

Construction Project Management Issues and Development in Current for Future Construction Project: Challenges and Prospects in Sustainable Project Management

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ABSTRACT

The global construction industry faces escalating pressure to embrace sustainable practices in response to increasing awareness of environmental and social issues. The construction sector, with its profound impact on the built environment, plays a pivotal role with far-reaching environmental, social, and economic implications. Stakeholders in the construction industry, driven by concerns related to climate change, resource depletion, and social equity, actively seek strategies to mitigate their environmental and societal impact. This has culminated in a heightened emphasis on sustainability in construction project management. The aim of this research is to investigate the challenges and propose proactive strategies among construction project stakeholders to effectively integrate sustainable practices into project management. This research systematically reviews existing literature to illuminate the challenges and prospects associated with integrating sustainability into construction project management, focusing on the future of construction projects. Challenges encountered by construction project managers include cost constraints, limited awareness and training, resistance to change, and the complexity of sustainability metrics. Understanding and addressing these challenges are imperative for the successful implementation of sustainable construction practices tailored to the unique context of construction firms. On the positive side, integrating sustainability into construction project management holds promising prospects. It is anticipated to result in reduced resource consumption, enhanced energy efficiency, lower operational costs, and an improved public image. Furthermore, aligning construction projects with sustainable development goals opens avenues for innovation and market differentiation. This research underscores the necessity of proactive strategies and collaborative efforts among project stakeholders to overcome challenges associated with sustainable construction. It highlights the potential for future construction projects to contribute significantly to a more sustainable built environment, emphasizing the growing importance of sustainability in construction projects. By addressing these challenges, the construction industry can progress towards a more sustainable future, aligning with global efforts to combat climate change and promote responsible resource management.

Keywords: Sustainable, Environmental, Challenges, Prospects, Project Management

INTRODUCTION

The construction sector as a significant influencer in shaping the built environment, faces mounting pressure to incorporate sustainable practices. This pressure is fueled by heightened awareness of climate change, resource scarcity, and social equality (Sim & Putuhena, 2015). The evolution towards sustainable construction practices, often referred to as green building or eco-friendly construction, represents a paradigm shift in the industry's principles (Generalova et al., 2016). These principles encompass resource efficiency, waste reduction, and the use of environmentally friendly materials, with contemporary practices integrating resilience, circular economy concepts, and social sustainability.

Examining current projects reveals difficulties that include cost implications, regulatory compliance, and

stakeholder involvement. Addressing these challenges is crucial for effective project management in a sustainable manner (Wang, 2021). The significance of sustainability in the construction industry is undeniable, driven by factors such as climate change, regulatory requirements, and market demand. Sustainable construction practices offer benefits like cost savings, reduced environmental impact, and improved corporate social responsibility (Chofreh et al., 2019). Additionally, the study anticipates how the construction sector is preparing for a future where sustainable practices will play an increasingly significant role, necessitating potential alterations in project management procedures and requirements.

The global construction industry is undergoing a transformative shift towards sustainable practices in response to environmental concerns and evolving regulations (Stanitsas & Kirytopoulos, 2023). This study aims to investigate the challenges and propose proactive strategies among construction project stakeholders to effectively integrate sustainable practices into project management. This research contributes to the understanding of difficulties, problems, and opportunities related to the incorporation of sustainable practices into construction project management. It serves as a valuable resource for industry experts and policymakers seeking to enhance construction project management practices.

METHODOLOGY

A Systematic Literature Review (SLR) involves a rigorous and systematic approach to analyzing a body of existing research to answer specific research questions or explore a particular topic comprehensively (Crippa et al., 2020). The method of analysis in an SLR is crucial for extracting, synthesizing, and interpreting information from selected studies. The method of analysis in a Systematic Literature Review requires a systematic, transparent, and thorough approach to extract meaningful insights from a diverse body of existing research. It aims to provide a comprehensive and unbiased understanding of the research questions or topics under investigation (Mengist et al., 2020). By systematically reviewing existing literature, researchers may shed light on the complexities faced by the industry, ranging from cost implications and regulatory compliance to stakeholder participation. A detailed explanation of the steps involved in the method of analysis for a Systematic Literature Review is provided in Figure 1.

