

Characterization of Leadership Associated with Project Management: A Bibliometric Review

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Abstract: The importance of leadership competency is a key success factor in the era of project management, especially during the Industrial Revolution 4.0. Understanding this competency is essential to be developed by project managers. Bibliometric studies and scientometric tools through a qualitative approach were employed to characterize leadership competency in project management. The use of T-LAB software for the analysis of textual corpora associated with leadership, developed by relevant global organizations in project management, enabled the identification of the skills, abilities, and tools required to competently lead projects.

This study identified eleven (11) clusters, generated as a result of grouping terms related to the practice of leadership in project management. The identified clusters revealed diverse key themes, including team development and management; adaptability; proactivity in changing situations; communication and decision-making; the development of leadership styles; administrative and interpersonal skills; the role of influence; the capacity to manage in agile contexts; vision through interaction; the role of guiding and developing individuals; and decision-making based on information are crucial aspects that must be skilfully managed by competent leaders.

These clusters reflect a spectrum of skills and tools which project leaders must possess to drive and sustain success in increasingly complex and volatile work environments. This academic work not only underscores the importance of leadership, but also provides a valuable guide for the identification and strengthening of this competency, establishing a pragmatic approach for its development and practical application.

Keywords: cluster, competency, leadership, scientometrics, skills, project management.

1. Introduction

Globally and historically, countless disciplines, including politics, sociology, education, military science, history, and business development, have extensively explored leadership, recognizing its position as a significant social phenomenon [1]. This extensive research has led scholars to formulate a variety of models and theories that establish the role of the leader in the organizational context [2]. However, for the purposes of this study, the focus was on models associated with leadership competency, particularly those conceived by scholars specialized in Project Management (PM), thereby constituting the specific domain of interest for this article.

Leadership is recognized as a personal competency [3], which has been of great importance not only in the context of the contemporary workforce, but also in the face of the challenges presented by the Industrial Revolution 4.0 [4]. The key competencies in PM encompass diverse abilities and personality traits, among which leadership is recognized as one

of the most significant. [5]. This competency takes a significant importance in the context of organizations [5, 6].

A re-evaluation where the individual is placed at the centre of organizations is required, giving those with outstanding leadership ability a crucial role, such as driving the creativity of project members [7]. Currently, for the executives of various entities, the concept of leadership has gained high relevance, being considered a determining factor for corporate success not only in times of calm, but also in times of crisis [8]. Consequently, there is a marked preference among managers for initiatives and projects within their corporations to be led by individuals who have developed leadership competency abilities as individuals with this profile have a favourable impact on their organizations [2]. Numerous studies and research indicate that the most prosperous entities are adjusting their procedures to ensure their teams possess an advanced level of influence skills or power skills, a modern term formerly known as soft skills [5]. In a

projection made by the World Economic Forum in October 2020, the disappearance of 85 million jobs due to automation and technology was anticipated. In this scenario, societies need to rapidly adapt to the transformations of the labour ecosystem, promoting intensive training in power skills [9]. In the contemporary environment, companies are immersed in a scenario of intense competition and rapid evolution [10, 11]. Industries have implemented innovative processes which currently constitute and will continue being an engine for job creation in different fields. In this context, there is a growing and urgent demand in the industrial sector for young professionals equipped with abilities and skills relevant to the labour market [12, 13]. This need is exacerbated by the integration of cutting-edge technologies and automation in the workplace, factors that amplify the requirement for specific competencies, among them, leadership competency [14].

2. Objectives

In an effort to understand and characterize leadership associated with PM and to document the abilities which should be developed by project leaders in organizations where the organizational culture is based on PM, eight (08) global organizations were identified which have studied, defined, and evolved concepts related to PM, with a particular focus on leadership.

Comprehending the evolution of a particular field, its primary subjects and areas of research, and the interconnections between these topics, is an area which can be addressed through a bibliometric network study or analysis [15]. In the sociology of scientometrics and science, the identification of a specific domain has been accomplished through different approaches [16]. These types of methods are known as co-word analysis, modelling or bibliometric analysis [17-21]. Measurement sciences and evaluation methods are highly useful, as they enable the visualization of maps or graphs that represent academic activities and the relationships existing within the domain.

