Essential Soft Skills for Construction Project Managers to Achieve Sustainable Development Goals: A Bibliometric and Comprehensive Review

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Essential Soft Skills for Construction Project Managers to Achieve Sustainable Development Goals: A Bibliometric and Comprehensive Review

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Abstract: *The construction industry is considered one of the significant industries behind the economic success of most developed and developing countries. Its detrimental effects on the environment and society raise concerns among global leaders and environmental groups, leading to the birth of the United Nations Sustainable Development Goals (SDG) in 2015. Project managers play a crucial role in the success of any construction project. They must possess technical and soft skills to handle evolving needs, financial limitations, and diverse teams with various cultural backgrounds. However, soft skills are often overlooked and have only recently gained interest in global research. Hence, the main objective of this study is to identify the essential soft skills of project managers and uncover their connections with attaining the SDGs using the published articles in the Scopus database. The bibliometric review was performed on a corpus of 403 articles through CorText Manager to identify the prominent journals, visualize their relationship with the top keywords, and analyze the co-occurrence and evolution among the keywords based on the string search keyword used. A comprehensive review of these articles found that the essential soft skills of project managers are Leadership, Communication, Stakeholder Management, and Conflict Resolution. Also, the reviewed papers were most aligned with attaining SDGs 9, 11, and 12. Likewise, most of these studies used the PLS-Structural Equation Modeling (PLS-SEM). Future research should continue to explore the interplay between soft skills and project outcomes, employing diverse methodologies to capture the nuances of interpersonal dynamics in construction management.*

Keywords: Bibliometric Review, Construction Project, Project Manager, Soft Skills, Sustainable Development Goals.

1. INTRODUCTION

The construction industry has been a driving force behind the economic growth of all countries for centuries [1]. With an expenditure value that reached almost 12 trillion U.S. dollars before the COVID-19 pandemic and a projected annual increase of three percent until 2035 [2] it constitutes about 13% of the global Gross Domestic Product (GDP) [3], [4]. Rapid population growth, urbanization, and industrialization have led to a global surge in construction projects [5], presenting the industry with several constraints, such as limited resources, high risks, logistical problems, project delivery delays, cost and schedule overruns, and sometimes subcontractor disputes [6].

Due to its massive use of energy, nature, and raw materials, the construction industry is primarily to blame for resource depletion and environmental deterioration [7]. Its various activities and processes are accountable for the non-renewable consumption of about 40-50 percent of global raw materials and 40–50 percent of global energy [8], [9]. Meanwhile, it has been proven to be a principal waste contributor, accounting for 37 percent of global carbon emissions, 30-40 percent of solid waste, and 19 percent of greenhouse gas emissions worldwide [9]. To resolve these global concerns properly, sustainable practices must be included in the construction workflows at every stage of the project lifecycle, including designing, planning, and constructing [10], [11]. The United Nations Sustainable Development Goals (SDGs) press all countries, regardless of their economy and population, to achieve the 17 SDGs to safeguard the future, promote prosperity, and mitigate the impacts of climate change [12]. The Construction industry must reorient its attention to sustainability in processes and outputs to achieve the goal and prevent environmental harm.

On a project-level scale, the project managers are essential in encouraging and guiding their team in choosing sustainable practices [13]. As construction projects tend to be labor-intensive [14], it requires hiring a diverse team of workers with varying cultures, attitudes, and socio-economic backgrounds [15]. Their technical knowledge and soft skills, such as leadership, communication, conflict resolution, and decision-making, may prove beneficial in mitigating risks, enhancing communication among stakeholders, and resolving on-site issues [16]. By cultivating a collaborative atmosphere, proficient project managers instill trust and motivation in construction workers, improving productivity and job quality [17]. Therefore, the soft skills of project managers are crucial factors in achieving project success [18].

Given the massive volume of published articles related to the crucial soft skills of project managers, it is imperative to consolidate all existing knowledge and published material to guide future scholarly investigations and research endeavors. Therefore, this study was conducted to evaluate the current research trends regarding the soft skills of project managers and their link to the attainment of SDGs by examining an extensive collection of bibliographic information. Through conducting a comprehensive review, this study also assessed the soft skills of project managers according to published literature and their relevance to accomplishing SDGs. The bibliometric and comprehensive analysis results were also utilized to highlight issues and future research areas surrounding the soft skills of project managers and their link to the attainment of SDGs.