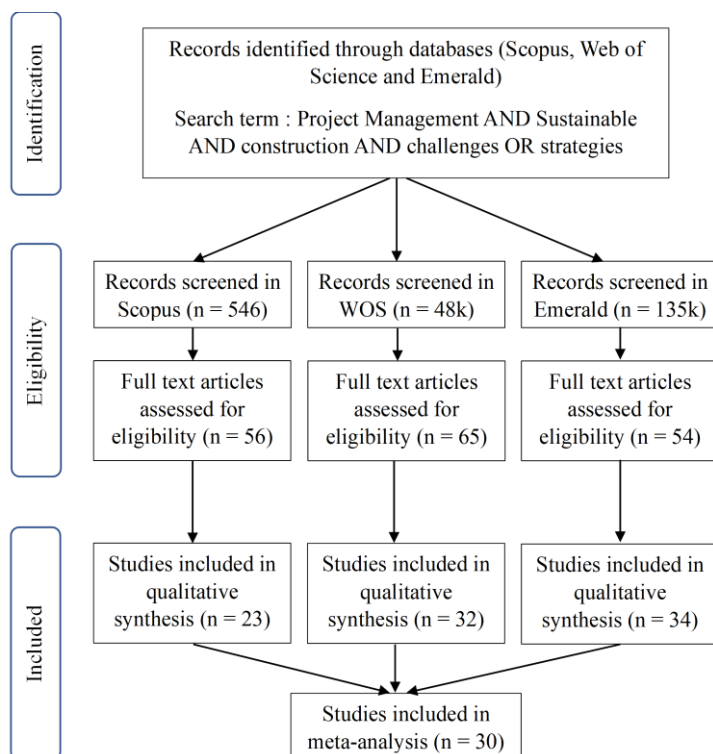


Figure 1 Literature screening process

The SLR selects related academic articles in the span of past 5 years only (2018-2024) to ensure the contemporariness of the findings. The research utilises 3 databases for screening process, which are Scopus, Web of Science (WOS) and Emerald. The number of research articles yielded are in massive amount. However they were screened according to the articles' outcome, analysis and conclusion. Many of the articles were duplicated among the three databases, therefore they were omitted. Furthermore, some of the literature were also not in article format but in other formats such as book part, earlycite article, expert briefing, case study, executive summary and graphic analysis, therefore they were also omitted in the eligibility phase. Finally, the selection of each remaining articles were further refined by omitting the ones without clear conclusion, irrelevant context, redundant findings, incomplete data and unavailability of full text. This final screening is the phase when researchers conclude on the selected articles to be reviewed in the SLR.

RESULTS AND DISCUSSION

Cost and Time Challenges

There are several challenges to sustainable practices or the project management, particularly green construction, such as the ability to complete a green project within reasonable cost and schedule constraints (Robichaud & Anantatmula, 2016). The PM plays a critical role in determining the success or failure of the project, as they are responsible for tasks such as planning, cost estimation, and ensuring quality and timely completion (Ferrarez et al., 2023). It is because productivity, which has a direct impact on the time and costs of a construction project, may enhance several elements of sustainability, particularly economic sustainability, by lowering the time or expenses of a building project (Vivek et al., 2023). Overall, it is obvious that the aspects connected to project control and management are highly important in enhancing the sustainability performance of construction projects in the opinion of construction managers. Cost and time are one of the important success criteria in the implementation of the renewable energy project (Arabpour & Silvius, 2023). Investment expenses, operation and maintenance costs, R&D costs, manufacturing costs, and return on investment are all economic considerations in sustainable project.

The initial expenditure necessary for sustainable building projects is sometimes greater than that required for typical ones (Makovšek et al., 2012). While sustainable initiatives offer long-term savings due to lower operating costs, the higher initial expenses can be a substantial hurdle for many stakeholders. The calculation of the ROI for green construction initiatives can be difficult. While green buildings may save operational costs, enhance property value and improve tenant happiness, the initial investment might take several years to recoup. Some stakeholders may be put off by the lengthy repayment time (Teik, 2019). Green building sometimes necessitates an initial investment in environmentally friendly materials, technology, and design elements (Othman et al., 2012). These upfront expenses might be greater than those of traditional building methods, making it difficult for developers and investors to justify the additional investment. However, long-term cost savings and benefits of green buildings, such as lower energy and water use, must be considered (Nasereddin & Price, 2021).

It can be said that obtaining financing for green construction projects can be difficult, particularly for smaller developers or organisations. Thus, it is hard for them to manage the project well and effectively. Many financial institutions may be inexperienced with the risks and rewards of green building, making it more difficult to get financing on advantageous conditions. The elements that influence project expenditure might be investigated. This is critical in a developing country because funds may be dedicated to other institutions, cultures, infrastructure, science, and technology development. The use of renewable energy in Malaysia can help to reduce carbon dioxide emissions and contribute to the country's long-term alternative energy options. Hence, more expenditure will need to expense to successfully implement this alternative

option (Goh et al., 2014).

Furthermore, project deliverables or projects themselves might have long-term social, economic, and environmental consequences. Then, in order to align portfolio selection and monitoring with the principles of sustainable development, numerous choices must be evaluated and compared, and they must be ranked based on their immediate costs, long-term costs, and contribution to organisational goals. These expenses and contributions might be difficult to quantify or convey in monetary terms at times. Another difficult issue is determining if initiatives are contributing to planned goals and reset them if the organizational goals change (Sánchez, 2015).

