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Bibliometric Analysis of Key Issues and Objectives in Environmental, Economic, and Social Sustainable Project Management

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Abstract

The environmental, economic, and social sustainability of construction project management was researched through a literature review in this study. This paper aimed to analyze the trends in studies about issues in sustainable project management and to research the importance and components of environmental, economic, and social sustainability and their interrelationships. In the scope of the bibliometric analysis, the articles were analyzed by their publication years, authors, authors' countries, authors' organizations, and keyword occurrences. Then, the problems in ensuring the sustainability of construction project management and suggestions for overcoming these problems were reviewed. In previous studies, high energy and raw material consumption and waste became the main factors that prevented environmental sustainability. A strong relationship was found between economic sustainability and life cycle cost assessment, and effective stakeholder engagement is considered the major contributor to the social sustainability of construction management. Sustainability regulations and policies, managerial capabilities, and organizational learning also have critical significance for achieving sustainable construction. The dimensions of sustainability in construction management are closely related to one another, and each one is crucial to achieving the other aspects of sustainability in construction projects. Therefore, a comprehensive strategy that takes into account social, economic, and environmental sustainability criteria should be adopted in construction project management.

Keywords

project management, bibliometric, sustainable project management, environmental sustainability, economic sustainability, social sustainability

1 Introduction

The First International Conference on Sustainable Construction took place in November 1994 in Tampa, Florida, United States of America. The meeting resulted in the broad acceptance of sustainable construction as a novel profession (Kibert, 1994). At first, sustainability in the construction industry was associated with only the environmental effects and energy consumption of buildings and construction activities. Then, the concept was expanded by including the effects of material and technology selection. Factors other than technical ones like regulations, standards of conduct, managerial abilities, and stakeholders' collaboration have also been considered in the scope of achieving economic and social sustainability (Shen et al., 2006). In addition to the traditional triangle of time, cost, and quality, the sustainability achievements of construction projects should be evaluated (Guo et al., 2019). Briefly, constructing in an environmentally friendly way by considering the social and economic effects of the construction project throughout its entire life cycle can be defined as "sustainable construction" (Huovila and Koskela, 1998). A novel approach to achieving sustainable project management was provided by Green Project Management (GPM) by extending the traditional triangle to risk management and considering benefits and values (Green Project Management, 2023).

Besides the environmental aspect of sustainable construction management, the economic and social extents of this phenomenon have been discussed in academia. Shen et al. (2010), investigated the inhibiting factors of sustainable construction practices in Mainland China by

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reviewing plenty of project documents and interviewing construction practitioners, in their study. They obtained 18 economic, nine social, and eight environmental attributes from this case study. They stated that some of these attributes are considered more important than others, and concluded by stating that economic attributes have priority over environmental and social factors. Armenia et al. (2019) determined the five dimensions of sustainable construction project management through a literature review: corporate policies and practices, resource management, life cycle orientation, stakeholders' engagement, and organizational learning. Then they proposed a conceptual framework that merges these dimensions and highlights the relationship among them. The "extended project life cycle" concept, which includes organizational learning and relationships with stakeholders besides the conventional life cycle process of the project, was also dwelled on. Stanitsas and Kirytopoulos (2023), determined 82 indicators, which are used for identifying a construction project's sustainability, by reviewing literature and having interviews with construction experts, in their study. They pointed out that 27 of these indicators are related to economics, 37 of them are about social or management issues, and 18 of them are connected to environmental aspects of sustainability. It as suggested that project managers can cover either all three aspects of sustainability or select the ideal combination of the indicators according to the aspect that they prefer to focus on.

Environmental, economic, and social aspects of sustainable project management were discussed individually in many studies, and some studies considered more than one dimension of sustainable construction management. Gibberd (2022), highlighted the relationship between economic and social sustainability in construction management by stating that the construction industry provides both economic as well as social advantages. Santos et al. (2017), have an approach that includes both environmental and economic evaluations of sustainability in construction. However, there is still a need for studies that cover every aspect of sustainable construction management.

In this study, a systematic literature review about issues in sustainable project management was conducted using the Web of Science (WoS) database after the introduction of systematic literature review as a methodology. The findings of the analysis of the studies are then presented. Next, some prominent papers in terms of environmental, economic, and social dimensions of sustainability were selected, and a conceptual framework that represents the barriers, suggestions, and goals in sustainable project management was created by interpreting these papers.

2 Methodology

In the first phase of this study, the related data was gathered from one of the most comprehensive and reliable databases. In the next phase, a bibliometric analysis was conducted to review the papers, their subjects, and the connections among the papers in terms of various criteria systematically and objectively. Finally, some notable papers related to environmental, economic, and social sustainability in project management in the construction industry were selected. The issues and objectives of the theme were presented by analyzing these papers.

2.1 Data collection

WoS is one of the most extensive and commonly used databases in many academic fields (Zhu and Liu, 2020). It is a convenient search platform that allows users to list journals, analyze papers, and reach materials for bibliometric analysis (Li et al., 2018). WoS, being one of the major bibliometric databases, can provide thorough citation screening and superior research data (Zheng et al., 2020). In WoS, "sustainable construction management" topic and "project management" and "construction" and "sustainabl*" words under the all fields category and "barriers" or "issues" or "challenges" or "problems" or "hurdles" or "obstacles" words under the all fields category were searched on May 24th, 2023. All field categories were searched on May 24th, 2023. Only articles written in English were included in the search. As a result of the filtered search, 1269 articles related to the study topic of this paper were found. The data files of the articles were then downloaded in "tab-limited files" format with the "full record and cited references" option.

2.2 Bibliometric analysis

The bibliometric analysis was conducted using VOSviewer (version 1.6.19). VOSviewer is a computer program that has a comprehensive text mining feature. It is used to identify and create scientific graphs by deciphering and comprehending the networks that connect researchers, papers, locations, institutions, and keywords (van Eck and Waltman, 2011). The downloaded tab-limited files of the papers, which were found in WoS, were imported into VOSviewer. Then, keywords' co-occurrence analysis, countries' co-authorship analysis, authors' co-authorship analysis, papers' citation analysis, and authors' citation analysis were conducted using VOSviewer.

