Manager enters into.	Technical competencies are considered as other competencies, and the PMCD does not meet the specific competencies of the industry.	The elements of technical competence will be specified, implemented and managed.	Technical competencies are related to the integration of the design and production of project products.
Management competencies: Project management competencies associated with major project management activities	Knowledge: The knowledge of the project manager is from project management processes, tools, and techniques for project activities. Function: Use of project management knowledge. In general, what the project manager can do with his/ her knowledge.	Executive competence: Fourteen skills related to projects, program and portfolio knowledge limitations, and project management processes.	Among the 27 competencies created, there is a combination of behavioral, managerial, and field skills. Some APM competencies relate to the knowledge of project management and project management processes such as procurement, planning and risk management.
Subjective competencies: Qualifications related to the field and business of the company	Subjective competency is raised as other competencies, which PMCD does not refer to, yet recognizes the concept of organization and maturity.	Prospects competencies: Five skills in the field of a project: strategy, governance, structure and processes; compliance; standards and regulations; strength and interest; and culture and values.	Of the 27 abilities created, there is a mix of behavioral, managerial, and ground qualities. For example, government order and arrangement are one of APM's competent.

Mention: APM= Association for Project Management; IPMA= International Project Management Association; PMCD= Project Management Competency Development.

Therefore, in this paper, in order to study the competence of project management in PBOs, it studied the criteria of competence in internationally recognized standards and the conditions and requirements of such organizations for attracting required human resources. With the identification and categorization of criteria and by using the interpretive structural modeling method steps and results presented in the form of the following tables. This research applied to answer this question: What are the competency priorities for choosing project managers? While addressing this question, is the main objective of the current study, it implies to propose a comprehensive model, which was designed with a holistic and systemic view (Bastan et al., 2016b, Habibifar et al., 2019, Jamili et al., 2018, Hamid et al., 2019, Ebadi et al., 2011; Babae Tirkolae et al., 2019; Mostafaeipour et al., 2019; Tirkolae et al., 2019a; Tirkolae et al., 2019b; Goli et al., 2019; Tirkolae et al., 2018). Decision making based on such model which was built without a systemic view can lead to unexpected results (Bastan et al., 2018, Hamid et al., 2018b, Yazdanparast et al., 2018,

Sheikhmohammady et al., 2011). There are some reported problems in different cases which faced counterintuitive behavior during management, due to relying on a non-systemic analysis, and policy evaluation (Abbasi et al., 2016, Abniki et al., 2017, Azizi et al., 2017, Bastan et al., 2016a, Kasiralvalad et al., 2016, Khoshneshin and Bastan, 2014, Tabarzan et al., 2017, Zadfallah et al., 2017, Bisheh et al., 2018, Gharoun et al., 2019, Esmaeili et al. 2015, Malmir and Spicar, 2014, Hamid et al., 2017, Hamid et al., 2018a). In the following, we will examine the literature review to express the competence of project management. Then, the methodology of the project is analyzed, and finally, we will conclude.

Table 2 – Summary Identified Competencies

Categories	Terms	References
Behavioral	Leadership Communication Emotional intelligence Motivation Influence Dynamic Creative Flexibility Ethical Sensitivity	(Clarke, 2010, Henderson, 2008, Marsh and Stock, 2003, Müller et al., 2012, Müller and Turner, 2010, Paajanen et al., 2009, Skulmoski and Hartman, 2010, Torkaman et al., 2011); APM (2008); PMI (2007); IPMA (2006); AIPM (2010b)
Technical or Specific	Product Technical Software Industry Engineering Test	(Chipulu et al., 2013, Giraldo González et al., 2013, Grant et al., 1997, Marsh and Stock, 2003, Rose et al., 2007); APM (2008); PMI (2007); IPMA (2006); AIPM (2010b)
Management	Planning PMP ¹ Resource Management Certification Change Management Monitoring Negotiation Risk Management	(Ahsan et al., 2013, Buganza et al., 2013, Crawford and Nahmias, 2010, Creasy and Anantatmula, 2013, Giraldo González et al., 2013, Hwang and Ng, 2013, Skulmoski and Hartman, 2010, Starkweather and Stevenson, 2011), APM (2008); PMI (2007); IPMA (2006); AIPM (2010b)
Contextual	Organization Business Relationship Environment Process Marketing	(Anbari et al., 2008, Kræmmergaard and Rose, 2002, Müller and Turner, 2010, Paajanen et al., 2009, Skulmoski and Hartman, 2010), APM (2008); PMI (2007); IPMA (2006); AIPM (2010b)

2. Method & Result

ISM is one of the modeling techniques developed for strategic policy planning. This method can also be used by planners to analyze complex problems that cannot be done by traditional operational research approaches and descriptive statistics. Also, it is relevant to the interpretation of an object or a representative of the whole system through the application of theory in a systematic and iterative graphics. The stages carried out for ISM includes the following steps:

1. Identifying elements that can be obtained through research such as brainstorm related to needed competency for project managers.
2. Building a contextual relationship between elements based on the purpose of modeling.