The strategic value of a project may be measured in terms of the different social, ecological, and economic components associated with sustainability (Martinsuo & Killen, 2014). Evaluating the environmental and social implications of various options can lead to longer decision cycles as project teams carefully weigh the sustainability aspects of each choice. There is one more notable challenge is the time-intensive nature of planning. Sustainable projects often require more detailed and comprehensive planning processes, involving the identification of sustainability goals, assessment of environmental social impacts and the design of sustainable strategies (Ferrarez et al., 2023). These activities might extend the project's initial planning phase. Sustainable project management may also involve extended decision-making (Hosseini et al., 2016). As sustainability initiatives often demand additional reporting and documentation to demonstrate compliance with sustainability standards, this heightened administrative work can further extend project timelines.

Projects are carried out to attain a certain purpose and set of goals. Companies are increasingly concerned about a project's broader advantages and value, in addition to the iron triangle objectives of scope, time, and money (Silvius & Schipper, 2014). Traditional project management techniques and practices must be modified for project managers to provide sustainable construction within customers' cost and timely expectations.

Organization Technical Challenges

The project manager (PM) as defined in this study, is the individual responsible for overseeing and managing a project, utilizing their available skills and tools to achieve a specific objective. A professional is appointed by the project owner prior to the project's commencement (Shin et al., 2018). Construction project managers considered that productivity of organization had a significant impact on the sustainability performance of building projects. Without active involvement by the PM, the crucial decisions may not be made, and the client's ideas may not effectively communicate with other project stakeholders (Harris et al., 2021). When it comes to stakeholder engagement, a key issue is the lack of effective communication among project team members, leading to reduced satisfaction during meetings and a diminished understanding of project objectives (Loo & Wong, 2023). The scarcity of information often compels stakeholders to make assumptions and decisions, which can subsequently lead to errors throughout the project's lifecycle. Inadequate management signifying that poor management practices and techniques can result in subpar project outcomes. Ineffective management by the project manager can impact various aspects of the project, including decision-making, resource control, project quality, and timeliness (Sadullah et al., 2018). Proper planning is essential for the success of projects, as it influences the other factors like the project's cost, budget, risk assessment and the establishment of clear objectives and goals (Ali, 2020). The responsibilities of a project managers are extensive in a project, and as such, the PM cannot afford to be passive in project control. The project's success is significantly dependent on the active contribution of the project management.

It has been shown that the construction business faces tremendous opposition to change. Accepting innovation in process and materials is a problem influencing the industry's progress. Similarly, this issue

has an impact on the adoption of sustainable construction materials since both clients and professionals prefer to remain with what they know rather than what is new. As a result, since the impacts will affect the delivery in sustainable construction, there is no improvement in the sustainable construction. Hence, a shift from the usual to the adoption of innovative concepts is required. Science and technology development is not an issue in industrialised and advanced nations, but it is a major difficulty in developing nations (Aghimien et al., 2019). R&D development, technical, innovative technology, advanced technology, new technology, and information technology are some of the technological aspects that influence the success of renewable energy (Abdulwahab et al., 2022). Sustainable construction frequently requires the integration of new technologies and materials. It is significant to ensure the performance and durability of these innovations can pose technical challenges. The purpose is to overcome these obstacles necessitates rigorous research and development, testing, and industry adoption.

Incorporating the social and environmental aspects of sustainability into programs and projects presents a significant challenge, particularly in the context of large sustainable construction projects (Thamhain, 2014). There is a clear need for further research to create user-friendly tools, techniques and methodology. These resources are essential for seamlessly integrating sustainability into the routine functions of project management. Other than that, organisational culture has been identified as one of the most important factors distinguishing exceptional organisations from the other aspects, since it impacts the whole functioning of a company through its environment. The usage of non-renewable resources and the use of low-carbon fuels can be influenced by culture (Liu et al., 2020). According to Liu et al. (2020), well-established modern construction businesses should include sustainability into their culture, which will impact the regular behaviours of other organisations and their affiliates. Environmental and friendly initiatives performed within organisational culture limitations have a favourable influence on project sustainability. As a result, cultural development should take precedence over other company initiatives (Arditi et al., 2017). Many businesses have acknowledged bringing environmental management into the heart of their business strategy.

Knowledge and Training Challenges

Sustainability in project management can be defined as the delivery of projects supported by planning, monitoring, and control systems that incorporate environmental, economic, and social considerations throughout the project's lifecycle (Sabini et al., 2019). Research suggests that the key to more sustainable construction lies in adopting Project Management Practices (PMPs) because project management significantly influences project performance (Banihashemi et al., 2017). The quality of project managers, shaped by their knowledge and experience, underscores their substantial impact on sustainability implementation. Factors such as leadership, teamwork, top management support, risk management, and stakeholder engagement play a pivotal role in the success of renewable energy initiatives (Abdulwahab et al., 2022). Managers' decisions can influence the course of a construction project, emphasizing the importance of prioritizing the environmental aspect of sustainability. Addressing issues like adopting clean energy sources, mitigating environmental degradation, reducing greenhouse gas emissions, and preserving biodiversity highlights the need for effective integration into construction projects. Energy consumption reduction techniques and energy management by construction managers are crucial. The social dimension of sustainability, including motivation and workers' commitment, significantly influences sustainability performance in construction projects. However, there is often a lack of education and training programs for construction experts, hindering the widespread adoption of sustainable practices. Bridging this knowledge gap is essential. Incorporating sustainability principles into design and contracts is a critical factor influencing the improved implementation of sustainability principles during the construction process (View of Construction Managers' Perception of the Factors Affecting Sustainability in Construction Projects, n.d.).