2. METHODOLOGY

This study followed a systematic and rigorous quantitative and qualitative approach to reviewing literature from a database. This process entails (1) gathering and perusing published materials from a respected research database, (2) enhancing the search by using a suitable combination of keywords and other accessible filters, (3) performing a bibliometric analysis of the gathered corpus of data, (4) visualizing the relationships between authors, keywords, and journal citations through infographics, and (5) examining the existing literature to identify research gaps and recommendations for future research [19]. Figure 1 displays the review process framework followed in this study.
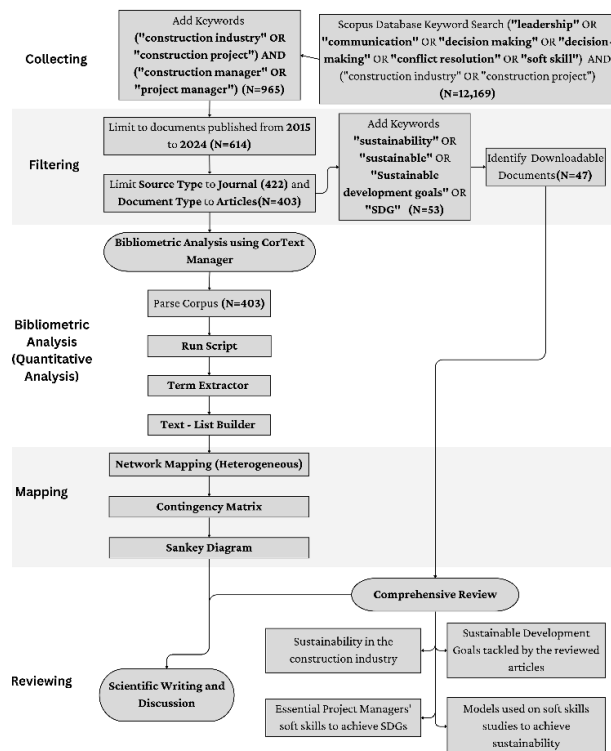

Fig. 1. Review Methodology Framework used in this study

2.1 Bibliometric Analysis

The Scopus database was used to gather bibliometric information on project managers' soft skills from published journal articles. A string-type keyword, TITLE-ABS-KEY ("leadership" OR "communication" OR "decision making" OR "decision-making" OR "conflict resolution" OR "soft skill") AND ("construction industry" OR "construction project") AND ("construction manager" OR "project manager"), was used to extract bibliometric information from the Scopus database. The total number of published documents based on the search query results is 965. Moreover, to include only the reliable and reviewed documents, the following filters were used to refine the search in preparation for the bibliometric analysis: (1) To cover only the published documents in the last decade, the year was set to 2015 – 2024, which resulted in 614 documents, (2) The Source Type was limited to Journals only, narrowing the result to 422 documents, and (3) Document type was limited to articles and reviews, which comprised the final 403 documents.

The metadata of the resulting 403 documents, particularly the Citation Information and the Abstract and keywords, were exported from the Scopus database in a Comma-Separated Value (CSV) file format on September 06, 2024. The CSV file was parsed into the corpus and uploaded to the CorText Manager to perform a quantitative analysis of its bibliometric information by running several scripts, such as term extractor, Text list-builder, Contingency Matrix, Heterogeneous Map, and Sankey Diagram.

2.2 Systematic Literature Review

After the bibliometric review, a comprehensive review was conducted to thoroughly analyze the connections among the documents in the exported corpus. To facilitate this, the corpus of published papers underwent further filtering by including the terms "sustainability," "sustainable," "sustainable development goals," and "SDG" in the initial string-type keyword search. Additionally, only the published articles that the researchers can download are used, thus giving a result of 47 papers. Through the SLR, the research gaps and future directions were identified and used to draw conclusions and recommendations.

