Forging the Future: Pioneering Approaches in Business, Management and Economics Engineering to Overcome Emerging Global Challenges - 2024

https://doi.org/10.24867/FUTURE-BME-2024-049 Original scientific paper

USING INTERPRETATIVE STRUCTURAL MODELING FOR ANALYZING KEY PROJECT MANAGERS' AND PROJECT TEAM MEMBERS' SKILLS, CRITICAL FOR PROJECT SUCCESS

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Abstract

Project management is one of the most challenging jobs in any organization, as it requires a broad understanding of the various areas that must be coordinated. Over the past few decades, a number of studies have emerged on the correlation between project managers' and project teams members' competencies and project success. To improve project success, the organizations have to consider various skills such as communication (internal and external), effective control and monitoring, effective planning, ability to manage risk, etc, and their significance and the role in the project success. The aim of this paper is to use Interpretative Structural Modelling (ISM) and MICMAC analysis in order to analyze contextual interrelationships among the identified skills, divided into clusters, to develop structural relationship among these skills and to classify factors based on their driver and dependence power and their mutual relationships.

Key words: *competences, project manager, project team members, project success, structural modelling.*

1. Introduction

Realizing the importance of people management skills, Turner reformulated his definition of a "project" to recognize its human aspects. He defines a project as: "An effort in which human, financial, and material resources are organized in a new way to undertake a unique scope of work, given specifications, within cost and time

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constraints, to achieve beneficial change defined by quantitative and qualitative objectives (Turner, 1999).

The role of the project manager has evolved from a project administrator to a much higher managerial and leadership position, and to fulfilling organizational strategic needs. The project manager manages the project through the identification of project requirements; establishment of clear and achievable goals; balancing competing demands for quality, scope, time and cost; by adapting plans and approaches to different interests and expectations of different stakeholders; and project management in response to uncertainty. The role of a project manager is one of the most challenging jobs in any organization, as it requires a broad understanding of the various areas that must be coordinated. In addition, it requires strong interpersonal skills (Ahsan et al., 2013).

On the other hand, although it is clear that the success of the project largely depends on the project manager and related factors, the literature indicates that it also depends on the members of the project team. Successful project teams consist of individuals who share common goals and operate in the same way (Waweru, 2018).

In this regard, critical project factors depend on the skills and competencies of the project team and the leadership skills of the project manager to get the best out of his team (Mwinzi & Moronge, 2018). Project success is determined by project team effectiveness, project scope management, project time management, project costs, and project quality, which positively and significantly affect sustainability. Although extensive research has been conducted on the critical competencies of project managers and team members, there is a lack of structured analysis of the interrelationship between these competencies. This study aims to bridge this gap by employing Interpretative Structural Modeling (ISM) and MICMAC analysis to systematically examine the mutual dependence and driving power of these competencies. This will provide project managers with a clear hierarchical framework for prioritizing skill development.

2. Project and project seccuss

Considering that the field of project management is increasingly complex and diverse, a deeper understanding of the factors that contribute to project success is required. When we talk about project management, different project managers have different definitions of success, depending on their experience, knowledge, and the context in which they work. Some consider the number of projects completed on time and within the available budget to be the key factors of projects, which results in customer satisfaction, while others consider effective communication, successful cooperation, and the involvement of interested parties as success criteria.

All projects depend on some critical and key factors that represent the factors that determine the success of the project (Gupta et al., 2013). In this regard, they are those inputs into the management system that directly or indirectly lead to the project's goal (Murphy & Ledwith, 2007; Cooke-Davies, 2002).

Success is a subjective term and different people perceive it differently, but it is generally considered that a successful project is one that meets the requirements of the client/project orderer and other interested parties, especially the quality dimension.

Despite the well-developed body of knowledge in the field of project management, no comprehensive and unique agreement, i.e. consensus among authors, has been reached on the definition and method of measuring project success that would be appropriate for all projects (Ahimbisibwe et al., 2015, Savkovic et al., 2023), taking into account different human, budgetary and technical variables of each project. Criteria for measuring project success have evolved from simply measurable iron triangle criteria (time, scope and cost) to multidimensional frameworks that have a long-term perspective and relate to efficiency and organizational impact.