In consistent with previous studies in Malaysia, Jordan, and Ghana, information issues are identified as significant concerns in developing nations, affecting the adoption of sustainable construction practices. The

limited adoption of sustainable construction in developing nations impacts the availability of historical data for reference. The project management community needs to be acquainted with sustainability issues to contribute to a more sustainable society. The inadequacy of project managers in addressing sustainable development poses a challenge to the knowledge, competence, and skills of professionals, especially architects and engineers (Martens & Carvalho, 2016). Efforts to advance sustainable development in the built environment have been somewhat limited in their effectiveness. While these efforts have generated valuable knowledge instrumental in advancing technology, products, simulation tools, and building assessment systems, the challenge lies in managing this extensive knowledge. Accessing knowledge through various channels such as portals, producers, professionals, educational institutions, and organizations is crucial. However, as knowledge expands, there is a risk of losing sight of the holistic perspective, especially for young professionals or those lacking education and training in sustainability. This raises concerns about reverting to the common pitfall of focusing on individual components rather than considering the building as an integrated whole.

Regulatory and Compliance Challenges

This aspect is critical in ensuring the success of a sustainable project management. Government policy, politics, financial assistance, and the government-based programme are all elements that influence the success of sustainable project implementation. (Abdulwahab et al., 2022) According to ECMLG 2017 13th European Conference on Management, Leadership and Governance ... – Google Books, 2017), The relationship between governance and project performance and success is evident. High project performance is linked to various aspects of project governance, including stakeholder and public satisfaction. However, it is important to counter this notion and emphasize that the coordination and control functions have a direct impact on project performance. When governance mechanisms are not aligned, it can lead to significant performance issues in organizations. Moreover, project governance in projects serves various functions, including authorizing project initiation, approving the progression of project milestones, authorizing changes, ensuring compliance with the organization's policies, and meeting any relevant legal or regulatory requirements (Too, E., & Weaver, P. (2014). Governance involves both internal and external mechanisms which are used to govern the organization.

Sustainable project management goes beyond relying solely on indicators; it involves implementing a comprehensive control framework with tailored mechanisms for different sustainability dimensions. Sustainable project governance enhances internal project control by connecting the project to external stakeholders and regulatory requirements. The alliance contract serves as an incentive for partners to embrace innovation opportunities, thereby fostering economic, environmental, and social sustainability (Kivilä et al., 2017). Navigating the complex and dynamic environment of rules and green construction certifications can be challenging. Achieving compliance requires significant effort and knowledge, and inadequate government policies and support pose a barrier. Government assistance through policy development and enforcement is crucial for the increased adoption of sustainable construction (Oke et al., 2019). Previous discussions by Powmya and Abidin (2014) emphasized the critical role of the government in shaping policies affecting sustainable construction, aligning with findings by Ametepey et al. (2015) and Osaily (2010), highlighting the impact of a lack of government support on sustainable construction project management.

Current literature identifies various barriers hindering sustainable project management, including a lack of common values in municipal governing policies, limited localized adaptations, inadequate implementation and maintenance of sustainable practices, and poor city planning (Maqbool & Amaechi, 2022). Economic growth often takes precedence over sustainability during the expansion of smaller cities into larger ones (Liu et al. 2014). Government engagement is identified as a common issue, particularly in the consideration of low-carbon options for energy supply (IPCC 2015). Governing authorities need to recognize the

significance of these issues and adopt policies promptly, despite challenges such as underdeveloped, absent, diffused, or fragmented powers (Gouldson et al. 2016). The absence or inefficiency of governance frameworks hinders the investigation and implementation of low-carbon electrical alternatives. Support and education are essential for sector-specific reforms and the decarbonization of the electrical industry. National climate targets, while deemed achievable, lack ambition, and governments often choose economically attractive options. Financial incentives for governments to collaborate on low-carbon programs and engagement with international groups are needed to make significant progress in climate change mitigation. Substantial financial commitment is required for appealing low-carbon strategies, especially in rapidly growing cities that heavily rely on high-carbon alternatives, emphasizing the urgency and dependence on political involvement at the international level (Reckien et al., 2018).

