

Leadership Competency for Megaproject's Complexity Management: A Conceptual Study

R. W. Damayanti, B. Hartono, and A. R. Wijaya

Abstract—This study aims to formulate a project manager's leadership competency to manage megaproject's complexity. Through qualitative literature exploration, this study integrates seven organizational leadership theories to develop megaproject leadership competency. Technical, emotional social and adaptive competencies are proposed as components of megaproject leadership competency that are crucial for managing structural, social, and emergent complexity. This study contributes to scholarship by giving insight into the leadership theories that potentially expanded the megaproject realm. For the practitioners, among others the project manager, this study gives a description of competencies that could be considered for managing megaproject complexity.

Index Terms—Competency, complexity, leadership, megaproject.

I. INTRODUCTION

A megaproject is an unusual project, due to its high cost (more than USD 1 billion) [1], [2], large size (scope) [3], involvement of many people (team and stakeholders) with different interests [2], and long duration (multiple years) [4]. Along with these characteristics, the complexity is also beyond that of an ordinary project [5] and makes it highly challenging to achieve megaproject success [6]. Hence, the complexity factor is often considered to be one of the causes of megaproject failure [5], [7].

Complexity indeed naturally exists because of a megaproject's characteristics. Therefore, it is crucial how one manages the complexity to reduce the risk of failure and increase the success opportunity [6]. There are three types of complexity associated with a megaproject: structural, social, and emergent complexities. These complexity types are adopted and expanded from project complexity by Maylor and Turner [8].

The structural complexity is termed from the challenge that is related to the megaproject size and factors relationship, for instance, the task and activity, the schedule, technology,

the scope, and the organizational structure [8]. Megaprojects have a high level of structural complexity due to the large number of activities [9], [10], many entities and teams [11]-[13], close relationship between factors [12], [14], [15] and new technology [11], [13], [14].

The social complexity is the matter associated with the social (culture) and political aspects from project entities [8]. In megaprojects, these aspects are related to the involvement of human elements, both the project team and stakeholders, who each have different goals or motives, for example politics [15], [16] or different work cultures, organizations or countries [10].

The emergent complexity is a matter related to uncertainty and change [8] that makes a project to have high turbulence, be unstable and have unplanned activity, which imply that the project condition is not conducive because of the difficulties of evaluation and control [17]. Uncertainty and change in megaprojects come from external factors such as the natural environment, regulations, social environment and market or political conditions [11], [16], and from internal factors such as technological and material logistics supply uncertainty [9], project team changes and unclear contracts [14].

As the complexity varies and has its own characteristics, the management to overcome the megaproject complexity must consider the project's condition [18]. Management of varying complexities in a megaproject should not only focus on many linkages of activities or work required to achieve targets but also be oriented to human relations in and outside the megaproject. From this perspective, "the project as a temporary organization" concept is an appropriate approach for managing complexity in a megaproject, as it not only considers the project task but also regards a leadership role that focuses on managing the people in the megaproject and the relationship with external stakeholders to achieve the project's final targets [19], [20].

From this perspective, leadership becomes a key aspect that project managers must possess. However, until now, there is no firm leadership formulation yet in megaprojects, especially for handling the complexity. Besides the limited number of studies in this field, researchers are still trying to explore proper leadership in the megaproject context, among others, in the construction infrastructure [21], [22], sports event [23], [24], space station [25], the defense industry [26] and other industries [27].

From this background, this study aims to formulate the leadership competencies concept from a complexity perspective to achieve megaproject success. This initiating study proposes a contribution to scholars and practitioners. For the scholar, this study gives insight into the knowledge of leadership theory in megaproject complexity management. For the practice aspect, this study provides leadership

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R. W. Damayanti is with the Department of Mechanical and Industrial Engineering, Universitas Gadjah Mada, Yogyakarta, Indonesia. She is also with the Industrial Engineering, Universitas Sebelas Maret, Surakarta, Indonesia (e-mail: retno.wulan.d@mail.ugm.ac.id, rwd@ft.uns.ac.id).