¹ Project Management Professional

3. Creating a Single Interaction Matrix (Structural Self-Interaction Matrix/ SSIM²). This matrix element represents the element of preparation for the intended respondents. Four symbols are used to represent the type of relationship that exists between the two elements of the system being considered:
 V... relationship of the elements E_i to E_j, not vice versa;
 A... relationship of the elements E_j to E_i, not vice versa;
 X... interrelated relationship between E_i and E_j (to the contrary);
 O... shows that E_i and E_j are not related.
4. Making a reachability matrix (RM) by changing the SSIM symbols into a binary matrix.
5. Grouping sub-elements into four sectors: Technical or specific, Contextual, Behavioral and management, based on values of Driver Power (DP), and Dependence (D) on reachability matrix.
6. Creating a hierarchy based on values of Key Elements (KE) and level on reachability.

The ISM methodology collects views and contributions from experts/managers through the brainstorming and group methodology concerning examining the effects of the criteria extracted from the literature review. Table 3 lists these competencies.

Table 3 - Identified Competencies

Row	Technical or specific Competence	Coding	Contextual Competence	Coding	Behavioral Competence	Coding	Management	Coding
1	Product	Prod	Organization	Or	Leadership	Le	Planning	Pl
2	Technical	Te	Business	Bu	Communication	Co	PMP ³	PMP
3	Software	So	Relationship	Re	Emotional intelligence	Em-in	Resource management	Re-m
4	Industry	Ind	Environment	Env	Motivation	Moti	Certification	Cer
5	Engineering	En	Process	Proc	Influence	Inf	Change management	Ch-m
6	Test	T	Marketing	Mar	Dynamic	Dy	Monitoring	Moni
7					Creative	Cr	Negotiation	Neg
8					Flexibility	Fle	Risk management	Ri-m
9					Ethical	Eth		
10					Sensitivity	Sen		

In this study used Group ISM methodology with MATLAB. After creating a survey an aggregating, them, then made Power and Dependency. After that made this formula:

$$\begin{aligned}
 V(i,j)=0 & \quad \text{if} \quad SS(i,j) \leq \text{mode}(SS) \\
 V(i,j)=1 & \quad \text{if} \quad SS(i,j) > \text{mode}(SS)
 \end{aligned}$$

Then the input set, the output set, and the same set were made to create the level with the similarity between the same set and the output set.

Following the purpose of the study, of thirty sub-elements from literature review only five elements were selected. These are the first level. Leadership, PMP, Resource Management, Change Management, and Risk Management. The second levels were motivation and communication, and other items were on the third level. Figure 1 shows the process of this methodology.