3. RESULT AND DISCUSSION

3.1 Bibliometric Analysis

3.1.1 Prominent Journals and Contingency Matrix

Table 1 presents the distribution of papers per journal based on the keywords included in the Scopus search query. One hundred sixty-eight journals were identified, with articles from the top 10 comprising about 40 percent of the overall article count. The three journals with the highest published publications according to project managers' soft skills research are Engineering, Construction, and Architectural Management, with 30 articles; Sustainability (Switzerland), with 26 articles; and International Journal of Construction Management, with 21 articles.
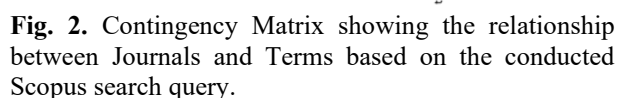
Figure 2 presents a contingency matrix illustrating the co-occurrence of terms and journals based on the conducted Scopus search query. A red cell signifies a robust correlation between the two fields, indicating a high magnitude of co-occurrence. A blue cell signifies a tenuous association between the two fields and suggests a low degree of co-occurrence. Furthermore, a white cell signifies neutrality between the two domains. It can be observed from the figure that the term "risk management" has the highest co-occurrence with the Journal of Engineering, Design, Technology, indicating that most of the published papers in this journal mainly discussed risk management—likewise, the term "transformational leadership" strongly co-occurrences with the Sustainability (Switzerland) Journal.

3.1.2 Network Map and Sankey Diagram of Terms

As shown in Figure 3, a heterogeneous network map was created using the CorText manager platform to elucidate the relationships among pertinent terms and years to project managers' soft skills. Keywords located within and next to a solid circle exhibit significant co-occurrence rates. In contrast, keywords encircling a specific year signify a substantial degree of co-occurrence between the keywords and that year. It can be observed that the essential soft skills of a project manager were found in various years. For instance, leadership

styles such as "safety leadership" were tackled in 2016 and 2022, and "transformational leadership" in 2017 and 2018. "Leadership competencies" were also explored in conjunction with "sustainable practices" in 2019. This indicates that the leadership style of project managers was deemed critical to achieving sustainable construction. Another soft skill, communication, was observed to take various forms, such as "project communication," which was studied in 2021, "information management system" in 2023, and "communication network" in 2024, which may be associated with the limited mobility brought by the lockdown protocols and community quarantines experienced during the peak of COVID-19 pandemic. At the same time, safety in construction sites has been explored for years, starting in 2019, which was also an adverse effect of the COVID-19 pandemic.

It is also interesting to note that various modeling tools and algorithms were observed in the figure, indicating the influence of emerging technologies and automation on the future trend of project managers' soft skills impact on sustainable development goals.

Table 1. Journal Ranking based on the conducted Scopus search query.

Rank	Journal Name	Number of Articles
1	Engineering, Construction, and Architectural Management	30
2	Sustainability (Switzerland)	26
3	International Journal of Construction Management	21
4	Journal of Construction Engineering and Management	21
5	Journal of Management in Engineering	15
6	Buildings	12
7	Construction Innovation	11
8	Journal of Engineering, Design and Technology	10
9	International Journal of Managing Projects in Business	10
10	Built Environment Project and Asset Management	9
11-168	Others	238

Fig. 2. Contingency Matrix showing the relationship between Journals and Terms based on the conducted Scopus search query.

The evolution of terms associated with the study of project managers' soft skills from 2015 to 2024 was illustrated by generating a Sankey diagram, also referred