This research used a co-word analysis method in the area of personal leadership competency in PM to identify aspects which significantly contribute to the understanding of leadership associated with the study area of PM. This analysis will be based on

relevant existing literature elicited from global organizations that study PM.

3. Methods

A qualitative approach was employed for the development of this research, with an inductive process which began with the exploration and description of the topic, followed by the generation of theoretical perspectives [22]. The depth of meanings, interpretive richness, and the breadth of analysis were strengths which allowed the research to be developed under a qualitative approach. This approach also facilitates the transformation and visualization of collected data into diagrams or maps that enable detailed interpretations and descriptions [23].

The methodology structure for this study was based on methodologies from authors who have conducted characterizations in other areas of knowledge through bibliometric analyses with the generation of clusters, producing similar conclusions in their respective fields. According to Cai, et al. [24], a bibliometric analysis facilitates the interpretation of scientific knowledge in a visually appealing and deductive manner. This method not only can encompass a large amount of data, but also identifies and describes relevant aspects in transnational studies.

The characterization of leadership and its relationship with PM was developed through methodological steps, which consisted, firstly, on identifying globally recognized organizations in PM because of a comprehensive literature review. Secondly, the guide texts rigorously developed by the PM organizations were identified. Subsequently, information related to leadership competency was extracted from the selected guide texts to compile a document focused on information about this competency. Finally, T-LAB software was used to manage the co-occurrence of terms related to leadership and PM, generating the proposed characterization.

The identification of globally relevant organizations oriented towards the study, development, and research of PM was conducted and is described in Table 1.

Table 1. Outstanding organizations in Project Management

Continent	Country	Organization	Abbreviation
America	The United States of America	Project Management Institute	PMI®
Europe	European Union	Centre of Excellence in PM ²	PM ²
	Austria	International Project Management Association	IPMA
	The United Kingdom	Association for Project Management	APM
	The United Kingdom	Projects in Controlled Environments	PRINCE2
	Switzerland	Guidance on Project Management	ISO 21500
Oceania	Australia	Australian Institute of Project Management	AIPM
Asia	Japan	Project Management Association of Japan	PMAJ

The identification of the aforementioned organizations provided an overview of entities focused on the development of standards and guidelines for PM across different continents. These organizations undeniably agree on some aspects and differ on others concerning theories, models, and concepts. A detailed analysis was conducted within these organizations through a review of their literature to identify the fundamental texts, guides, and standards related to PM. These documents served as the essential pillars for the study. The

review revealed that these documents are standards developed and recognized under rigorous academic review, as listed in Table 2.

Table 2. Fundamental documents of organizations focused on project management

PM Organization	Document	Issue of Publication	Approach
PMI	Agile Practice Guide	2017	Servant leadership
	PMBOK 7 th edition	2021	Leadership abilities, leadership models (Situational leadership® II, OSCAR Model)
	Process Group: A Practice Guide	2023	Qualities and Skills of a leader, leadership styles
	Project Manager Competency: Development Framework, 3 rd edition	2017	Leading
	Project Management Methodology PM2 Guide 3.0.1	2021	Leadership
IPMA	Individual Competence Baseline	2015	Leadership in projects

	for Project, Programme & Portfolio Management. Version 4.0		
APM	APMBOK Body of Knowledge 7 th edition	2019	Leadership
PRINCE2	Managing successful Projects with PRINCE2	2017	Leadership capability
ISO	ISO 21500 Guidance on Project Management – A Pocket Guide. 1 st Edition	2013	Leadership
AIPM	Professional Competency Standards for Project Management. Part C–Certified Practising Project Manager (CPPM). Version 1.12	2010	Leadership
PMAJ	A Guidebook of Project & Program Management for Enterprise Innovation	2005	Project leadership

	P2M. Volume 1		
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In order to conduct the characterization of leadership associated with PM, a co-occurrence analysis of terms or words was used [33]. This academically validated technique is employed to examine the structure and recurring patterns of words that commonly coexist in datasets or documents. For this purpose, titles, key terms, and all relevant information related to leadership competency were extracted from primary sources, specifically the fundamental documents of eight (08) globally important organizations related to PM. Understanding the components, tools, and variables of leadership associated with PM and how they are interrelated was the primary goal of this bibliometric analysis.