2.3 Selection of articles

The 1269 articles reached by the bibliometric analysis underwent a two-stage analysis. First, they are reviewed according to their themes and abstracts. Then, an entire document analysis was conducted on the articles. After these steps, a large number of papers were eliminated, considering the relevance of the papers to the scope of the study.

3 Results

3.1 Results of bibliometric analysis

3.1.1 Number of published articles

The bar chart provided illustrates the division of the papers related to issues in sustainable project management in construction in terms of publication years. The publication number peaked in 2021, reaching 38, while in 2005, the lowest number of papers were published. Between 2005 and 2017, the growth was slow despite the fluctuations. In 2018, the figures for publications saw a rapid increase to 20. Since 2018, the number of publications has never been less than 16 (Fig. 1).

There are 421 journals that have published articles about issues in sustainable project management in construction. According to Table 1, 444 of the 1269 publications about the topic were published in 10 journals; 200 of these publications belong to Sustainability, which is the number one journal in terms of number of publications. The second journal with the highest number of articles is the Journal of Cleaner Production, with 85 articles. Each of the other journals on the list has 35 or fewer published articles.

3.1.2 Analysis of articles by authors

According to the results, there are 22 prominent authors who have at least five papers related to issues in sustainable project management in construction. Kineber, A.F. (25 articles and 213 citations), Oke, A.E. (21 articles and 209 citations), Chileshe, N. (12 articles and 228 citations), Zuo, J. (11 articles and 408 citations), Hamed M.M. (10 articles and 26 citations), Skitmore, M. (10 articles and 353 citations), Othman, I. (8 articles and 155 citations), Hosseini, M.R. (7 articles and 61 citations), Darko, A. (7 articles and 150 citations), and Ye. K. (7 articles and 142 citations) are the top 10 authors with the highest numbers of articles. The result of the co-authorship network analysis among 22 authors who published five or more papers about issues in sustainable project management in construction illustrates that there are seven clusters. The red cluster (centered by Oke, A.E and Kineber, A.F.) has a close link to the green cluster (consisting of Edwards, D.J., Martek, I., Darko, A., Hosseini, M.R., Shooshtarian, S. and Chan, A.). The blue cluster has no connection with other clusters, and it is represented by Zuo, J., Ye, K., Skitmore, M., Ng, S., Zhang, X., Wu, Z. The yellow, cyan, orange, and purple clusters do not have links to any other cluster, and each of them consists of two authors (Fig. 2).

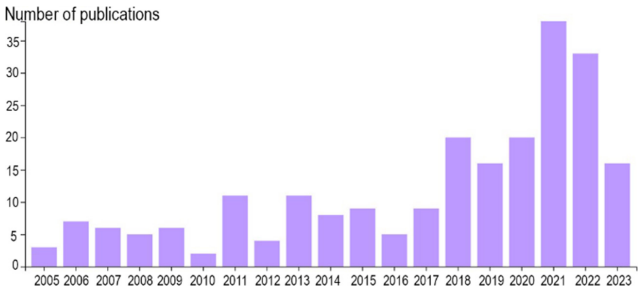

Fig. 1 Distribution of the articles by years between 2005 and 2023

Table 1 Top 10 journals publishing the highest numbers of articles about the issues in sustainable project management

Journals	Number of articles
Sustainability	200
Journal of Cleaner Production	85
Engineering Construction and Architectural Management	35
Buildings	27
Journal of Construction Engineering and Management	21
International Journal of Construction Management	17
Environmental Science and Pollution Research	16
Journal of Engineering Design and Technology	15
Applied Sciences-Basel	15
Environment Development and Sustainability	13

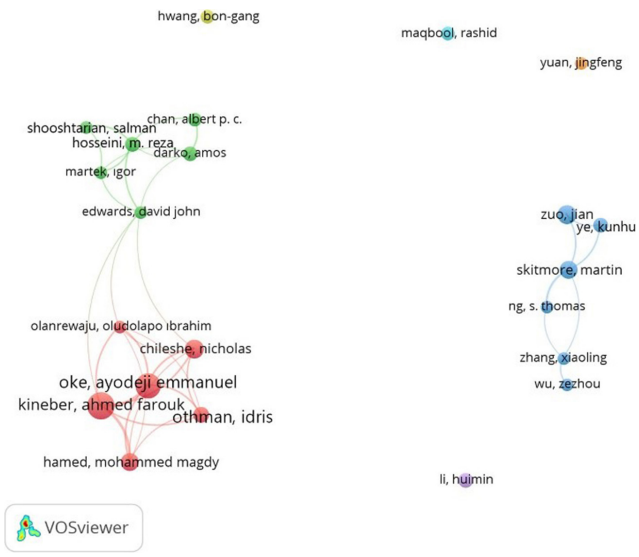

Fig. 2 Network analysis of co-authorship among authors

3.1.3 Number of papers by countries

The results show that 104 countries have articles related to issues in sustainable project management in construction. There are 60 countries with five or more articles. 56 of them are in the countries' network connection, which has 18 clusters, while Austria, Ukraine, Latvia, and Slovakia have no connection (Fig. 3). 444 articles related to issues in sustainable project management were published in China, and China's citation score is 7302. This makes China the leader in terms of the number of articles and citation scores. England, Australia, and the USA also have considerable figures. Their publications are 152, 132, and 124, and they have 3306, 3096, and 3430 citations, respectively (Table 2).

3.1.4 Analysis of articles by organizations

According to the results, 1611 organizations published articles about issues in sustainable project management in construction, and 33 of them published 10 or more articles. The Hong Kong Polytechnic University is the organization that published the most articles about the topic, with 47 articles and 1991 citations. The Chinese Academy of Sciences has the second highest number of articles, and the University of Johannesburg has the third-highest number of contributors. Their publication and citation scores are 38, 27 and 843, 132, respectively (Table 3).

The collaborative link among the author universities is illustrated in Fig. 4. Among the top 33 contributor organizations to issues in sustainable management in construction, 31 organizations are in the network of authors' affiliations, in which there are 10 clusters. The strength of the links was indicated by the size of the node. Therefore, a larger node means more collaboration with other universities (Fig. 4).