to as a river network. A tube of deeper hue linking two keywords signifies a robust association between them. Furthermore, the tube's thickness signifies the degree of co-occurrence between the two terms. It can be observed from Figure 4 that the terms "case study & multi-criteria decision-making" and "management system & safety management" in 2020 merged to form the term "Analytic Hierarchy Process & Construction Phase" in 2021. This indicates the integration and application of multi-criteria decision analysis (MCDA) methods in explicitly evaluating multiple conflicting criteria in decision-making during any construction phase, emphasizing safety management and risk management. Another significant evolution of the term was "project communication & project participants" in 2020, which split into "project team members & extra-role performance" and "system dynamics & purpose of the study" in 2021. This indicates that communication among project team members has been vital for effective system dynamics and extra-role performance.
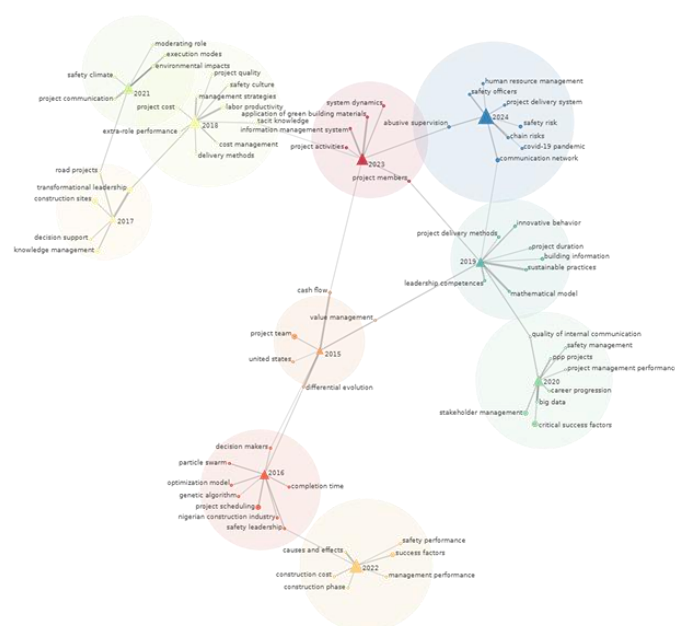

Fig. 3. Heterogeneous Map showing the relationship between Terms and Years based on the conducted Scopus search query
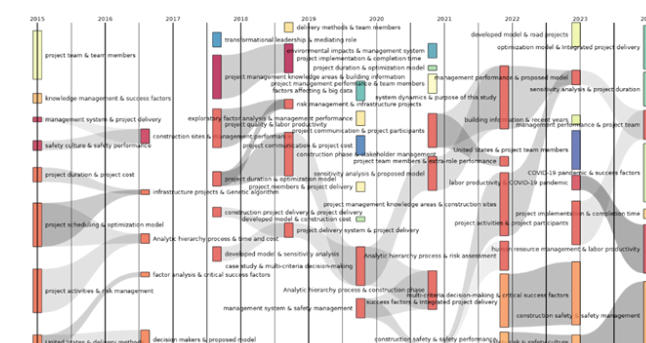

Fig. 4. Sankey Diagram showing the evolution of terms with respect to years based on the conducted Scopus search query.

3.2 Systematic Literature Review
3.2.1 Sustainability in the Construction Industry
Sustainability in the construction industry takes place through the environmental, economic, and social dimensions, in which different practices and innovations

are played out during project lifecycle integration. Integrating these dimensions has positively impacted construction firms' sustainability performance. This way, it strives for energy efficiency, resource conservation, and waste management. Extended profitability outlines the economic dimension of sustainability, which comprises proper long-term usage of resources and reduced carbon emissions, often in the presence of suitable competent leadership for construction management [20].

Social sustainability is equally important in large projects as stakeholder engagement, particularly that of the community, which is fundamental to responsible practices and avoiding reputational risks [21]. Renewable energy projects have equal significance to sustainability, and organizational and leadership support are critical success factors [22]. Integrating ICTs can enhance process efficiency and waste reduction; hence, it is directly linked to sustainability goals [23]. However, attaining sustainability must consider cost-sustainability trade-offs because higher sustainability results in higher costs [24].

The construction context is precarious; thus, safety and risk management are essential. The conceptual notions of these intelligent systems predict and mitigate risks, making the concepts safer and more sustainable in practice[25]. Establishing trust and collaboration with other stakeholders helps alleviate information asymmetry and enables the achievement of project objectives[26].

Retrofitting existing buildings is a central strategy for sustainability, minimizing the extraction of resources, and reducing CO_2 emissions [27]. Information management systems have been demonstrated to enhance the efficiency of project implementation, but challenging the realms of time, cost, and quality constitutes a complex scenario in sustainable construction [28] [29]. Innovation by transformational leadership encourages sustainable practices and tackles complex problems in the industry [30]. Additionally, new green building materials and the use of BIM technology may further reduce the environmental footprint [31]. Closely related to the four principles of circular economy, it is going to improve upon sustainability in construction by encouraging closed-loop systems [32]. The construction industry must embrace these holistic approaches to balance economic, social, and environmental goals.