The field of study focused on analysing and measuring scientific publications and information is scientometrics, which helps to understand and characterize an issue [33, 34]. The most commonly used methods for this purpose are bibliometric analysis or modelling, co-word analysis, citation cartography, and citation mapping [33]. The visualization of graphs or maps representing the relationships within a topic is also possible through the application of these methods [35].

For key terms related to leadership in the context of PM, the word correlation method can identify a significant connection among words that frequently appear together. This process also allows the interwoven stream of interests, resulting from scholarly and research activities, to be understood as structurally self-organizing groups, referred to as science maps or bibliometric maps [35]. Within the maps, elements with different characteristics are located at a distance from each other, while similar elements are located very close to each other, generating symbolic representations of the elements [33]. The relationships of the variables of leadership associated with PM were extensively explored through these bibliometric maps.

The data used to compose a textual corpus (a collection of texts selected for the purpose of conducting linguistic research) consisted of titles, keywords, and related content development from eleven (11) fundamental texts and guides (documents published between 2005 and 2023)

from eight (08) globally recognized organizations in PM (see Table 2).

The textual corpus was analysed using T-LAB software, whose content analysis and visualization functions were employed to generate word co-occurrence and mapping. The input for T-LAB is a textual corpus, which allows each word to be converted into a lexical root or lemma and to make contrast among different grammatical categories, for example: adjectives, verbs, and nouns [33]. The maps and graphs generated by T-LAB are labelled using lemmatization, which act as analysis units. T-LAB is a tool which facilitated the analysis of leadership associated with PM, based on the generation of keyword frequencies; the background and application of keywords within the sentences and paragraphs in which they appear; and the co-occurrence patterns among keywords. Similarly, to determine the key co-occurrence relationships around leadership and its components or variables, the terms "Project," "leadership," and "leader" were tagged. Consequently, the word co-occurrence analysis method was employed. For each keyword selected under these terms, the method of word association identified a substantial connection among words which frequently co-occur. The term frequency and inverse document frequency (TF-IDF) measure, accessible in the T-LAB program, was employed to choose keywords from the document loaded with all the information extracted from the eleven (11) guide texts mentioned in Table 2, specifically related to leadership in PM.

4. Results

The T-LAB program generated a similarity coefficient which effectively determines the frequency of keyword occurrences throughout the corpus. For each key term selected at the centre, the other words that co-occur were allocated around the central term at proportional distances according to the degree of association resulting from each term's relationship with the central keyword. This implies that the keywords closest to the centre appear more frequently with the word placed at the centre

Additionally, since TF-IDF is employed as a keyword selection method, the algorithm assesses the significance of the words in the document. When

the T-LAB program was run with the entire corpus, it generated visual maps that showed the keywords that co-occur with the selected key terms at the centre: *project*, *leadership*, and *leader*. As a result of the number of keywords in the visualization of the map generated by the software in Figure 1, based on the central term of the map, project, the following analysis can be inferred.

The keyword *project* in Figure 1 shows an association with words, such as: leadership, members, skills, vision, teams, individuals, and management. Among these, leadership is one of the terms with the highest association with projects and, consequently, is the term associated with projects that is explored and analysed in detail.

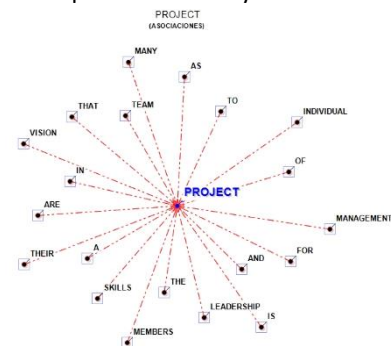


Figure 1. Mapping of the term: Project

In the word analysis, using *leadership* as the central term, as shown in Figure 2, a high association of words with leadership related to PM can be inferred. These associated words include skills, communication, members, team, leader, styles, situational and servant (related to leadership model), manage, interpersonal (related to skills), and needs.