3.1.5 Analysis of the co-occurrence of keywords

The keywords are indicative of the theme of the paper and represent the field of study. In this study, the threshold for the minimum number of occurrences of a keyword is 15, and 40 keywords were found. Sustainability, sustainable development, sustainable construction, the construction industry, project management, construction, China, the circular economy, barriers, and waste management are the keywords with the 10 highest numbers of occurrences (Fig. 5). They

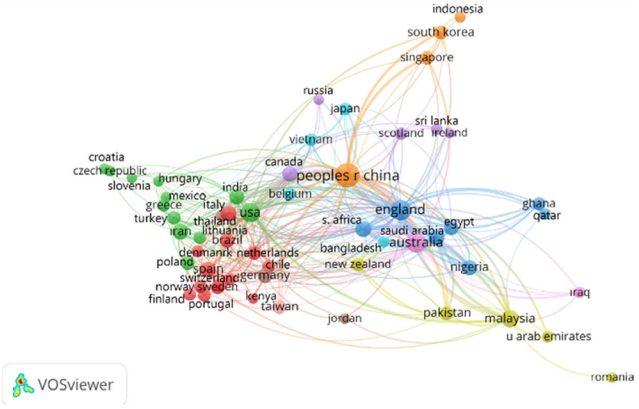

Fig. 3 Network analysis of authors in terms of their regions

Table 2 Top 10 countries that make the highest contribution to issues in sustainable construction management

Country	Number of papers	Citations
China	444	7302
England	152	3306
Australia	132	3096
USA	124	3430
Malaysia	67	704
South Africa	46	282
Italy	45	952
Saudi Arabia	42	225
Iran	42	740
Spain	41	813

Table 3 Top 10 organizations publishing the highest number of articles

Organization	Number of articles	Citation
Hong Kong Polytechnic University	47	1991
Chinese Academy of Sciences	38	843
University of Johannesburg	27	132
Chongqing University	26	885
Federal University of Technology Akure	23	206
University of Hong Kong	22	515
Prince Sattam Bin Abdulaziz University	18	189
Deakin University	17	342
University of South Australia	17	521
City University of Hong Kong	16	190

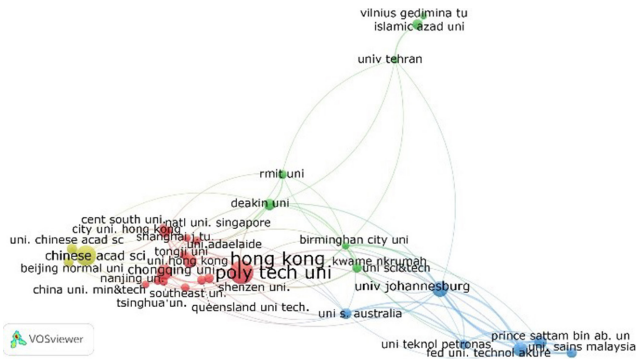

Fig. 4 Network analysis of author organizations

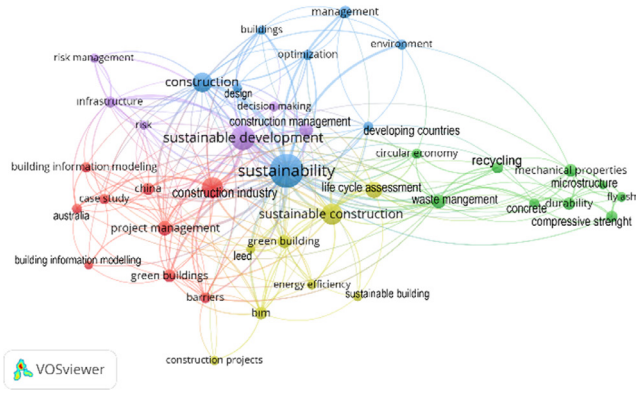

Fig. 5 Keyword co-occurrence analysis

have 154, 104, 82, 48, 42, 39, 36, 31, 29, and 28 occurrences, respectively. The final illustration of the keyword network analysis has 7 clusters and 306 links.

3.2 Article selection results

As a result of the summary and content analysis, 257 articles were selected, and the detailed full-text analysis carried out afterwards determined the 78 articles most suitable for the subject studied among these 257 articles. Finally, 32 of the 78 selected articles were selected as final materials. These 32 articles' scopes are presented in Table 4. Environmental issues in sustainable project management were discussed in 17 of these papers. The number of articles related to the economic dimensions of the issues in sustainable project management is 13. 15 of the articles are about social aspects of the issues in sustainable project management. Other dimensions of the issues in sustainable project management were introduced in 13 articles (Table 4).