STRATEGIES IN INTEGRATING SUSTAINABLE PRACTICES

Collaborative Approaches

Collaboration among a diverse group of stakeholders forms the cornerstone of successful sustainable construction projects. Stakeholder engagement is pivotal, and it guarantees that all voices are heard, and concerns addressed. This approach encourages knowledge sharing, allowing stakeholders to learn from each other's experiences and best practices. In addition, when challenges or conflicts related to sustainability arise, a collaborative approach allows for open dialogue and resolution, preventing disputes that could hinder project progress.

Previous research has shed light on several strategies employed to enhance and ensure sustainability in project management. One such strategy involves the establishment of strategic and tactical sustainability objectives. Aarseth et al. (2017) emphasize that setting sustainability goals plays a pivotal role in aligning projects with the broader organizational strategies. The authors underscore that sustainable development aids in streamlining the alignment process between project management and the overall business strategy. They recommend that organizations prioritize sustainability concerns when formulating project strategies and concentrate on situations where these concerns harmonize with other organizational priorities (Norhernani & Mohd Saidin, 2024).

Organizational culture is produced by its leadership ideals, procedures, and priority functions (Liu et al. 2020). The result of every construction project is reliant on the culture of the organisations involved. It interprets the project's goal and has therefore been identified as a crucial influencing element (Liu et al. 2020). Another study, conducted by Schein (2010), discovered that the intensity of an organization's culture influences its performance. Engaging various parties, including contractors, architects, suppliers, and local communities, fosters a collective commitment to sustainability. This collaborative effort not only brings together a wide range of expertise but also ensures that sustainability is a shared goal, not limited to the responsibility of a single party. There is also research indicates that when crucial project stakeholders maintain a harmonious relationship, the overall project is more likely to achieve success. This is primarily attributed to the collective experience and shared knowledge among these individuals. Therefore, when managed effectively, stakeholder collaboration can be regarded as a valuable instrument for enhancing satisfaction with project sustainability goals.

Design and Planning

The early stages of project design and planning offer a critical opportunity to incorporate sustainability into every aspect of the project. An integrated design process, where project managers, architects, engineers and other professionals work together from the project's inception is crucial. This collaboration allows for the consideration of sustainability factors, such as energy efficiency, materials selection, and waste reduction, right from the start. Sustainable materials are a key component. Selecting materials that are environmentally

friendly, durable, and have a minimal ecological footprint is essential. Moreover, site selection plays a pivotal role. Careful consideration of site selection can reduce the environmental impact. Choosing locations that minimize disruption to ecosystems, reduce transportation needs, and optimize energy efficiency is a fundamental part of sustainable project planning.

The strategy calls for organizations to place a strong emphasis on sustainability during the project design phase. This approach involves making strategic choices aimed at crafting sustainable projects. Project managers can integrate value management and life cycle management as integral components of project design to enhance sustainability performance. Sustainability indicators provided proves to be an effective method of ensuring sustainability throughout the project's design and execution phases. Organizations should also establish sustainability policies, advocate for sustainable project practices, and cultivate sustainability competencies. This can be achieved by ensuring that project teams possess the requisite knowledge and skills related to sustainable project management. Additionally, project teams can draw inspiration from previous sustainable projects, adopting the necessary practices and procedures to implement sustainable project management successfully.

Sustainable project management throughout its entire life cycle can be accurately assessed right from the initial stage based on seven crucial parameters, profitability, safety, transparency, ethicality, environmentally friendly practices, social acceptability and meeting stakeholders' and customer expectations. Companies can ensure sustainability in their projects by formulating multi-objective project criteria, considering these critical parameters. These multi-objective criteria can then be transformed into a single objective using appropriate weighting, typically following the weighted sum approach.

Project Management Approaches

Adopting project management approaches that prioritize sustainability can significantly impact the success of a project. Utilizing structured frameworks, such as the Project Management Institute's Project Management Body of Knowledge (PMBOK), tailored for sustainable projects, provides a structured approach to managing sustainability aspects. This ensures that sustainability is not overlooked at any stage of the project. Implementing key performance indicators (KPIs) specific to sustainability is equally important. These metrics track the project's environmental and social impact, helping to assess and improve sustainability throughout the project's life cycle. Establishing dedicated sustainability teams or roles within the project management structure can further ensure the integration of sustainability at every stage. Other than that, promoting a culture of continuous improvement, where project teams regularly assess their sustainable practices and seek opportunities for enhancement is essential for long-term success in project management.

The success of sustainable project management heavily relies on decision-makers, policymakers and the implementation of decisions and policies geared towards project sustainability. Human resources within a project company are typically organized into three main levels, firstly project staff who including staff, supervisors, and junior managers, secondly project managers who encompassing managers, senior managers, and general managers, and the project company's management comprising high-level management and policymakers, such as directors, chief executive officers, vice presidents, and presidents. To ensure smooth business operations and effective management, there must be proper coordination, communication, and the appropriate delegation of powers and responsibilities among these three levels of human resources. Clarity in communication and collaboration is essential. To infuse sustainability into projects, a feedback component should be integrated at each level of the project management organization. This feedback should encompass decisions, actions, processes and be subject to thorough evaluation and review by the organization, stakeholders and even customers. These assessments are crucial for making necessary corrections and achieving sustainability within projects. Within the field of project management, Naoum et al. (2015) elaborates on this by claiming that the decision-making process in project management

is influenced by the aims of the companies involved, resulting in a distinct project management culture.