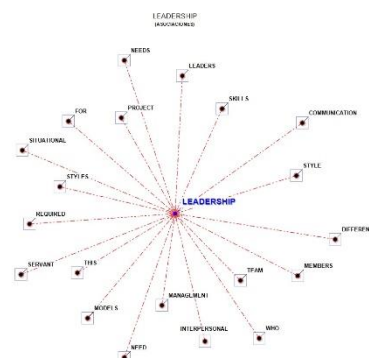


Figure 2. Mapping of the term: Leadership

Meanwhile, the keyword *leader*, as shown in Figure 3, indicates a strong relationship and indicator with central areas of knowledge, such as: projects and leadership. Additionally, it has a high association with terms, such as: coaching, teams, servant

(related to the servant leadership model), effectiveness, need, people, skills, purpose, objectives, styles, and means.



Figure 3. Mapping of the term: Leader

In Figure 4, the word cluster matrix identifies the relationship among clusters or word families identified by colours within a plane. Each circle in the figure represents a key term or theme, where clusters closer to the centre are of greater relevance and frequency within the word analysis. The green cluster has the largest proportion within the plane through the key term: Project, followed by the second most relevant term, which is: leadership. Around this cluster, there is a group of keywords associated with these terms, such as: leader, teams, initiative, means, support, goals, coaching, purpose, decisions, skills, and servant (related to the servant leadership model).

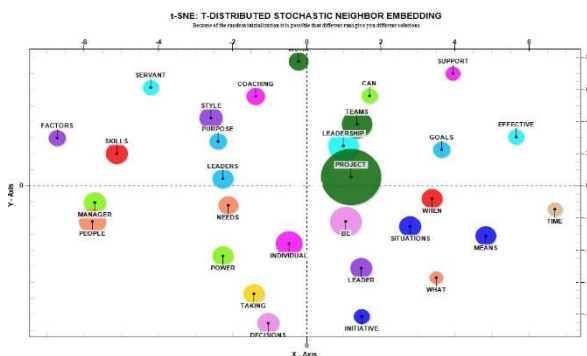


Figure 4. Mapping by word clusters

Similarly, in Figure 5, the mapping of keywords associated with leadership and projects identifies the existing impact among words related to leadership. It shows the strong relationship between leadership and projects, and in co-occurrence with them: initiative, situations, power, purpose, skills, support, coaching, teams,

objectives, means, styles, manager, and effectiveness.

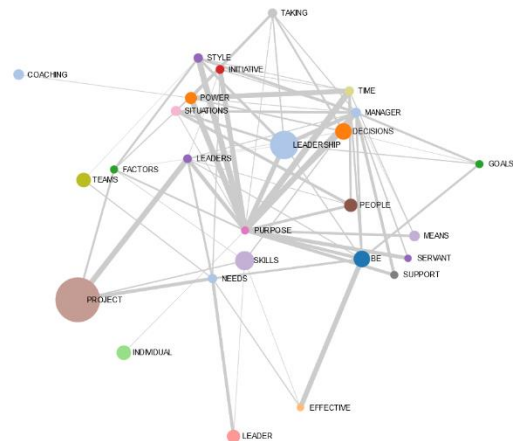


Figure 5. Mapping of keywords associated with leadership and projects

The image in Figure 5 also presents a network of interconnected nodes which represent different concepts related to leadership and team management.

Central Node: leadership, this node is the main one within the figure and is directly connected to other nodes, suggesting that it is a central concept in Figure 5. The leadership node and the identification of the nodes generated within the figure allow an analysis which facilitates determining that there are related concepts, team dynamics, personal development, service and support, project and objectives, and other concepts.

Related Concepts: style, power, time, manager, decisions, people: these nodes are directly connected to *leadership*, indicating that they are key aspects which influence or are influenced by leadership.

Team Dynamics: teams, factors, leaders. These nodes suggest the different elements that compose or affect a team.

Personal Development: coaching, initiative, skills, needs, individual, effective. These nodes may be related to personal development and how a person becomes an effective leader.

Service and Support: servant, support, means. These nodes may represent the idea of servant leadership, where the leader serves their team and provides the necessary means and support to achieve objectives.

Project and Objectives: project, goals. These likely refer to the execution and aims of the tasks or missions of a team.

Other Concepts: be, situations, purpose. These nodes could represent the essence of the leader, the different situations they face, and the purpose behind their actions.