2.1 Key project managers' and project team members' competences

Factors based on the project manager are grouped into 4 clusters, namely: communication skills, technical knowledge, management skills and management-leadership style, where each cluster represents a set of skills needed for successful project implementation. The "communication skills" group assesses the importance of the project manager's communication skills to the success of the project. The "technical knowledge" cluster analyzes the importance of the project manager's technical ability for the successful completion of the project. The "management skills" and "management-leadership style" clusters assess the importance of the managerial ability and leadership style of the project manager for the success of the project (Jokanović Đajić et al., 2024).

Unlike project success factors based on the project manager, which are distributed in 4 clusters, factors based on project team members can be divided into input and process (Liu & Cross, 2016). Input factors include the characteristics of the internal environment in which the team operates and the characteristics of the team members, as well as the work on the project, e.g. leadership, management support, rewards, team diversity, clear goals, management skills and ability to use tools and techniques. On the other hand, process factors describe the internal interaction between team members and the external interaction between team members and other stakeholders, i.e. project stakeholders and include: cooperation, communication, learning activities, cohesion, commitment, conflict resolution, team climate and performance. These factors highlight the importance and suggest that successful project implementation is not an isolated process, but a joint effort involving various stakeholders (Jokanović Đajić et al., 2024). The previously mentioned clusters, with the corresponding associated factors, are shown in the following table 1.

Table 1: Key project managers' and project team members' competences (Jokanović Đajić et al., 2024, Jokanović Đajić et al., 2023)

	CLUSTERS	FACTORS
F1	**COMMUNICATION SKILLS**	• frequent and clear communication, • quality of communication, • expressed verbal communication skills, • strong graphic communication skills • spend more time in informal conversations, • active listening • the level of understanding of the communication of all participants in the project • establishment of formal communication channels • appropriate communication with different audiences • establishment of informal communication channels, • explains and continuously communicates any changes to the project plan, as it changes throughout the project's life cycle, • provide specific instructions to team members, related to each task
F2	**TECHNICAL KNOWLEDGE**	• effective planning, • effective use of technology, • risk management, • abilities (technical skills), • problem solving, • ability to use project management methodologies (process analyses, system design and so on), • focusing on critical elements of technical management (key factors of project success, deadlines, financial reports), • adaptation of traditional and agile tools, techniques and methods for each project, • thorough planning and prioritization, • managing project elements, including schedule, costs, resources, risks, • establishing a technological solution for the customer, • control of the availability of individual competencies, • selection and control of subcontractors, • implementation and management of schedules and their implementation, • establishing and assessing the technical risks of the project, • setting deadlines, • understanding the specific request

	CLUSTERS	FACTORS
F3	**MANAGEMENT SKILLS**	• managers capable of managing agile processes, • teamwork, • conflict management, • effective planning • effective coordination, • effective use of managerial skills, • effective control and monitoring, • ability to know the available resources (funds, equipment, people and the like), • manager's ability in agile processes, • project portfolio management
F4	**MANAGEMENT-LEADERSHIP STYLE**	• self-awareness, • motivation of the team, • human resource management, • development of human resources, • sensitivity, • empowerment of the team • the influence of the project manager on the team members • critical thinking
F5	**INPUT**	• leadership, • management support, • prizes (awards), • knowledge/skills • team diversity, • clearly defined goals, • management skills, • ability to use tools and techniques, • personal competences
F6	**PROCESS**	• cooperation, • communication, • activities related to learning, • cohesion, • commitment, • conflict resolution, • team climate, • performance

3. Interpretative structural modeling methodology and MICMAC analysis

The aim of ISM is to analyze complex systems (Warfield, 1974) It is an interactive process where a set of directly and indirectly related elements for a specific case are hierarchically organized and enable developing a map of relationships between the elements involved in situation (Ansari et al., 2013).

In this study this methodology is integrated with MICMAC analysis, in order to establish a hierarchical model of the identified key project managers' and project team members' competences and to explore their interrelationships. The choice of ISM over other methods like AHP is justified by its ability to map complex interdependencies in a structured and visual manner. Additionally, the fuzzy approach to MICMAC analysis will account for uncertainties in expert judgment, providing a more robust classification of competencies.