A study conducted by Ogunde and colleagues in 2017 delved into the challenges that construction project management systems encounter in Nigeria. They identified that for a construction project manager to effectively implement project management practices, it is essential to possess management skills related to planning, organization, command, coordination, and control. This finding implies that further training programs could be beneficial or that existing academic programs should be enhanced to achieve a smooth progress in project management. There is also a strategy involves organizations implementing sustainable supplier practices to guarantee project sustainability. The project owner should establish guidelines that facilitate the adoption of sustainable practices (Aarseth et al., 2017). These guidelines should emphasize resource conservation through increased reusability, the promotion of renewable resources, preservation of the natural environment, quality enhancement, and the fostering of socio-economic growth through good project management.

PROSPECTS FOR FUTURE PROJECTS

Benefits of Sustainable Construction

Sustainable project development, rooted in a regenerative approach, fosters a partnership between humans and nature. It represents a sustainable development approach capable of continuously generating and regenerating a built environment where human and natural systems evolve sustainably together. Several principles underpin regenerative thinking, supporting the notion that it can be a promising avenue for more effective sustainable development in the construction of buildings and the built environment whether it is grounded in a holistic worldview that transcends the limitations of a reductionist approach, aligning with the paradigm shift needed for sustainability or views natural and human systems as unified entities whose evolution is sustained through a development process that enhances their mutual relationships for mutual benefit. Sustainable construction projects offer a multitude of benefits. They reduce environmental impact by minimizing resource consumption and waste production. They also contribute to economic savings through reduced operational costs, and they enhance corporate social responsibility by addressing social and community needs.

Sustainable project with good management helps in departing from the conventional approach that relies solely on human interventions to address environmental degradation and instead focuses on creating a self-sustaining built environment (Jamil et al., 2016). It characterizes regenerative development and design as an evolving collaborative effort in practice. Well managed sustainable project also underscores the importance of ‘place’ and the need to seek design solutions that are context-specific for a nature-built environment that thrives in a harmonious partnership. Embracing the regenerative perspective, sustainable development in the built environment becomes a dynamic process capable of self-reinvention over time. Environmental sustainability is driven by the principle of leaving the Earth in a better condition for future generations. Under this definition, human actions can foster environmental sustainability by living in a way that does not harm the environment or deplete natural resources. This entails the exclusive use of materials derived from recycled or renewable sources, comprehensive waste recycling, the adoption of renewable and clean energy sources like wind, solar, nitrogen, and geothermal energy to conserve energy, safeguarding natural biodiversity, and reducing greenhouse gas emissions.

The term “sustainable construction” typically refers to the construction industry’s responsibility in advancing sustainable development. In essence, sustainable construction serves to contribute to sustainable development within the construction sector, anchored in three fundamental pillars such as environmental protection, social well-being and economic prosperity. Environmental sustainability concentrates on responsible resource utilization and the built environment, encompassing construction activities that may

negatively impact the environment. Social well-being encompasses human emotions, including security, satisfaction, safety, and comfort, as well as human contributions such as skills, health, knowledge, and motivation. Economic sustainability is closely linked to financial gains from projects, benefiting clients, builders, the public, and the government. Integrating sustainability into project management offers various benefits to organizations. According to Kahachi (2017), sustainability in project management enhances organizational value, creates opportunities, mitigates risks, increases profits, and reduces costs. The incorporation of sustainability enables businesses to enter new markets, opening up possibilities for enhanced income generation. Additionally, sustainability in organizational management fosters product diversification, providing businesses with a competitive edge, thereby increasing the likelihood of acquiring clients and growing revenue. Lagas (2015) notes that sustainable practices make firms more appealing to environmentally conscious consumers. In this regard, sustainable organizations enhance their reputation, attracting more clients and boosting sales. Sustainability plays a crucial role in decreasing risks associated with projects and business in general, as risk management practices are integrated into the sustainability strategy. Consequently, project managers can identify hazards early on and design mitigation strategies to minimize losses for the organization (Lagas, B. (2015). *Five Benefits of Embracing Sustainability and Green Manufacturing*. – References – Scientific Research Publishing, n.d.). Sustainability initiatives also contribute to cost savings and energy conservation. Energy is a vital component of project management and project execution (Kahachi, 2017). Sustainable practices emphasize the conservation of resources, enabling firms to spend less on them. Furthermore, sustainability advocates for the use of renewable energy sources, reducing energy expenses. Sustainability enhances process efficiency, allowing businesses to reduce manufacturing and other expenses during the project implementation phase.