4 Discussion

4.1 Issues in sustainable construction management

Despite the advantages of sustainable construction practices, there are various barriers to their implementation. Sustainable construction projects have significant benefits that non-sustainable projects cannot provide, such as energy efficiency, lower water consumption, lower running and maintenance costs, high property value, and an important contribution to the local economy (Eichholtz et al., 2013). However, in some cases, these benefits can be neglected by focusing on the initial cost of the project. It is stated that the sustainability of the construction project does not lead to any extra costs (Salem et al., 2018). In addition to the economic issues, rigorous sustainability regulations, insufficiently available information resources for professionals, the need for the collaboration of stakeholders at every phase of the project, and the lack of knowledge about sustainable construction among stakeholders are the barriers to sustainable construction management indicated in the studies (Yu et al., 2018). Fathalizadeh et al. (2021), investigated the barriers to achieving sustainable construction project management in Iran by using a social analysis method in their studies. For this purpose, they surveyed construction professionals, and then to analyze the gathered data from the survey, they used social network analysis (SNA) tools (Gephi) and principal component analysis (PCA). Through this process, it was determined that the project context of insufficient regulation, absence of sustainability knowledge, poor funding for innovation, volatile interest in sustainability in society, and lack of motivation within construction firms for transitioning to sustainable project management were five main barriers. They highlighted that the cluster of these barriers leads to more complex and destructive problems for sustainable construction management, and thus, the main barriers should be resolved first. Lin et al. (2022), surveyed construction practitioners in order to investigate the barriers and determine the measures to overcome them in their study about barriers to value management in small construction projects. As a result of the survey, it was found that value management is very rarely taken into consideration by practitioners. They also categorized the barriers to value management implementation as knowledge and guidance barriers, cultural barriers, resource barriers, environmental barriers, and methodological barriers. It was stated that in construction projects, knowledge, guidance, and environmental barriers constitute the majority of the barriers. Gunduz and Almuajebh (2020), classified CSFs for sustainable construction project management by reviewing the literature as project-related factors, company- and work-related factors, client-related factors, project management factors, design-team-related factors, contractor-related factors, and project-manager-related factors. Then, they surveyed construction professionals by including these factors and evaluated the survey results using the relative importance index (RII) and the traditional analytic hierarchy process (AHP). The results showed that most of the factors are related to financial problems, the authorities' approval mechanisms, and administrative aspects. Ershadi et al. (2021), investigated barriers to sustainable procurement management (SPM) in the construction sector in their paper. They conducted interviews with construction conductors and reviewed previous studies on this topic. As a result of the study, they defined ten barriers under the resources, communication, culture, compliance, and policy

Table 4 Content analysis of selected articles

Author	Year	Environmental sustainability	Social sustainability	Economic sustainability	Managerial skills and other elements
Ahuja	2012	x	x		x
Bovea and Perez	2012	x			
Brent and Labuschagne	2006		x		
Bribián et al.	2011	x		x	
Buyle et al.	2013	x			
Dempsey et al.	2011		x		
Eichholtz et al.	2013			x	
Ershadi and Goodarzi	2021	x	x	x	x
Ershadi et al.	2021			x	
Fathalizadeh et al.	2021		x		x
Gunduz and Almuajebh	2020		x	x	x
Hussin et al.	2013	x	x	x	
Hutchins and Sutherland	2008		x		
Hwang and Tan	2012	x		x	x
Jaillon et al.	2009	x			
Kiani Mavi and Standing	2018	x			x
Kosheleva and Elliott	2006		x	x	x
Koskela	1993	x	x	x	
Larsson and Larsson	2020				x
Lin et al.	2022		x		x
Maddaloni and Sabini	2022		x		
Martinez et al.	2022	x			
Nawaz et al.	2023	x			
Qazi et al.	2021				x
Rajabi et al.	2022	x	x	x	x
Ramos et al.	2023	x			
Salem et al.	2018	x		x	
Shen et al.	2006	x	x	x	x
Valdes-Vasquez and Klotz	2013		x		
Yu et al.	2018				x
Zhou and Lowe	2003			x	
Ashtiani and Muench	2022	x			

titles for SPM. They explained that intra-organizational reasons that lie behind these barriers are the lack of management commitment, integration, internal controls, teamwork, and specific training programs. Insufficient funds, incentives, audits, collaboration, and consensus are defined as extra-organizational reasons by them.

4.1.1 Issues led by the environmental impacts of construction activities

The environmental impacts of construction activities were discussed in various papers. In general, they can be determined as pollution, intense energy use, and resource consumption (Buyle et al. 2013). The key elements of reducing these effects are increasing the effectiveness of the steps in the construction process, protecting natural and energy resources by using renewable resources, and achieving minimum waste generation (Langston and Ding, 2001). Implementing these elements into the entire life cycle process of a building to construct durable, non-hazardous construction for both the environment and human health is the most effective way to tackle the environmental hurdles in achieving environmentally

sustainable construction management. Environmental problems caused by the construction industry can be significantly reduced with conscious decision-making in project management.

Energy and material consumption

Excessive resource and energy consumption, which poses a significant threat to the environment, is the most concerning aspect of the construction sector. The construction industry uses 24% of the total raw materials, 50% of the energy consumed worldwide, and 42% of the water consumed in the construction or usage processes (Bribián et al., 2011). In addition, 50% of greenhouse gases that cause global warming, 40% of pollution in drinking water, 24% of air pollution, and 50% of CFC and HCFC emissions are caused by activities related to construction (Dikmen et al., 2011). Martinez et al. (2022), made the pre-construction assessment of the embodied environmental impacts of a diversion dam project in Spain from the production-based perspective and the consumption-based perspective by using the Environmentally Extended Input-Output Analysis tool. According to their research, the high amounts of steel and cement used have a negative impact on the environment. According to their research, cement and steel make 17.2% and 29.5% of the total environmental contribution, respectively, from a production-based perspective, and from a consumption-based perspective, their total environmental contribution is 74%. They concluded that the embodied impact can be reduced by deciding to use environmentally friendly materials in the early stages of a construction project. Zokaei Ashtiani and Muench (2022), considered water use, vegetated area, lightning power, waste generated, local material used, pedestrian area, bicycle facilities, recycled content, pavement reused, carbon footprint, and energy footprint as 12 sustainable performance metrics for 33 roadway projects they evaluated. It was mentioned that it is possible to calculate a roadway project’s energy consumption and greenhouse gas emissions by using just the project price, and paving materials are the major elements that increase roadway projects' energy footprint and carbon footprint.

Waste generation and pollution

Waste generation from buildings throughout their life cycle is another significant issue in the construction sector. An increase in construction waste leads to reduced efficiency, delays in deliveries, inefficient material consumption, and financial harm in an inevitable way (Koskela, 1993). 30–35% of construction costs belong to construction waste, which is equal to 9% of the building materials used in construction by weight. The main contributors to the high amount of construction waste are revising project plans often, inadequacies of building materials' quality, organizational skills, procurement, scheduling, and effectiveness of labor (Hussin et al.,2013).

The principles of construction and demolition waste management are called 4R (reduce, recycle, reuse, and regulate) (Ahuja, 2012). This is supported by many studies, one of which was done by (Nawaz et al., 2023). By surveying, they conducted a study to determine waste maximization and minimization factors in critical management practices in construction projects. After determining the factors, they applied confirmatory factor analysis (CFA) to reveal the relationship among these factors. They mentioned the connection between the amount of waste and onsite practices such as contract management, logistics management, waste segregation, and material reuse. In their study, it was stated that the amount of waste produced can be reduced with effective management of design, storage, workers and equipment, material handling, and onsite management practices.