3.2.2 Sustainable Development Goals tackled by the reviewed articles

The radar chart presented in Figure 5 illustrates patterns in the emphasis of the research. It indicates that specific Sustainable Development Goals (SDGs), namely SDGs 9, 11, and 12, are likely to demonstrate a more significant proportion of publication counts according to the conducted comprehensive literature review. This implies that most studies published on this subject concentrated more on these SDGs. Conversely, SDGs with diminished values may signify a need for more research emphasis, underscoring potential deficiencies in literature or reduced interest in specific domains.

The innovation concepts of SDG 9, "Industry, Innovation, and Infrastructure," are supported in construction: build resilient infrastructure and support inclusive industrialization [24], improve the application of green building materials [31] And consistent with this is the

role of communication networks[33]. For SDG 11, "Sustainable Cities and Communities," local communities are included in the decision-making process [63] [54], and project managers' sustainability expertise and impact [34] [32]. SDG 12, "Responsible Consumption and Production," is also highlighted through articles focusing on waste management and resource efficiency [35] [36].
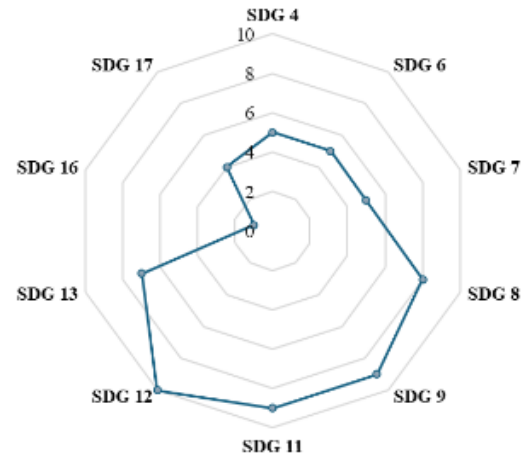

Fig. 5. Radar chart showing the distribution articles alignment in their SDGs

3.2.3 Essential Project Managers' Soft Skills to Achieve SDGs

Figure 6 shows that, based on the reviewed articles, leadership, communication, stakeholder management, and conflict resolution are identified as project managers' top essential soft skills. These would enable project managers to navigate the tasks of complex projects by maintaining a delicate balance between environmental, social, and economic aspects of sustainability. Leadership, particularly transformational leadership, continues to be a significant catalyst for sustainability. Effective leadership inspires teamwork and changes that bring organizations closer to the aim of being sustainable [13]. Communication is also crucial in ensuring that stakeholders embrace sustainability-related objectives. Clear communication is important in transforming goals into actualizable plans [37]. Stakeholder management and conflict resolution skills are also critical because, while playing out, some sustainability-based projects do encounter conflicting stakeholder interests [38] [17].
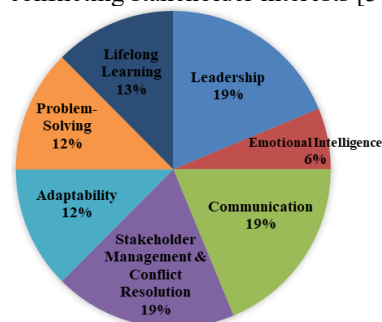

Fig. 6. Essential Soft Skills Discussed in the Reviewed Articles.

3.2.4 Models used on Soft Skills Studies to Achieve Sustainability

Figure 7 presents the models applied in the reviewed articles on essential project managers' soft skills to

achieve SDGs and the number of published articles using them. Various models, including Partial Least Squares Structural Equation Modeling (PLS-SEM), Multi-Criteria Decision-Making (MCDM), and Nonparametric Tests, have been utilized in the research landscape to examine how leadership, communication, decision-making, and adaptability affect sustainable construction project success.
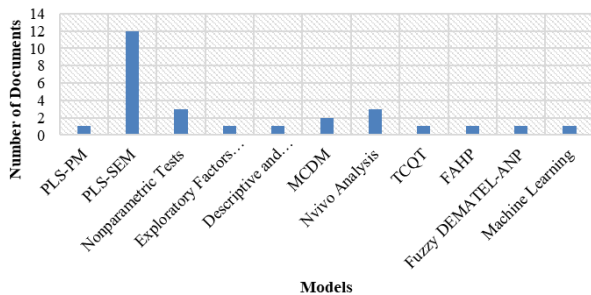

Fig. 7. Models used in Reviewed Articles.