The interconnection of the mentioned nodes suggests that leadership is not only an isolated concept, but also is influenced by and affects many other aspects from team dynamics to personal development and project execution. This visual representation allows to understand how different elements interact and influence each other in the context of leadership and management.

5. Discussion

The elements that enabled the characterization of leadership competency associated with PM, after analysing different visualizations which facilitated understanding the elements or variables surrounding leadership, were described thanks to the generation of clusters using the T-LAB software and the analysis of the textual corpus. In Figure 6, the co-occurrence matrix enabled the identification of eleven (11) groups of words or clusters which are related throughout the document and that facilitated the discussion based on the level of term co-occurrence.

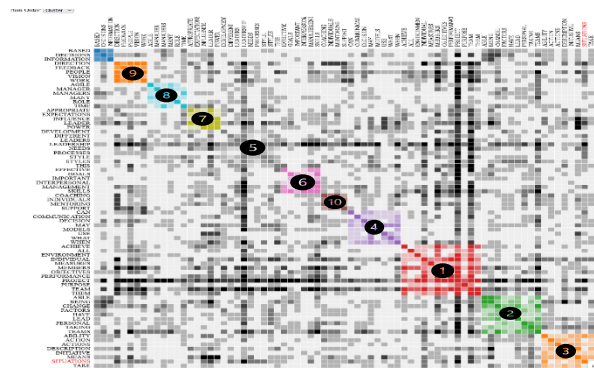


Figure 6. Co-occurrence matrix

Within the eleven (11) clusters generated in Figure 6, an analysis and discussion of the clusters were conducted, ranked from highest to lowest co-occurrence. The analysis and discussion of each cluster also included a proposed title for each cluster based on the relationship of words and the cluster analysis.

Cluster 1: Team development and management in projects. A strong relationship was identified among the words: individuals, measures, members,

objectives, development, projects, purpose, and teams. This cluster focuses on the intersection of leadership and team management in the context of PM. The words suggest that an effective leader in PM not only focuses on the project's milestones and objectives, but also on the development, cohesion, and effective guidance of their team, ensuring that everyone understands the purpose behind the actions and objectives.

Cluster 2: Leadership in the context of change and adaptability in team management. A close relationship was identified among the words: change, lead, teams, and factors. This cluster is based on the essential ability of a leader in PM to navigate and adapt to changes. Instead of resisting change, an effective leader recognizes, anticipates, and proactively manages the factors that cause it, guiding their team through adaptation. The relationship among the words suggests that effective leadership in times of change is a complex interaction among understanding the factors driving the change, making informed decisions, and ensuring that teams are equipped and prepared to adapt.

Cluster 3: Proactivity and adaptability in changing situations using abilities and resources. A close relationship was identified among the words: abilities, actions, initiative, means, and situations. This cluster highlights the importance of being proactive and adaptable. A leader must not only possess relevant skills, but also be willing to act and innovate based on the situations that arise. The combination of abilities, efficient use of resources, and strong initiative are essential for effectively handling a variety of situations and ensuring the success of a project. The relationship between these words suggests that effective leadership is achieved through a dynamic interaction of action and adaptability.

Cluster 4: Interaction of communication and decision-making based on established frameworks. A close relationship was identified among the words: communications, decisions, and models. This cluster focuses on the interrelationship between effective communication and decision-making. In project management, it is not sufficient to make decisions or communicate in isolation; rather, it is crucial that decisions are made based on clear information and communicated effectively. At

the same time, these processes should be supported or informed by established models that provide structure and coherence. The relationship among these words suggests that effective project management combines structure and fluidity in both decision-making and communication.

Cluster 5: Development and adaptability in leadership styles based on changing needs. A strong relationship was identified among the words: development, leader, leadership, needs, and styles. This highlights the dynamic and adaptable nature of leadership within PM. It not only emphasizes the importance of constant development (both the leader and the team), but also underscores the necessity for a leader to recognize and respond to the varied needs of the team and the project. Additionally, the mention of the term styles reaffirms the idea that leadership is not static. Effective leaders understand when and how to adapt their style to meet the changing demands and needs of the team and the project.