B. Hartono and A. R. Wijaya are with the Industrial Engineering Study Program, Department of Mechanical and Industrial Engineering, Universitas Gadjah Mada Yogyakarta, Indonesia (e-mail: boed@ugm.ac.id, andi.wijaya@ugm.ac.id).

competency attributes that should be considered when managing the megaproject complexity.

II. METHOD

This study used a qualitative approach based on literature exploration to achieve the research objective. Two research stages were utilized, namely 1) the leadership theory exploration and 2) the megaproject leadership competency formulation. This mechanism is presented in Fig. 1.

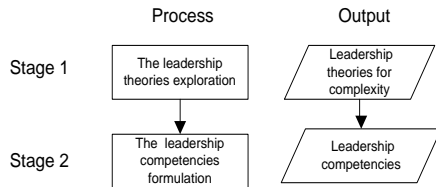


Fig. 1. The research mechanism.

III. RESULT AND DISCUSSION

A. The Leadership Theory Exploration

Leadership is “the action of leading a group of people or an organization” [28]. This definition is in line with definition by Bass [29] who stated that leaders were the focus of change in group activities. To apply this “leading activity,” the skills, knowledge and style or behavior are needed a leader to be able to influence a group of individuals to achieve common goals. These skills, knowledge and style or behavior are known as “competencies” [30].

Based on the “One Size Does Not Fit All Projects” concept of Shenhar [31], there is no best type of leadership at managing projects. Leadership competency needs to be adjusted to the type of project itself, including its complexity [32]. Therefore, project managers or project leaders are expected to have competencies to manage the three megaproject complexities (structural, social, and emergent). For instance, technical skills in planning and controlling to cope with structural complexity, the ability to conduct social relations (agreements and engagement) to handle social complexity, and the ability to adapt or be flexible to cope with the emergent complexity. To formulate the competencies of leadership, an exploration of leadership theory is carried out, which focuses on the orientation of “competency” with those criteria that have been identified.

Currently, there has been a reference to the project manager competency that has been formulated by the Project Management Institute [33], termed as the Project Manager Competency Development (PMCD) guideline. The PMCD formulates six competencies that need to be considered by project managers, namely communication ability, leadership, management, cognitive abilities, effectiveness, and professionalism. PMCD is developed in accordance with the Project Management Body of Knowledge (PMBOK). However, competencies in PMCD are tended for structural aspects in the standard project management, and they are still inadequate for overcoming the megaproject structural, social, and emergent complexities. Therefore, it is imperative for one to further explore the theories of organizational

leadership and integrate them with the existing PMCD guideline.

This study successfully found seven leadership theories that cover competency to overcome the structural, social, and emergent complexity in the megaproject, namely the competency leadership theory, complexity leadership, ambidextrous leadership, emotional social leadership, mindful leadership, adaptive leadership, and agile leadership. The theories are explained as follows.

1) The competency leadership theory

This theory was developed by Dulewicz and Higgs [34]. This theory consists of three leadership dimensions, the intellectual (IQ), managerial (MQ), and emotional (EQ) competencies. The IQ and MQ abilities are appropriate for planning management and control requirement in megaprojects for handling the structural complexity. The leadership's EQ dimension, which provides an opportunity for agreements (engagement) when anticipating social complexity.

This theory also accommodates the intuitive ability for one to balance rational and emotional decisions (EQ) when dynamic changes occur. This theory has been used to examine leadership in projects by considering the context of project complexity [35]-[37], such that it has potential to be expanded in the megaproject context.

2) The complexity leadership theory

Complexity leadership theory consists of three types of competency, namely operational, entrepreneurial, and enabling competencies [38], [39]. Operational competency is related to the ability to realize creative concepts and ideas from the innovation team into the organization's operational system, including controlling its sustainability. This mechanism is carried out through sponsoring, synchronizing, aligning, integrating, and executing activities with planning and controlling system operations [40]. This concept aligns with the need for planning and control management for the structural complexity of a megaproject.