Market Trends

The advancement of technology has altered the way projects are handled. Currently, project managers often focus on successfully completing projects within the period specified and without exceeding the initial budget (Jafari Navimipour & Charband, 2016). Various studies have identified gaps in models, procedures, and tools for measuring project management sustainability. They emphasize the need for systematic monitoring, measurement, and understanding of critical sustainability parameters to drive developments in sustainability. To assure accuracy and relevance, the sustainable project management procedures of planning, monitoring, implementing, and assessing have also experienced a paradigm shift. Alvarez-Dionisi, Turner, and Mittra (2016) assert that artificial intelligence (AI) has played a crucial role in supporting effective project management processes and mitigating certain shortcomings. The adoption of AI has been instrumental in enhancing accuracy and streamlining project management tasks. Moreover, contemporary views on sustainable project management have been influenced by the need for a broader skill set to achieve efficiency. Zheng et al. (2016) argue that, in today's corporate environment, project managers must deploy a diverse range of skills to attain sustainability in project management. Therefore, individuals involved in a particular project should possess a varied skill set to establish sustainability and ensure the project's successful execution. Additionally, UI Musawir et al. (2017) suggest that a hybrid project management strategy, emphasizing diversity among project members, can foster competitive project management. A project manager employing a hybrid strategy ensures the fulfillment of project members' demands. Moreover, (Mi et al., 2019) indicate that using a hybrid project management approach promotes sustainability and ensures the overall success of the project management process. Project managers should consider integrating these concepts to achieve sustainability and alleviate challenges associated with poor project management.

The localized dynamics within a specific place play a crucial role in its sustainable development. Understanding the history of a place forms the basis for comprehending these local dynamics, showcasing how nature, humanity, and constructed systems have interacted to shape a built environment capable of adaptability and resilience over time. This learning process presents a new challenge for project managers,

requiring them not only to acquire technical expertise but also to develop novel abilities to engage in dialogue with inhabitants. A thorough understanding of the place's history and context serves as a valuable source of knowledge, inspiring innovative pathways for sustainable development in the built environment. Consequently, it seems more promising to enhance our understanding of natural, human, and man-made systems as intricate, interconnected entities that must evolve sustainably (Khatib et al., 2020). Architects and engineers must expand their considerations beyond the building's scale to encompass the broader context in which the building exists, recognizing interactions between various elements in the built environment. The prevalent performance-based approach in sustainable building design should be reinterpreted to evaluate sustainability across the entire built environment system. Project managers need to shift away from a reductionist approach and embrace principles of complexity and holistic thinking in their professional practice.

Other than that, the prevalent performance-based approach, along with evaluation and assessment systems gauging sustainable performances, can contribute to reimagining the built environment if they consider integrated performances spanning different scales. In this new educational landscape for project managers, architects, and engineers, there is an increased need to cultivate a culture of collaboration among students. Given the extensive body of knowledge related to sustainability and the diverse sources from which this knowledge is derived, assembling this knowledge on a project-by-project basis, the ongoing need for technical skills, and the necessity to engage with the built environment as a complex, interrelated whole, design solutions and implementations should be rooted in collaborative efforts drawing from multiple areas of expertise. While designing as a team is commonplace today, true cooperation demands that professionals not only share their approaches and methods but also develop a common language of communication regarding the built environment. This collaborative approach leverages the diverse expertise of the team in the pursuit of innovative, sustainable development solutions unlikely to be uncovered through individual efforts (Conte, 2018).

In some of the earliest publications concerning sustainability and project management, Labuschagne and Brent establish a connection between the principles of sustainable development and project life cycle management within the manufacturing industry. They propose that the forward-looking nature of sustainability necessitates the comprehensive evaluation of a project's entire life cycle, extending from its inception to its eventual disposal. Expanding on this life cycle perspective, they contend that when integrating sustainability into project management, it's not sufficient to only consider the total project life cycle, including initiation, development, execution, testing, and launch. It is equally crucial to account for the output generated by the project, representing a change in assets, systems, behaviour and so on (Hassan, 2020). This output, referred to as an asset by Labuschagne and Brent, should also be evaluated throughout its complete life cycle, encompassing stages such as design, development, manufacture, operation, decommissioning, and disposal. The life cycle perspective, taken even further, should also contemplate the life cycle of the product or service generated by the asset. To conclude that, the market for sustainable construction is evolving rapidly. Consumers are increasingly demanding green buildings, and companies that embrace sustainable practices gain a competitive edge. Thus, staying attuned to market trends and consumer preferences is crucial for future success.