4.1.2 Economic issues

One of the most important issues regarding sustainable construction projects is that the cost of sustainable construction projects is not considered within the scope of life cycle costing and that the post-construction economic benefits are not given sufficient importance. Salem et al. (2018), claimed that sustainable construction does not end with completing the construction process, adding that adopting the life cycle method is an effective approach to achieving sustainable goals in the construction industry. It indicates that sustainable buildings are financially advantageous considering the life cycle cost of construction projects in their study. They mentioned that this approach reveals indirect economic benefits, comfort, and soundness to users and decreases greenhouse gas emissions, natural resource consumption, and pollution. They used Mastar City Eco-Villa, which releases a low amount of carbon and uses less energy and water, as a concrete example to support their argument.

There is a strong relationship between environmental and economic aspects of sustainability in the construction industry, and several studies have investigated this relationship by mentioning the initial cost of sustainable construction projects and emphasizing the financial benefits of sustainable building in the long run. Eichholtz et al. (2013), examined a wide range of office buildings

and showed that energy-efficient buildings had significant economic benefits. They linked the economic benefits of green buildings to their comparative energy performance, finding that both sustainability and heat loss are associated with higher rental income and asset values. Hwang and Tan (2012), determined the barriers to sustainable construction projects in Singapore. In their study, they examined the effects of these barriers and proposed various solutions to tackle them by interviewing and surveying construction professionals. They found insufficient investment in sustainable project management as the major barrier, besides the application of knowledge and technical difficulties. They deemed an innovatively sustainable project management framework implementation necessary to solve the issues found. Qazi et al. (2021), stated that design revisions, the client's limited budget, and uncompleted sustainable design operations are the critical risks in a sustainable construction project if the conventional ranking scheme is used. In their article, they proposed and used a new risk matrix for risk prioritizing in sustainable projects. However, they mentioned that when the proposed process is followed, a rigorous schedule, low-productive labor, and construction equipment are the critical risks. Comparing the different results of the two approaches, they claimed that the new risk matrix enables project managers to evaluate tail risks, which are ignored by the conventional risk ranking scheme.

4.1.3 The issues related to social sustainability and stakeholder engagement

The phenomenon of social sustainability embodies user comfort, well-being, and security; the availability of services; diversity and fairness; and growth in communities (Goh, 2017). Social sustainability is closely associated with determining and controlling the impact a business has on people, and the effectiveness of its stakeholder interactions and involvement is crucial (Social Sustainabilty, 2021). Therefore, the social sustainability of a construction project has a strong correlation with the intensity of relationships among its stakeholders. Maddaloni and Sabini (2022), conducted a two-stage survey with project managers in both the construction industry and other industries to determine the barriers to extensive stakeholder inclusion in major construction projects (MCPs) from a social sustainability perspective by adopting the normative stakeholder theory approach in their study. They emphasized the need for the incorporation of external stakeholders like local communities to ensure social sustainability in MCPs and eliminate reputational risks. Kiani Mavi and Standing (2018), investigated the critical success factor (CSF) of construction project management by surveying senior professionals working in construction project management. After grouping the CFSs into five main categories and subcategories and determining the priority factor of the CFSs, they found stakeholders' expectations to be the second most significant sub-criteria, after full top management and sponsor support. Larsson and Larsson (2020), determined sustainable project management components as corporate policies and practices, resource management, life cycle orientation, stakeholder orientation, and organizational learning. They also stated that the intensity of the collaboration has a great impact on planning and problem-solving single-mindedly, the duration of the collaboration affects the level of organizational learning, and deep and wide collaboration plays a vital role in having stakeholder engagement.

To improve collaboration with the professional education of project managers, designing and implementing managerial skills education like a project management academy within the company is an efficient action. Such education programs assist project managers in adjusting to evolving requirements efficiently, which is vital for both the education of upcoming project managers and general human resource improvement strategies that construction businesses might use (Changali et al., 2015). The relationship between social sustainability and financial activities should be noted. Hutchins and Sutherland (2008), investigated the link between financial choices and social sustainability, with an initial emphasis on how it would directly affect measurements. They suggested a broad approach to taking into account social sustainability methods and discussed several corporate social responsibility factors. It was stated that money-related activities and measures of social sustainability were connected, and an individual company's action may have an impact on national sustainability benchmarks. They concluded that it would not be possible to fully achieve sustainability in the supply chain process without a deeper comprehension of the connections between business and society.

4.2 Objectives and suggestions for achieving sustainable construction management

In sustainable construction management, stakeholder decision-making must always be approached from a multi-criteria point of view by adding environmental factors to other sustainability requirements (Bovea and Pérez-Belis, 2012). Environmental indicators of a construction project's sustainability are energy consumption, renewable energy use, material recycling and reuse, water

consumption and recycling, pollution, construction and demolition waste management, land use, and the impact on biodiversity (Rajabi et al., 2022).

The approaches adopted to achieve environmentally sustainable construction project management may vary. Ershadi and Goodarzi, (2021) stated that there are two main approaches, besides life cycle assessment (LCA) and life cycle costing (LCC), to achieving sustainable project management: execution-oriented capabilities and product-oriented capabilities, in their review article related to capabilities for achieving sustainable construction projects. They mentioned that while execution-oriented capabilities provide an effective way of bridging the gap between sustainability and the effect of the relationship among stakeholders, product-oriented capabilities related to post-construction needs like environmental harmony and energy consumption are needed to be met. They concluded by stating that both types of capabilities are needed for achieving sustainable project management. Meticulous planning and implementation phases with the most appropriate materials and construction methods avoid unnecessary construction waste. Hussin et al. (2013) stated that the amount of construction waste can be decreased with initially effective planning, which provides the lowest amount of waste generation, production done by capable laborers, and implementing a just-in-time inventory system that avoids overuse of materials and unnecessary waste. Prefabrication is also an effective way of reducing construction waste. Jaillon et al.(2009), investigated the influence of the application of prefabrication in construction projects on reducing construction waste in Hong Kong. They determined that utilizing prefabrication instead of common building methods produces roughly 52% less construction waste.