Entrepreneurial or innovation competency plays a role in exploring creative ideas, looking for novelties that are then realized for the organization [38]. The ability to innovate according to the conditions of dynamic change has the potential to accommodate the emergent complexity in megaprojects.

Enabling competency supports the leaders to act as intermediaries or “bridges” to reduce conflicts between the entities. The activity carried out by means of networking and linking up between entities [38], for example, between team and stakeholders. This capability has the potential to accommodate megaproject social complexities.

3) The ambidextrous leadership theory

The concept of ambidextrous leadership is aimed at balancing operational and innovation systems in an organization [41]. In organizations, exploitation and exploration are applied such that they complement each other [42]; they are also applied in the project context, where neither of them is dominant, but, instead, they become a unit of project manager capabilities [43].

The concept of exploitation and exploration in

ambidextrous leadership is in accordance with the formulation of megaproject complexity management. Exploitation competency is in line with planning management and appropriate for the management of structural complexity. Exploration competence is suitable for adaptive or flexible contexts managed with flexibility management to accommodate emergent complexities. The exploitation and exploration abilities are two competencies become the basis for the consideration of ambidextrous leadership as a subset of megaproject leadership competency.

4) *The emotional social leadership theory*

Emotional social intelligence (ESI) leadership is leadership that focuses on managing personal and social aspects from the internal and external organization [44]. ESI leadership has four dimensions, namely self-awareness, self-management, social awareness, and social management [44], [45]. In the megaproject area, the dimensions and attributes of its competence potentially support agreements and engagement abilities to manage the social complexity of megaprojects.

5) *The mindful leadership theory*

Mindful leadership emphasizes the calm and deep-thinking concept, aware of self and the existence of others, and focuses on the problems at hand [46], [47]. This competency is needed in megaprojects, such as practitioners' need for soft skills in managing pressure or stress to maintain a positive mindset [24].

Some literature states that mindful leadership is beneficial for team management in organizations and projects because it incorporates communication skills that focus on the existence of others [48] and solving problems without blaming others [47]. This is a competency needed when one manages megaprojects with multiple entities that are prone to social and political conflicts. This concept indicates that mindful leadership has the competency attribute to manage the social complexity of megaprojects. The ability to think calmly also has implications for the ability to control self and others [47]. This ability relates to flexibility [46], [49] and beneficial when there is a sudden change (emergent complexity).

6) *The adaptive leadership theory*

Adaptive leadership theory developed by Heifetz [50] consists of administrative, innovation, and supporter competencies [30], [51]. Administrative competencies are abilities to carry out organizational operational activities. The required abilities are emphasized on understanding the linkages that occur between divisions, sections, or activities and integrating them in the organization [52]. This is in accordance with the concept of integration that is a necessity for managing the structural complexity of megaprojects.

The ability to innovate is also one of the roles of megaproject leaders [21], [53], not only in the technology but also in a social approach. This social innovation capability is also used to adjust the organization quickly, especially against external change [52]. This competency has the potential to be included in the megaproject leadership, particularly to accommodate emergent complexities.

To support adaptation, leaders also need to have self-confidence and self-control to consistently support

“adjustment” and not be affected by emotional reactions of team members or stakeholders [52]. Therefore, it is considered for further development into a part of megaproject leadership to overcome social complexity.

7) *The agile leadership theory*

Agile leadership is the leadership's ability to think and act in the number of different ways according to context or circumstances by involving team members [54]. Agile leadership is characterized by 1) team management competencies to accommodate the basic to complex problems, 2) utilization of a humanist approach to explore creative ideas and encourage organizational team entities to achieve their best performance in reaching targets, and 3) the ability to accommodate change [54].