² Structural Self-Interaction Matrixes

³ Project Manager Professional

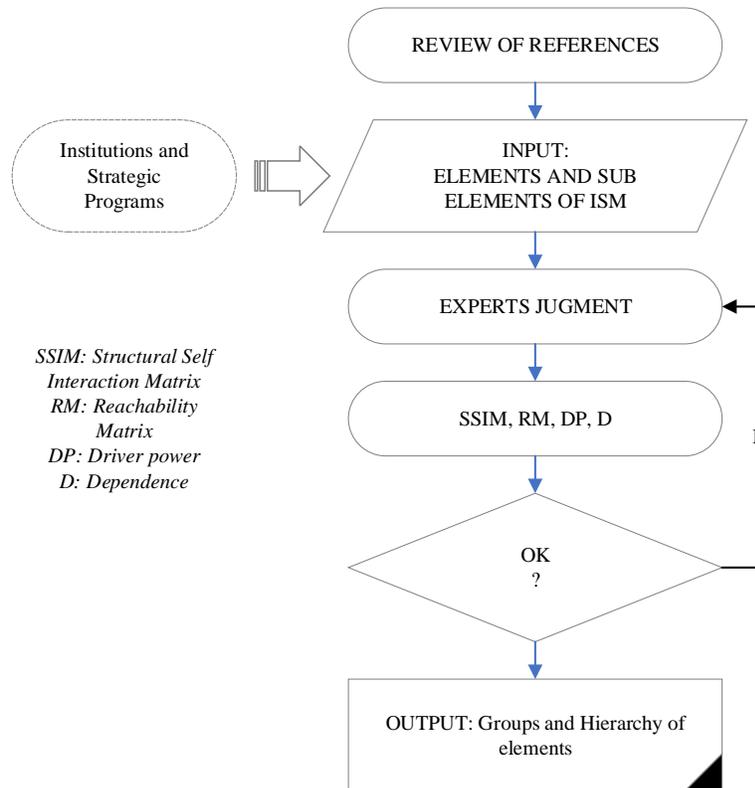


Figure1- Steps of ISM analysis

Based on the interviews with the experts by using the concept of the matrix, SSIM (Structural Self Interaction matrix) was obtained. On the matrix RM the sub-elements can be seen as the main drivers of the others by looking at the Driver Power (DP) and Dependence (D).

In categorizing the competency development framework project management (PMCDF) is divided into three groups of knowledge, performance, and individual competencies, and also the standard classification of project management competency basis (ICB) into three categories: technical, behavioral, and conceptual competence.

The technical competence scope describes the core components of the project management competence and includes the contents of the project management. Project managers must communicate with all project stakeholders to integrate the project into the broader spectrum of the organization in order to benefit both the customer and the organization (Kloppenborg and Baucus, 2003). The range of behavioral competence that describes the project management suitability of individual aspects is in line with the project manager's behavior concerning other individuals and groups involved in the project, and the conceptual competence scope describes the project components management that addresses the environment and requirements of the project are related. However, with assessing in the literature review, the fourth criteria can be added. It is a new viewpoint as management. It should be achieved academically and also should be in his/ her personality. In other words, it describes the concepts of the project and the portfolio of the project. Studying and evaluating the standards and models of project management competence of different organizations and companies show that project management competencies are classified into four areas: technical, contextual, behavioral, and management competencies (ICB, APM, USA-NCB, NIOC). On the other hand, this type of division is such that it is possible to include the competency of standards and other models in this type of classification. Based on this, the competencies of lots of different standard and project management competence models (ICB⁴, APM⁵,

⁴ IPMA Competency Baseline

⁵ Association for Project Management

GAPPS⁶, NCB⁷, PMCD⁸, SAQA⁹, ECITB¹⁰, PMCC¹¹, NASA¹², SHELL¹³, BUCEC¹⁴, and NIOC¹⁵) are divided into three categories: technical, conceptual and behavioral. After analyzing it, competencies with the highest emphasis on project management competency standards and models were prioritized, and then some of the top competencies related to each competency level were categorized and identified as key competencies required by project managers.

3. Conclusion

The objective of this paper is to contribute to the discussion of how to understand critical competencies in project-based organizations. In other words, based on three case studies with a significant number of managers in each of them, we tried to understand how the different levels of competencies are analyzed and coordinated in PBOs. In addition, we tried to find a way to allocate unambiguous roles and responsibilities to the right people in the right projects at the right time, so a survey questionnaire was administered across different PBOs. Survey items from validated projects which used in the previous studies were adapted to operationalize in the model (ICB, APM, USA-NCB, NIOC). For a pilot study, participants were project directors or project managers.

From this perspective, the work has achieved its goal by identifying the competencies expected according to both the project management literature and the case studies. The competence analysis was driven by four categories: contextual, behavioral, technical, and managerial. These categories were divided into key competencies in each category. Then used the ISM model to analyze and choose the critical competencies. This technic assist to understand if a system needs to change which factors will have a critical role in attention that means a factor with highly driven and low dependence. Based on a survey conducted by managers, it is clear how the importance of each competency in the project is to improve its performance. Accordingly, organizations that seek to find project managers with greater competence, improve the performance of project managers, and design and develop competency models can use this priority.

⁶ Global Alliance for Project Performance Standards

⁷ USA National Competence Baseline

⁸ Project Manager Competency Development

⁹ South Africa Qualification Authority

¹⁰ Engineering Construction Industry Training Board

¹¹ Project Management Core Competencies

¹² National Aeronautics and Space Administration

¹³ Royal Dutch Shell

¹⁴ Boston University Corporate Education Center

¹⁵ National Iranian Oil Competency

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