With regard to the achievement of economic sustainability, companies normally manage up-front capital expenses with care; however, they rarely examine the complete life-cycle costs of development and operations. Procurement experts must consider life-cycle costs, which include not just the purchase price but also efficiency, maintenance, and disposal (Changali et al., 2015). Also, stakeholders should be provided with sufficient information about the economic benefits of sustainable buildings (Zhou and Lowe, 2003). Alternatively, (Ramos et al., 2023), claimed that supporting local communities financially can be efficient for mitigating cost and logistics issues.

To achieve social sustainability in construction project management, certain criteria must be met. Health and security are considered the major ones among these criteria in various studies. There should not be any security issues for final users, and at the construction stage, required precautions ought to be taken to avoid disruption, accidents, and damage to people and the environment (Brent and Labuschagne, 2006). Stakeholders' involvement plays a critical role in satisfying users of buildings. Especially at the early stages of a construction project, it offers a deep insight into the client's expectations (Shen et al. 2006). Another aspect of socially sustainable construction projects is using local resources like materials and people to create employment opportunities in the region (Valdes-Vasquez and Klotz, 2013). Social cohesion and interaction, an accessible environment, cultural values, and local communities are also considered significant parameters of the social sustainability of a construction project (Dempsey et al., 2011).

5 Conclusion

A bibliometric analysis on issues in sustainable project management in construction was conducted using the WoS database, and the results show that the highest number of articles related to issues in sustainable project management in construction were published in 2021, and with 200 articles, Sustainability is the journal with the most publications. Kinaber, A.F. made the greatest contribution to the topic with 25 articles and 213 citations. Among 104 countries, China is the leader in terms of both numbers of publications and citations, with 444 papers and 7302 citations. England, Australia, and the USA are the other significant contributors. They have 152, 132, and 124 articles and 3306, 3096, and 3430 citations, respectively. Hong Kong Polytechnic University published 47 articles about issues in sustainable project management and has 1991 citations. These figures make it the top contributor to the topic. According to the keyword analysis, sustainability, sustainable development, and sustainable construction are the keywords that have the most occurrences, with 150, 104, and 82 occurrences, respectively.

The bibliometric analysis provides a comprehensive insight into the trends and studies related to issues in sustainable project management in construction. The results will assist future studies in analyzing the current situation of the literature. As a result of the bibliometric analysis, 1269 articles were reached. These articles were evaluated in terms of their context, and the most important ones on the subject were selected. Afterwards, the selected articles were deeply analyzed, and a conceptual framework

was created. The result of the analysis of the selected articles indicates that sustainable construction management in every aspect of sustainability provides managers with the opportunity to be successful in delivering construction projects that have a minimum environmental impact, use resources efficiently, protect cultural values, improve the social environment, and meet the physiological, psychological, and sociological needs of final users.

However, achieving complete sustainable construction management may not be an easy task due to some serious impediments. In literature, besides the high initial cost of sustainable construction projects, the absence of sustainability knowledge, poor funding for innovation, volatile interest in sustainability in society, lack of motivation within construction firms for the transition to sustainable project management, rigorous sustainability regulations, and insufficiently available information resources for professionals are the major barriers to sustainable construction management.

Construction projects' sustainability depends on the projects' environmental, economic, and social impacts throughout their life cycle. The environmental impact of a construction project can be reduced with managerial decision-making that focuses on the protection of natural resources, renewable energy resource choices, efficient energy use, and waste minimization during the project's life cycle process. From the point of view of the economic sustainability of construction projects, overlooking the benefits of sustainable construction projects by prioritizing their initial cost is the main issue. However, sustainable projects have substantial benefits like efficiency in energy use, low operational costs, high asset value, and rental income in the long run. Such long-term benefits of sustainable construction should be appreciated by stakeholders. Regarding social sustainability, stakeholders' involvement at each step of the life cycle of a project, secure and healthy spaces, social cohesiveness and interaction, an accessible environment, cultural values, and local communities have key importance.

There is a strong relationship between the aspects of sustainability in construction management, and each of them plays a significant role in achieving other elements of sustainability in construction projects. Thus, in construction project management, a holistic approach that considers environmental, economic, and social sustainability criteria should be adopted. The review of the selected articles provides a useful guideline for a more exact characterization and comprehension of the aspects of sustainable project management in the construction industry. It is recommended that the next studies focus on evaluating and extending this conceptual framework using investigatory methodologies such as case studies and interviews. This would make significant contributions to the literature.

References

Ahuja, R. (2012) "Sustainable Construction: Is Lean Green?", In: Chong, W. K. O. (ed.) International Conference on Sustainable Design, Engineering, and Construction 2012, Fort Worth, TX, USA, pp. 903–911. ISBN 9781627480512 https://doi.org/10.1061/9780784412688.108

Armenia, S., Dangelico, R. M., Nonino, F., Pompei, A. (2019) "Sustainable Project Management: A Conceptualization-Oriented Review and a Framework Proposal for Future Studies", Sustainability, 11(9), 2664. https://doi.org/10.3390/su11092664

Bovea, M. D., Pérez-Belis, V. (2012) "A taxonomy of ecodesign tools for integrating environmental requirements into the product design process", Journal of Cleaner Production, 20(1), pp. 61–71. https://doi.org/10.1016/j.jclepro.2011.07.012

Brent, A., Labuschagne, C. (2006) "Social Indicators for Sustainable Project and Technology Life Cycle Management in the Process Industry", The International Journal of Life Cycle Assessment, 11(1), pp. 3–15. https://doi.org/10.1065/lca2006.01.233

Bribián, I. Z., Capilla, A. V., Usón, A. A. (2011) "Life cycle assessment of building materials: Comparative analysis of energy and environmental impacts and evaluation of the eco-efficiency improvement potential", Building and Environment, 46(5), pp. 1133–1140. https://doi.org/10.1016/j.buildenv.2010.12.002