Agile leadership attributes are in accordance with the complexities of a megaproject. For instance, the competence of team management for basic problems is appropriate for accommodating structural complexity; the humanist approach has the potential to address social complexity; and the ability to deal with change is likely to accommodate the emergent complexities of a megaproject.

Fig. 2 describes the conceptual framework based on leadership theories for megaproject complexity.

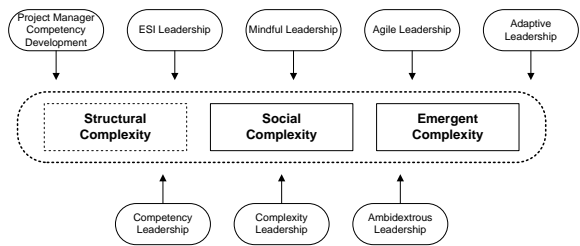


Fig. 2. Conceptual megaproject leadership framework.

TABLE I: THE LEADERSHIP THEORY APPROACH THAT IS IN ACCORDANCE WITH MEGAPROJECT COMPLEXITY

Complexity	Competency needed	Leadership Theory Approach
Structural	Technical: The leadership competency to plan, carry out control and integrate activities/processes/technology, and megaproject entities	Project Manager Competency Development (PMCD) [33]; competency leadership (IQ and MQ) [34]; complexity leadership (operational) [38]; Ambidextrous Leadership [55]
Social	Emotional social: The leadership competency to manage personal and other's emotions and manage social relationships between megaproject entities	PMCD [33]; competency leadership (MQ and EQ) [34]; complexity leadership (enabling) [38]; emotional and social intelligence (ESI) leadership [44]; mindful leadership [47]
Emergent	Adaptive/flexible: The leadership competency to ambidextrously accommodate megaproject change and uncertainty.	Adaptive leadership [52]; complexity leadership (entrepreneurial or innovation) [38]; PMCD [33]; competency leadership (EI) [34]; emotional and social intelligence (ESI) leadership [44]; ambidextrous leadership [55]; agile leadership [54]

From seven leadership theories and one guideline Project Manager Competency Development (PMCD) by PMBOK, this study mapped the ability required for management of the megaproject complexity, as shown in Table I.

B. The Leadership Competency Formulation

To formulate the leadership competencies, this study synchronized the complexity management need with the detail dimensions from leadership theories. The explanation is as follows.

1) The competency for structural complexity

The abilities expressed by project managers based on lived experience are related to hard skills that are termed practically in the project area as “planning and control management” [8]. However, in the realm of megaprojects, the ability of “integration,” not only limited to planning and control, is also emphasized. This is because activities, organizations, processes, etc. are broad and in large numbers, so harmonizing them requires the competence of managers.

The leadership's competence to plan, execute, control, and integrate the activities, processes, technology, and megaproject entities in this study is termed “technical competency.”

Technical competency consists of procedural, integration, and exploitation abilities. Procedural abilities are related to planning; among others, leaders can clearly define project objectives [33], [55], plan and build project teams [33], [44], [52], [55], diagnose problems and identify plans to overcome them (risk management) [33], [52]. Procedural abilities also include the ability to execute planning [38], direct the team to solve problems according to standards [54], balance team workloads and execute processes effectively and efficiently [55]. Control ability is also part of the procedural ability, including ensuring the validity of information in the project [33], monitoring and controlling target achievement and taking corrective actions if discrepancies are found in the field [55].

Integration abilities of megaproject leaders consist of the ability to understand to analyze processes and problems from a wide perspective [34] and the ability to synchronize various kinds of activities [38] within the organization [52].

Exploitation abilities consist of understanding the megaproject content/technique that is obtained from the experience and the ability to utilize current organizational capacities (teams, experts and technology) [55].

2) The competency for social complexity

In addition to technical competency, the ability to manage human aspects of the team and stakeholders is important for the success of a megaproject [53], [56], [57]. To solve the human aspects (social complexity), the management approach is not only based on procedural mechanisms in its resolution, but social innovation is needed [21]. The leadership's competency to manage personal and other people's emotions and carry out innovation in social relations between megaproject entities is termed “emotional social competency” in this study.