The steps of an ISM are as follow (Ansari 2013):

I: Identification variables/factors to be studied. In our research 6 key project managers' and project team members' competences have been identified as key factors for project success, as shown in table 1.

II: Contextual relationship among factors identified in step I should be examined. To indicate pair wise relationship among factors a structural self-intersection matrix (SSIM), table 2. Four symbols are used to denote direction of relationship between factors *i* and *j*: V – competence *i* will influence competence *j*; A – competence *j* will influence competence *i*; X - if both *i* and *j* are related together equally and O - competences *i* and *j* are unrelated.

III: An initial reachability matrix (IRM) is substituting the symbols (V, A, X and O) by 1s or 0s. The IRM for key project managers' and project team members' competences has been obtained as shown in table 2 adopting the following rules: if the entry in cell (i, j) in SSIM is V, then (i, j) is replace by 1 and (j, i) is replaced by 0 in the IRM; if the entry in cell (i, j) in SSIM is A, then (i, j) is replace by 0 and (j, i) is replaced by 1; if the entry in cell (i, j) in SSIM is X, then (i, j) is replace by 1 and (j, i) is replaced by 1 and if the entry in cell (i, j) in SSIM is O, then (i, j) is replace by 0 and (j, i) is replaced by 0 in the initial reachability matrix.

By adding the transitivity final reachability matrix is obtained (table 2). The transitivity of the contextual relationship is a basic assumption made in ISM and it states that if variable X is related to variable Y and variable Y is related to variable Z, then variable X is related to variable Z (Ansari et al., 2013).

Table 2. Final reachability matrix

	F1	F2	F3	F4	F5	F6
F1	1	0	1	1*	1	1
F2	1*	1	1	1	1*	1
F3	1	0	1	0	0	0
F4	1*	0	1	1	1	1
F5	0	0	1*	1	1	1
F6	0	0	1*	1	1	1

IV: Partitioning of levels of the reachability matrix obtained in step III. This is done to get the importance level of each project managers' and project team members' competence. According to the reachability matrix, the reachability set and antecedent set of every factor is determined. Reachability R(Si) and antecedent set A(Si) are calculated to partition the reachability matrix. R(Si)

refers to a set of factors on which the factor i has an impact while A(Si) refers a set of factors which impact factor i. The Intersection set is obtained by:

$$I(S_i) = R(S_i) \cap A(S_i)$$

If $I(S_i) = R(S_i)$ then the factors that are in a common Li will be located on the same level of the ISM and will be taken out from the set before the next partition (Zeng He and Huihua Chen, 2021), Table 3 for firs level.

Table 3. Decomposition of the reachability matrix for first level

Factor (i)	Reachability Set $R(S_i)$	Antecedent Set $A(S_i)$	Intersection Set $I(S_i)$	Level (Li)
1	1, 3, 4, 5, 6	1, 2, 3, 4	1, 3, 4	
2	1, 2, 3, 4, 5, 6	2	2	
3	1, 3	1, 2, 3, 4, 5, 6	1,3	I
4	1, 3, 4, 5, 6	1, 2, 4, 5, 6	1, 4, 5, 6	
5	3, 4, 5, 6	1, 2, 4, 5, 6	4, 5, 6	
6	3, 4, 5, 6	1, 2, 4, 5, 6	4, 5, 6	

V: Drawing the graph based on the contextual relationship in the reachability matrix. In accordiance with the results of partitioning the reachability matrix, structural ISM relationships diagram for this case was drawn as three-layer hierarchy, figure 1.

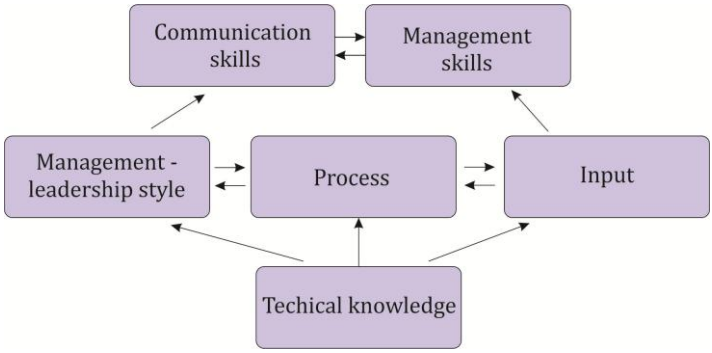

Figure 1: ISM based model

3.1. MICMAC analysis

MICMAC analysis analyze the dependence and driving power (Figure 2) of factors. Based on their dependence and driver power, the elements are subjected to MICMAC analysis and classified into four sectors, namely autonomous, dependent, linkage and driver/ independent. Factors with more driver power can strongly influence other factors, while factors with more dependence power are influenced by others.