Buyle, M., Braet, J., Audenaert, A. (2013) "Life cycle assessment in the construction sector: A review", Renewable and Sustainable Energy Reviews, 26, pp. 379–388. https://doi.org/10.1016/j.rser.2013.05.001

Changali, S., Mohammad, A., van Nieuwland, M. (2015) "The construction productivity imperative", [online] Available at: https://www.mckinsey.com/capabilities/operations/our-insights/the-construction-productivity-imperative#/ [Accessed: 30 April 2023]

Dempsey, N., Bramley, G., Power, S., Brown, C. (2011) "The social dimension of sustainable development: Defining urban social sustainability", Sustainable Development, 19(5), pp. 289–300. https://doi.org/10.1002/sd.417

Dikmen, Ç., Gültekin, A. B.,Kapsamında, S., Kaynaklarının, E. (2011) "Usage Of Renewable Energy Resources In Buildings in The Context Of Sustainability", Mühendislik Bilimleri ve Tasarım Dergisi (Journal of Engineering Science and Design), 1, pp. 96–100. [online] Available at: https://dergipark.org.tr/en/download/article-file/195367 [Accessed: 15 June 2023]

van Eck, N. J., Waltman, L. (2011) "Text mining and visualization using VOSviewer", [preprint] arXiv, arXiv:1109.2058, 09 September 2011. https://doi.org/10.48550/arXiv.1109.2058

Eichholtz, P., Kok, N., Quigley, J. M. (2013) "The Economics of Green Building", Review of Economics and Statistics, 95(1), pp. 50–63. https://doi.org/10.1162/REST_a_00291

Ershadi, M., Jefferies, M., Davis, P., Mojtahedi, M. (2021) "Barriers to achieving sustainable construction project procurement in the private sector", Cleaner Engineering and Technology, 3, 100125. https://doi.org/10.1016/j.clet.2021.100125

Ershadi, M., Goodarzi, F. (2021) "Core capabilities for achieving sustainable construction project management", Sustainable Production and Consumption, 28, pp. 1396–1410. https://doi.org/10.1016/j.spc.2021.08.020

Fathalizadeh, A., Hosseini, M. R., Silvius, A.J. G., Rahimian, A., Martek, I., Edwards, D. J. (2021) "Barriers impeding sustainable project management: A Social Network Analysis of the Iranian construction sector", Journal of Cleaner Production, 318, 128405. https://doi.org/10.1016/j.jclepro.2021.128405

Gibberd, J. T. (2022) "Social and economic sustainability targets in construction", In: Sustainability Handbook, Alive2Green, pp. 32–43. ISBN 978-0-620-45240-3

Goh, C. S. (2017) "Towards an Integrated Approach for Assessing Triple Bottom Line in the Built Environment", In: Amoêda, R., Pinheiro, C. (eds.) International Conference on Advances on Sustainable Cities and Buildings Development, Green Lines Institute, Porto, Portugal. [online] Available at: https://pure.hw.ac.uk/ws/portalfiles/portal/97260303/SB_Lab2017FullPaper_Goh.pdf [15 June 2023]

Gunduz, M., Almuajebh, M. (2020) "Critical Success Factors for Sustainable Construction Project Management", Sustainability, 12(5), 1990. https://doi.org/10.3390/su12051990

Guo, S., Wang, X., Fu, L., Liu, Y. (2019) "How Individual's Proactive Behavior Helps Construction Sustainability: Exploring the Effects of Project Citizenship Behavior on Project Performance", Sustainability, 11(24), 6922. https://doi.org/10.3390/su11246922

Huovila, P., Koskela, L. (1998) "Contribution of the Principles of Lean Construction To Meet The Challenges of Sustainable Development", In: 6th Annual Conference of the International Group for Lean Construction, Guarujá, Brazil. [online] Available at: https://iglc-storage.blob.core.windows.net/papers/attachment-2c0281d1-46a3-471c-9835-2db0de2d8906.pdf [Accessed: 15 June 2023]

Hussin, J. M., Abdul Rahman, I., Memon, A. H. (2013) "The Way Forward in Sustainable Construction: Issues and Challenges", International Journal of Advances in Applied Sciences, 2(1), pp. 15–24. [online] Available at: file:///C:/Users/user/Downloads/790-583-1-PB.pdf [Accessed: 15 June 2023]

Hutchins, M. J., Sutherland, J. W. (2008) "An exploration of measures of social sustainability and their application to supply chain decisions", Journal of Cleaner Production, 16(15), pp. 1688–1698. https://doi.org/10.1016/j.jclepro.2008.06.001

Hwang, B.-G. and Tan, J.S. (2012) "Sustainable Project Management for Green Construction: Challenges, Impact and Solutions", In: Senaratne, S., Sandanayake, Y. G. (eds.) Global Challenges in Construction Industry, World Construction Conference, Sri Lanka, pp. 171–179. ISBN 9789554516007

Jaillon, L., Poon, C. S., Chiang, Y. H. (2009) "Quantifying the waste reduction potential of using prefabrication in building construction in Hong Kong", Waste Management, 29(1), pp. 309–320. https://doi.org/10.1016/j.wasman.2008.02.015

Kiani Mavi, R., Standing, C. (2018) "Critical success factors of sustainable project management in construction: A fuzzy DEMATEL-ANP approach", Journal of Cleaner Production, 194, pp. 751–765. https://doi.org/10.1016/j.jclepro.2018.05.120

Kibert, C. J. (1994) "Sustainable Construction: Proceedings of the First International Conference of CIB TG 16", In: Kibert, C. J. (ed.) the First International Conference of CIB TG 16, Tampa, FL, USA. ISBN 9780964388611

Koskela, L. (1993) "Lean Production in Construction", In: 10th International Symposium on Automation and Robotics in Construction, Houston, TX, USA, pp. 47–54. ISBN 9780444815231 https://doi.org/10.22260/ISARC1993/0007

Langston, C. A., Ding, G. K. C. (eds.) (2001) "Sustainable practices in the built environment", Oxford: Butterworth-Heinemann. ISBN 0-7506-5153-9