Emotional social competency consists of two abilities, namely self-management ability and social-management ability. Self-management is the ability to understand oneself, namely self-awareness and self-control. This is necessary for maintaining emotional stability because it can have an impact on the emotional conduciveness of megaproject entities and in making strategic decisions [26]. Self-awareness and self-control are also in line with the development of

leadership's profound sense of serenity [47]. This means that a megaproject leader needs to be aware of and understand the condition and existence of oneself to manage personal emotions before managing other entities in a megaproject.

Social-management ability consists of social awareness and social control. In conditions of multiple entities, both teams and stakeholders, these capabilities are needed in coalition, collaboration, negotiation, engagement with stakeholders, and manage conflicts between megaproject entities [58]. Social awareness is reflected in the ability to build good relationships with all project entities [33], understand others (empathy), care about the organization and its entities by actively listening to the team members' and stakeholders' opinions [44] and solving the problem through the humanist approach [54]. Furthermore, the social control competency is related to the ability to influence others [34], [44], [52], which is essential in negotiations with stakeholders in the scope of megaprojects [24], [53]. In addition to influencing others, the ability to become a liaison and mediator between entities [38] is required for one to control social conflict [44].

3) The competency for emergent complexity

Emergent complexity is associated with uncertainty and change. Megaproject leaders should understand changes that originate from internal and external sources and their impact on megaproject activities and entities [16]. For example, it is important for leaders to manage uncertainty in project work due to delays in contracts such as logistics [9] and uncertainty due to certain political interests of stakeholders [9], [16].

The ability of megaproject leaders to accommodate uncertainties and changes in megaprojects is termed by “adaptive competency” in this study. Adaptive competency consists of flexible ability related to the ability to “shift” from one management context (e.g. planning management) to another management context (e.g. adaptive management) when there is more than one type of complexity in the organization [59], which is likely to occur in megaprojects. The ability to balance this management is needed to deal with varying complexity simultaneously [60]. Various challenges or project complexities are temporary in nature, potentially related to and constantly changing along with the project work cycle [61]. Therefore, the shifting and balancing abilities of a megaproject become critical for the megaproject leader.

Along with the ability to be flexible, the adaptive competency of the megaproject leader is also characterized by the ability to explore innovative solutions. Exploration ability consists of the leadership's personal innovation creativity and facilitation for other entities to innovate.

When changes occur, the information for available solutions is sometimes very limited. To accommodate this in the context of the project, innovation creativity is reflected in leaders who have the intuition to find solutions by combining a rational approach and an emotional intelligence perspective [62]. This ability is also related to leaders who are always proactive in finding solutions to contingent problems [51] by continuously stimulating themselves to think “out of the box” [63].

The leadership must also be able to support the creativity

and innovation of the megaproject team members, so that not only the creative leader looks for solutions, but the team is also involved. This is termed innovation context creation, which is realized by creating an open system through which all entities can provide ideas and criticism [52] and are allowed to learn from their mistakes (for example, experiment to find solutions) [42], [55]. These abilities are required for megaproject leaders to be self-organized so that they are sensitive or have “alerts” to changes that have been planned or occur spontaneously and understand how to find alternative solutions by involving megaproject entities.

The resume of megaproject leadership competencies with details of abilities based on complexity perspective is presented in Table II.