The most frequently used PLS-SEM models suggest a significant focus on examining relationships between latent variables such as leadership competencies and outcomes. PLS-SEM is an excellent tool for research to analyze the complex, multidimensional characteristics of leadership in construction projects, especially in sustainable environments [23] [39] [40]. Models are thus effective for exploring the relationship between abstract soft skills, tangible project performance, and alignment with SDGs. SEM underlines the roles of communication and leadership in bringing teams and stakeholders in line with SDGs [41] [20].

Furthermore, there can be huge disparities within the application of models. Despite the wide application of PLS-SEM in exploring the presence of leadership and communication, MCDM is used less in evaluating the decision-making process of sustainable construction projects. MCDM is an essential tool in the balancing act involving time, cost, and sustainability competencies within construction projects [42] [43]. However, the relatively small use here alludes to a gap in knowledge about how decision-making frameworks can be utilized better to move through these trade-offs.

Another gap that exists is the underutilization of qualitative methods like Nvivo Analysis, which has been applied in a minute number of studies [31] [44]. The dynamics of a team cannot be measured quantitatively in terms of emotional intelligence and other soft skills; hence, qualitative models would be helpful in further deepening how such skills manifest day-to-day in managing projects. The reliance on these quantitative models leaves a gap in understanding nuanced interpersonal relationships that impact the results of a project, especially when sustainable construction is very high-stress-oriented work.

In addition, the use of Machine Learning (ML) models in forecasting project outcomes has very few applications. Though ML models are increasingly being applied in construction management research, this aspect is only underexplored concerning how soft skills may ensure the effective achievement of sustainable projects. The predictability power of impact assessments of soft skills can be enhanced by adding techniques from machine learning, which allows the analysis of large data sets and the discovery of previously unnoticed patterns.

4. CONCLUSION

The research underscores the critical role of soft skills in construction project management, particularly in achieving the SDGs. The bibliometric analysis showed that researchers' interest in analyzing the relationship between project managers' essential soft skills and their role in achieving the SDGs has grown exponentially since the latter was conceptualized in 2015. This trend indicates that this topic is expected to continue increasing in publication volume in the coming decades, as evidenced by the number of published documents. Using a corpus of 403 papers from the Scopus Database, the bibliometric review identified prominent journals such as Engineering, Construction, and Architectural Management, Sustainability (Switzerland), and the International Journal of Construction Management. The evolution of extensively studied keywords was revealed through the Heterogeneous map and the Sankey Diagram. The systematic literature review highlighted that as the construction industry faces increasing complexities and challenges, project managers must master sufficient soft skills such as leadership, communication, stakeholder management, and conflict resolution to navigate these dynamics effectively. These skills support facilitation and innovation and ensure that the goods and services produced by construction projects make a meaningful positive contribution to the global pursuit of SDGs. Notably, the SDGs most frequently associated with construction project management include SDG 9: Industry, Innovation, and Infrastructure, SDG 11: Sustainable Cities and Communities, and SDG 12: Responsible Consumption and Production.

This literature review revealed significant research gaps, including the underutilization of qualitative methods to examine interpersonal dynamics within project teams and the scarcity of decision-making frameworks and machine learning models to predict and enhance project success. A balanced approach that incorporates quantitative and qualitative methodologies is necessary for a comprehensive understanding of the role of soft skills in sustaining project outcomes. Other identified gaps include less use of MCDM in applications for decision-making, less use of qualitative methods involving interpersonal dynamics, and more utilization of machine learning in predictive analysis. These gaps can be filled so that this will better express how soft skills, with all aspects they encompass, impact the success of a project through the achievement of SDGs.

Future research should continue to explore the interplay between soft skills and project outcomes, employing diverse methodologies to capture the nuances of interpersonal dynamics in construction management. A balanced application of the quantitative and qualitative models must also be pursued; it should further enhance the strategic development of soft skills in construction project management.

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