Larsson, J., Larsson, L. (2020) "Integration, Application and Importance of Collaboration in Sustainable Project Management", Sustainability, 12(2), 585. https://doi.org/10.3390/su12020585

Leiden University "VOSviewer, (1.6.19)", [computer program] Available at: https://www.vosviewer.com/ [Accessed: 20 May 2023]

Li, K., Rollins, J., Yan, E. (2018) "Web of Science use in published research and review papers 1997–2017: a selective, dynamic, cross-domain, content-based analysis", Scientometrics, 115(1), pp. 1–20. https://doi.org/10.1007/s11192-017-2622-5

Lin, X., Mazlan, A. N., Ismail, S. (2022) "Barriers to the implementation of value management in small construction projects", Journal of Building Engineering, 54, 104639. https://doi.org/10.1016/j.jobe.2022.104639

Maddaloni, F. D., Sabini, L. (2022) "Very important, yet very neglected: Where do local communities stand when examining social sustainability in major construction projects?", International Journal of Project Management, 40(7), pp. 778–797. https://doi.org/10.1016/j.ijproman.2022.08.007

Martinez, S., del Mar Delgado, M., Marin, R. M., Marchamalo, M., Alvarez, S. (2022) "Pre-construction quantification of embodied environmental impacts to promote sustainable construction projects: The case study of a diversion dam", Journal of Environmental Management, 314, 115061. https://doi.org/10.1016/j.jenvman.2022.115061

Nawaz, A., Chen, J., Su, X. (2023) "Factors in critical management practices for construction projects waste predictors to C&DW minimization and maximization", Journal of King Saud University - Science, 35(2), 102512. https://doi.org/10.1016/j.jksus.2022.102512

Qazi, A., Shamayleh, A., El-Sayegh, S., Formaneck, S. (2021) "Prioritizing risks in sustainable construction projects using a risk matrix-based Monte Carlo Simulation approach", Sustainable Cities and Society, 65, 102576. https://doi.org/10.1016/j.scs.2020.102576

Rajabi, S., El-Sayegh, S., Romdhane, L. (2022) "Identification and assessment of sustainability performance indicators for construction projects", Environmental and Sustainability Indicators, 15, 100193. https://doi.org/10.1016/j.indic.2022.100193

Ramos, M., Martino, G., Vasconcelos, L., Ferreira, F. (2023) "Local scale dynamics to promote the sustainable management of construction and demolition waste", Resources, Conservation & Recycling Advances, 17, 200135. https://doi.org/10.1016/j.rcradv.2023.200135

Salem, D., Bakr, A., El Sayad, Z. (2018) "Post-construction stages cost management: Sustainable design approach", Alexandria Engineering Journal, 57(4), pp. 3429–3435. https://doi.org/10.1016/j.aej.2018.07.014

Santos, M. T., Lamego, P., Frade, P. (2017) "Management Options for Construction and Demolition Wastes from Residential Recuperation", Waste and Biomass Valorization, 8(5), pp. 1679–1687. https://doi.org/10.1007/s12649-016-9675-1

Shen, L., Tam, V. W.Y., Tam, L., Ji, Y.-b. (2010) "Project feasibility study: the key to successful implementation of sustainable and socially responsible construction management practice", Journal of Cleaner Production, 18(3), pp. 254–259. https://doi.org/10.1016/j.jclepro.2009.10.014

Shen, L., Ou, X., Feng, C. (2006) "Sustainable Construction", In: Key issues of sustainable performance for construction projects, The Hong Kong Politechnic University, pp. 1–15. ISBN 962-367-518-6 [online] Available at: https://ira.lib.polyu.edu.hk/bitstream/10397/181/4/SDP-Book-Chap-1.pdf [Accessed: 16 June 2023]

Social Sustainabilty (2021) "United Nations Global Compact", [online] Available at: https://unglobalcompact.org/what-is-gc/our-work/social [Accessed: 30 April 2023]

Stanitsas, M., Kirytopoulos, K. (2023) "Investigating the significance of sustainability indicators for promoting sustainable construction project management", International Journal of Construction Management, 23(3), pp. 434–448. https://doi.org/10.1080/15623599.2021.1887718

Green Project Management "The GPM P5 Standard for Sustainability in Project Management 3.0", [online] Available at: https://www.greenprojectmanagement.org [Accessed: 30 April 2023]

Valdes-Vasquez, R., Klotz, L. E. (2013) "Social Sustainability Considerations during Planning and Design: Framework of Processes for Construction Projects", Journal of Construction Engineering and Management, 139(1), pp. 80–89. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000566

Yu, M., Zhu, F., Yang, X., Wang, L., Sun, X. (2018) "Integrating Sustainability into Construction Engineering Projects: Perspective of Sustainable Project Planning", Sustainability, 10(3), 784. https://doi.org/10.3390/su10030784

Zheng, C., Yuan, J., Zhu, L., Zhang, Y., Shao, Q. (2020) "From digital to sustainable: A scientometric review of smart city literature between 1990 and 2019", Journal of Cleaner Production, 258, 120689. https://doi.org/10.1016/j.jclepro.2020.120689

Zhou, L., Lowe, D. (2003) "Economic Challenges of Sustainable Construction", In: RICS Construction and Building Research Conference, School of Engineering and the Built Environment, University of Wolverhampton, Wolverhampton, UK, pp. 113–126. ISBN 1-84219-148-9 [online] Available at: https://pure.manchester.ac.uk/ws/portalfiles/portal/32552525/FULL_TEXT.PDF [Accessed: 30 April 2023]

Zhu, J., Liu, W. (2020) "A tale of two databases: the use of Web of Science and Scopus in academic paper", Scientometrics, 123(1), pp. 321–335. https://doi.org/10.1007/s11192-020-03387-8

Zokaei Ashtiani, M., Muench, S. T. (2022) "Using construction data and whole life cycle assessment to establish sustainable roadway performance benchmarks", Journal of Cleaner Production, 380, 135031. https://doi.org/10.1016/j.jclepro.2022.135031