TABLE II: MEGAPROJECT LEADERSHIP COMPETENCIES

Competencies	Abilities	Details of abilities (attributes)	
Technical	Procedural	the ability to plan, execute and control megaprojects according to standards	Planning; executing; controlling
	Aligned	the ability to synchronize and integrate multi-activity, process / technology, and megaproject entities	Having a wide perspective; integrating
	Exploitation	the ability to use / utilize the capacity of the current resources (team, technology and knowledge) to solve problems	Having knowledge and experience of the project at hand; optimizing the available capacity (resources)
Emotional social	Self-management	the ability to manage her/himself (interpersonal)	Self-awareness; self-control
	Social management	the ability to manage social others (team and stakeholders) (intrapersonal)	Social awareness; social control
Adaptive	Adaptation (flexibility)	the ability to deal with change (shift and balance the condition)	Shifting; balancing
	Exploration	the ability to explore and identify new potentials (technology, knowledge, methods, processes and entities) from various sources for problem solving	Innovating; creating a creative environment
	Intuitive (instinctive)	the ability to intuitively act fast and precisely when there is a sudden and uncertain change	Having intuition

IV. CONCLUSION

This study has formulated a megaproject leadership’s competency according to the megaproject’s complexity based on the literature. Three leadership competencies, namely technical, emotional social, and adaptive competencies are should be possessed by project managers for them to manage the complexity involved in achieving megaproject success. Technical competency is needed to manage structural complexity, consisting of procedural, alignment and exploitation abilities. Emotional social competency, which includes self-management and social

management, is needed to accommodate social complexity. Adaptive competency, comprising flexibility (adaptation), exploration of the innovation and fast and precise intuition, is required for project managers to deal with emergent complexities.

For further research, this competency formulation should be studied empirically in the megaproject case to assess its suitability and be confirmed.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Damayanti explored and analyzed the literature, wrote the paper, Hartono and Wijaya guided and reviewed the content; all authors had approved the final version.

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R. W. Damayanti was born in Surakarta, Central Java, Indonesia, in 1980. She received an undergraduate degree in industrial engineering from the Universitas Sebelas Maret in 2003; a master of engineering degree in industrial engineering from Institute Technology Bandung, Indonesia, in 2006. She is currently pursuing a doctoral degree in industrial engineering at Universitas Gadjah Mada, Yogyakarta, Indonesia.

From 2005 until now, she has been a lecturer and researcher at Industrial Engineering Universitas Sebelas Maret, Surakarta, Indonesia. Her research interest includes the project/megaproject management, complexity management, quality engineering and management.

Ms. Damayanti is a member of the Project Management Institute, Indonesia Chapter. In 2018, she received the grant from The Ministry of Research, Technology and Higher Education of the Republic of Indonesia for her dissertation research.



B. Hartono was born in Magelang, Central Java, Indonesia in 1976. He received a bachelor's degree in mechanical engineering from the Institute Technology Bandung, Indonesia, in 1999; a master of project management degree from Queensland University (UQ), Australia, in 2004; and a Ph.D from the National University of Singapore (NUS) in 2012.

He is a lecturer and associate professor in Industrial Engineering, Mechanical and Industrial Engineering Department, Engineering Faculty, Universitas Gadjah Mada, Indonesia. His research interests include project management, risk and complexity analysis, and systems approach.

Dr. Hartono was formerly the director of Project Management Institute, Indonesia Chapter, Yogyakarta Branch. In 2015, he received a Research Grant–International Collaboration and Publication from The Ministry of Research, Technology and Higher Education of the Republic of Indonesia.



A. R. Wijaya was born in Semarang, Central Java, Indonesia in 1974. He received a bachelor's degree in mechanical engineering from the Universitas Gadjah Mada, Indonesia in 1995; a master of industrial ergonomics degree; a master of engineering vibration degree; and a Ph.D in operations maintenance engineering from Lulea University of Technology, Sweden.

He is a lecturer and researcher in the Industrial Engineering, Mechanical and Industrial Engineering Department, Engineering Faculty, Universitas Gadjah Mada, Indonesia. His research interests include project management, operation and maintenance engineering, ergonomics, and big data.

Dr. Wijaya is a member of International Ergonomics Association (IEA) (2014–present). In 2017, he became a Quality Safety Environment Ergonomic Engineering (QSEEE) Audit consultant for Pertamina, the Indonesian oil company.