Technological Advancements

Technological advancements have significantly impacted the prospects for sustainable project management by offering innovative solutions to address environmental, social, and economic challenges. These advancements are reshaping how projects are planned, executed, and monitored, ultimately enhancing the sustainability of project outcomes. To further evaluate and enhance the defined objective functions, computational simulations and nature-inspired evolutionary algorithms, such as Design of Experiments, can be utilized. Prominent methods in this regard include Modified Memetic Particle Swarm Optimization, Grey Wolf Optimization Algorithm, Simulated Annealing Algorithm, and Genetic Algorithm. It is crucial to

emphasize that the assessment of sustainable project management should extend beyond the planning and design phases. For a comprehensive evaluation and comparison of sustainability throughout the entire project management life cycle, project execution and delivery stages should also be taken into consideration. This broadens the scope for research in integrated sustainable project management, where the assessment of project sustainability encompasses not only the planning and design phases but also the project execution, schedule, control and delivery stages.

One key area where the technology plays a pivotal role is data analytics and monitoring. Advanced data analytics tools and technologies allow project managers to collect, process, and analyse vast amounts of data related to a project's environmental and social impact. This enables real-time monitoring and assessment of sustainability performance, providing valuable insights that guide decision-making. For example, sensors and IoT (Internet of Things) devices can track energy consumption, emissions, and resource utilization, allowing project teams to make data-driven adjustments to reduce environmental impact (H. Wang et al., 2022). Advancements in project management software have improved collaboration and communication among project stakeholders. Cloud-based project management tools enable real-time collaboration, file sharing, and progress tracking, making it easier to coordinate sustainable efforts across geographically dispersed teams. This enhanced communication streamlines decision-making, helping teams stay aligned with sustainability goals throughout the project life cycle.

Moreover, the integration of Building Information Modelling (BIM) technology in construction projects is another significant advancement. BIM enables project teams to create digital models of buildings and infrastructure, facilitating collaborative design and planning (Rokooei, 2015). It allows for early detection of sustainability issues, such as energy inefficiencies or material wastage, and supports eco-friendly design modifications before construction begins. This proactive approach minimizes the need for corrective actions later in the project, reducing resource consumption and cost overruns. Renewable energy technologies have also made substantial contributions to sustainable project management. Solar panels, wind turbines, and other clean energy sources can be integrated into construction projects to reduce reliance on fossil fuels and lower greenhouse gas emissions. These technologies not only enhance project sustainability but also offer long-term cost savings as they generate clean, renewable energy.

In addition, technology has enabled the development of innovative materials and construction techniques. Sustainable building materials, such as recycled steel and reclaimed wood, offer eco-friendly alternatives to traditional materials. Modern construction methods, like modular construction and 3D printing, reduce waste, energy consumption, and construction time, contributing to more sustainable construction practices. The long-term viability of infrastructure investments in sustainable projects is crucial for meeting shareholder expectations. For infrastructure projects to be sustainable, they must meet the expectations of both shareholders and consumers during project execution. Various strategies can be employed to integrate sustainability into projects (Orouji, 2016). The true value of the project, including its innovations, is outlined only during the early planning phase. Typically, companies make sustainability decisions without having complete knowledge of critical decision factors. Subsequently, during project execution, companies update their information and revise decisions related to material selection, development procedures, and resource estimates necessary for project completion. Technological advancements have revolutionized sustainable project management by providing tools and solutions that enhance sustainability planning, execution, and monitoring. These innovations enable project managers to make data-driven decisions, optimize design and construction processes, harness renewable energy sources, and improve collaboration among project stakeholders. As technology continues to evolve, the prospects for sustainable project management are expected to further improve, driving positive environmental, social, and economic impacts.

CONCLUSION

The realm of sustainable project management emerges as a multifaceted terrain, marked by challenges and

promising avenues. As organizations recognize the paramount importance of integrating sustainability into projects, addressing these challenges becomes imperative for long-term success. Key challenges encompass the necessity for a comprehensive approach embracing environmental, social, and economic dimensions, effective stakeholder engagement, resource constraints, and timely adoption of sustainable practices. Despite these challenges, encouraging prospects indicate a positive trajectory for sustainable project management. Innovative technologies, collaborative approaches, and sustainable procurement practices stand out as catalysts capable of significantly enhancing project sustainability. The evolving roles of project managers, transitioning from traditional administrators to sustainability experts, promise ongoing positive transformations and the development of strategies to overcome challenges. The shift toward regenerative and nature-inspired approaches underscores a deepening understanding of our interconnectedness with the environment, suggesting more effective and lasting solutions. Recognition of the significance of local dynamics, the wealth of knowledge derived from past endeavors, and a focus on education and training collectively pave the way for continuous improvement. As project managers navigate challenges and leverage prospects in sustainable project management, choosing the path of sustainability becomes not just an ethical consideration but a strategic imperative. A future where sustainable practices are integral to project management is not only feasible but essential for addressing global challenges. With sustained commitment, ongoing innovation, and collaborative efforts, sustainable project management emerges as a guiding force toward a more resilient and harmonious future.

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