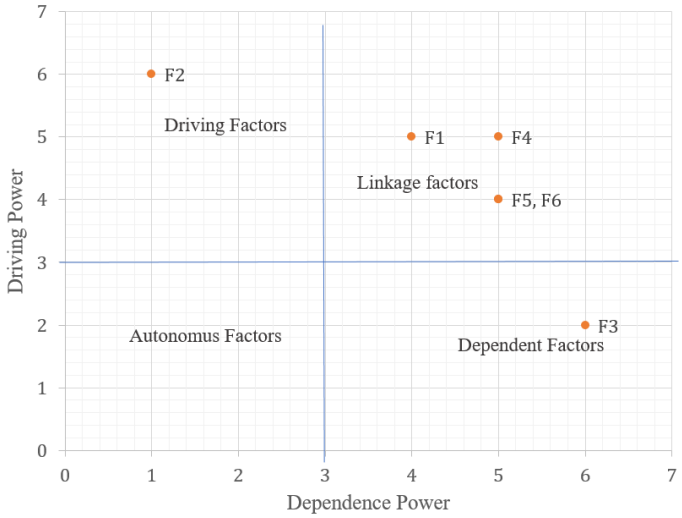

Figure 2: MIMAC analysis

3. Discussion

Figure 1 illustrates relationship between each pair of competences. As we can see factor F2 (Technical knowledge) is the root factor and this factor influence on other factors. On the other hand factors F1 (Communication skills) and F3 (Management skills) are direct factors and they are appearing at the top level of hierarchy.

Based on dependence and driving power competences have been classified in four categories using MICMAC analysis, figure 2. The autonomous competences have weak driver and weak dependence power. Relatively disconnected from the system, these elements have few links, which may be strong. In our research, no competences lies in this range. The dependent competences have weak driver power, but strong dependence power. These elements are sensitive to the action taken on the influent variables. (Poduval et al., 2015). In our study management skills is dependent factor and any action on this element will have effect on other elements**.** The linkage elements on the other hand have driver power and dependence, both of which are strong. These elements are unstable due to the fact that any action on these elements will affect the others and also a feedback on themselves. (Vivek et al., 2007). In our study four factors are lying in this range. The driving/independent elements strongly influence the system but is not influenced by the system. A competence with strong driver power called the “key factor” falls into this category. In our study one element named technical knowledge is lying in this range. This aligns with the PMI Talent Triangle’s emphasis on technical project management. However, our analysis positions 'Management Skills' lower in hierarchy, challenging the traditional views of its immediate importance."

4. Conclusions

This paper identifies and examines six key competencies of project managers and project team members that are critical to project success. Through the application of Interpretative Structural Modeling (ISM), we have developed a comprehensive hierarchical structure that reveals the contextual relationships among these competencies. ISM is particularly well-suited for analyzing the complex interrelations between competencies because it allows for a systematic breakdown of the factors into a clear hierarchy, providing insights into how each competency influences others. This enables project managers and organizations to better understand the priority of skill development and resource allocation.

Additionally, MICMAC analysis has been employed to classify the competencies based on their driving and dependence power, helping to identify the most influential factors. This method is invaluable in determining which competencies serve as key drivers for project success and which are dependent on others. Specifically, our analysis highlights that technical knowledge (F2) is the most critical driver, influencing all other competencies, while communication skills (F1) and management skills (F3) emerge as high-priority areas that require immediate attention due to their direct impact on project outcomes.

The findings suggest that a focused effort on enhancing technical knowledge as a foundational skill, complemented by improvements in communication and management capabilities, can significantly elevate the success rate of projects. Moreover, the classification provided by MICMAC enables project managers to strategically target key competencies for development, ensuring that training and resource allocation align with the overall objectives of project success.

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