Cluster 6: Integration of managerial and interpersonal skills to effectively achieve objectives. A strong relationship was identified among the words: effectiveness, objectives, interpersonal, management, and skills. This cluster highlights the interconnection between technical and power skills in PM. While it is crucial to have managerial abilities to plan and execute projects, interpersonal skills are equally essential for working with the team and other stakeholders. Project effectiveness is achieved not only through proper management, but also through effective communication and collaboration. The words in this cluster suggest a balance between these areas is fundamental to achieving objectives and ensuring project success.

Cluster 7: Role of influence and power in leadership and managing expectations in PM. A strong relationship was identified among the words: appropriate, expectations, influence, leader, and power. This cluster focuses on the dynamics of power and influence in leadership and how these relate to managing expectations. Being a leader involves exercising power and influence responsibly and appropriately, ensuring that expectations are managed effectively. The balance between these elements is fundamental to ensuring effective leadership and project success. The relationship between these words indicates that a leader's

ability to influence and exercise power appropriately is key to aligning and meeting the expectations of the team and other stakeholders.

Cluster 8: Role of the manager in an agile context and its temporal and functional relationship in PM. A close relationship was identified among the words: agile, manager, role, and time. This cluster emphasizes the dynamics and structure of roles in an agile project context. It highlights the importance of having clear roles that support collaboration and efficient delivery within the team. The focus on *agile* suggests an environment where adaptability and rapid response to change are essential, and where the relationship between the manager and the team is central to success. The relationship among these words indicates the need for clarity in functions and close collaboration in agile environments.

Cluster 9: Vision through interaction and feedback in PM. A close relationship was identified among the words: direction, feedback, people, vision, and work. This cluster focuses on the dynamic interaction between leaders and team members in the process of advancing towards a common vision. It highlights the importance of clear direction and continuous feedback in the work process and emphasizes the central role of people in the execution of any project. The relationship between these words suggests that success in PM is based on close collaboration, clear communication of the vision, and the skill to give and receive feedback effectively.

Cluster 10: The role of guidance and support in the development of individuals within PM. A close relationship was identified among the words: coaching, individuals, mentoring, and support. This cluster focuses on the importance of personal and professional development of individuals. The selected words suggest that an effective leader or project manager not only directs and supervises, but also acts as a coach and mentor, providing the necessary support for the growth of each member. In the context of projects, this focus on individual development can lead to stronger, more cohesive, and more efficient teams. The relationship between these words highlights the idea that project success is not only based on task and objective management, but also on investing in the development of the people who comprise it.

Cluster 11: Information-based decision making. A close relationship was identified among the words: basis, decisions, and information. This cluster suggests that one of the crucial aspects of leadership in PM is making decisions based on information. Effective leaders in this context are those who rely on concrete data and careful analysis to direct their teams and manage projects successfully. This approach minimizes risks and maximizes opportunities for success by ensuring that each decision is as informed as possible.

6. Conclusions

It can be determined that leadership is a key personal competency in project management. This competency has been highly studied and developed by numerous scholars globally across different fields of knowledge, highlighting the Servant Leadership Model and the Situational Leadership Model® II. These models and other forms of leadership have been incorporated into the guide texts of important organizations in the field of PM. However, not all organizations share the same models or theories; some organizations even lack leadership competency frameworks or have them less developed than other project management organizations.

Project development is currently surrounded by an environment where the Industrial Revolution 4.0 is booming with the advent of systematization and automation through emerging technologies, and project success is based on human leadership and the abilities encompassed by this competency.

Consequently, the themes of the eleven clusters generated in this article, focused on team development and management; adaptability; proactivity in changing situations; communication and decision-making; development of leadership styles; managerial and interpersonal skills; the role of influence; the skill to manage in agile contexts; vision through interaction; the role of guidance and individual development; and information-based decision-making, are elements of leadership which play an essential role in project success, providing a well-structured and explicit conceptual framework which outlines the inherent facets of leadership in PM.

Finally, this type of study can significantly contribute to the understanding of leadership competency transnationally by academics,

policymakers, and business leaders, among others. The cluster analysis of words generated by technological tools like the T-LAB software facilitated a deeper exploration of the personal competency of leadership. The bibliometric review of this research comprised extensive literature focused on the study topic, developed from different cultures and organizations, enabling an objective and generalizable analysis and conclusions.

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