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Enhancing Sustainable Development Practices in The Malaysian Construction Industry: Sustainable Built Environment, Sustainable Project Management, and Sustainable Construction

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ABSTRACT

Despite efforts to promote the adoption of Sustainable Development (SD) concepts in Malaysian construction projects, an often-overlooked element is the potential misinterpretation of Sustainable Built Environment (SBE), Sustainable Project Management (SPM), and Sustainable Construction (SC) and the relevancy within the context of SD. This misconception and the risk of fragmented knowledge leading to misguided strategies, inefficient resource allocation, and sub-optimal project outcomes. This paper provides insights from research aimed at addressing these concerns by redefining the concepts of SBE, SPM, and SC to enhance understanding of application in SD which SBE guides overarching planning, SPM applies sustainable practices to individual projects, and SC ensures eco-friendly building practices during construction. Employing a qualitative approach for the research method, in-depth literature analysis was conducted using multi-layered thematic analysis by reassessing the right understanding of these concepts by identifying their similarities, differences, and overlaps. The findings

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suggest that a sound understanding of the concepts must be the principal starting point for learning SD in the built environment. The concepts should be perceived as a cohesive entity to avoid misconceptions in knowledge and practices as well as the industry practitioner can take proactive steps to foster a more sustainable and resilient construction sector, benefiting not only the construction industry but also society and the environment at large.

INTRODUCTION

Notwithstanding the efforts to promote the adoption of SD concepts in Malaysian construction projects, it has not gained much traction, and the trajectory has been somewhat off-tangent. Various reasons have been given to explain the limited acceptance. Some have argued that the construction sector's resistance to change is due to factors like the continued application of low technology and practices (Shi et al., 2019; Hassan, 2023), financial implications (NST, 2022), insufficient awareness, fragmented approaches (Gholamreza et al, 2021; Hassan et al, 2018, Aminah et al, 2021) and inadequate policies (Mohd Sallehuddin, 2021). However, an often-overlooked element is the possible misinterpretation of SBE, SPM, and SC and their relevance within the context of SD. This misinterpretation could be a contributing factor to the poor performance (Olanrewaju et al, 2017; Ofori, 2023; Sandanayake & Vrcelj, 2024).

While some might argue that differentiating the concepts when learning and applying them in SD is merely a matter of semantics, it was appreciated that understanding their similarities, differences, and interrelationships is crucial as it underpins their learning and practice (González-Gaudiano, 2005; Agbedahin, 2019). Ensuring a clear and accurate understanding of these concepts is necessary as it influences how information is collected, grasped, shared, and explained to the community. This in turn impacts decision-making, planning, and implementation of projects. Misconceptions could lead to misguided strategies, inefficient resource allocation, and sub-optimal project outcomes (De Serres et al, 2010; Willar et. al.,2021; Abdelkhalik and Azmy, 2022; Lam, 2022; Tokuc, 2023; Eze et. Al., 2023; Moshood et. Al., 2024). Clarifying these terms and dispelling misconceptions can pave the way for more informed and aligned actions toward achieving sustainability goals within the construction sector effectively.

To address this, research was undertaken to examine the similarities, differences, and overlaps that exist between the concepts of SBE, SPM, and SC. In the absence of an established similar model for assessing similar concepts, the "5W and 1H" framework, which is commonly used in journalism to offer an all-encompassing understanding of a phenomenon Jang & Feng (2017); Cho & Lee (2018); Dwyer, et al., (2019); Gursoy & Chi (2019) was adopted for the research. Within the limits of the research, the focus was to explore and assess the concepts, their attributes (What), the management approaches of handling (How), and the parties (stakeholders) involved (Who) within the concepts. This is with the view to the necessity to convey the needed information to the community regarding their usage.

The Malaysian Construction Industry Green Initiatives

The development of sustainable practices in Malaysia began with the launch of the National Energy Policy in 2006 (Bujang et al., 2016), followed by significant milestones such as the establishment of the Malaysian Green Technology Corporation in 2009 (GreenTech Malaysia, 2014) and the introduction of the Green Building Index (GBI) in the same year (Dass, 2013). In 2010, the Malaysian Green Technology Corporation (MGTC) was established. Although MGTC was actually established in 2009, it became more prominent in 2010 as the central agency for green technology dedicated to coordinating and promoting green technology and sustainable practices throughout Malaysia (Hashim & Ho, 2011). The momentum for promoting sustainability continued to grow with the launch of the National Green Technology Policy (NGTP) in 2010 (KeTTHA, 2010), to lay the groundwork for comprehensive sustainability efforts across

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various sectors. In line with this policy, the government pledged to prioritize environmentally friendly goods and services in the budget speech, with the goal of eco-label certification for selected products and services purchased by the public sector by 2020. However, despite these commitments, there have been challenges in implementing the original policy, particularly in the construction industry (Ding et al., 2018). It appears that while Malaysia excels at making promises and pledges, the implementation of sustainable practices falls short. Subsequently, in 2011, the Green Technology Financing Scheme (GTFS), the Low Carbon Cities Framework (LCCF), and the Feed-in Tariff (FiT) to further advance green practices. The promotion continued with the introduction of the Green Procurement Policy (GGP) in 2013, Green Investment Tax Allowance (GITA) in 2014 and MyCREST (green audit tools) in 2015 (Sim and Putuhena, 2015; Bohari et al, 2015). In 2016, the Energy Efficiency and Conservation Act (EECA) was implemented to enhance energy efficiency efforts. In addition, the global Sustainable Development Goals (SDGs) and Electric Mobility Blueprint were introduced in 2021.

The significance of the construction industry in supporting Malaysian sustainable initiatives has been echoed by many (Jamilus et al, 2013; Asma Alia et al, 2015; Asri, 2022; Mohd Sallehuddin, 2019; CIDB, 2023) reports that the construction industry plays a significant role in supporting this initiative because it directly impacts the built environment and infrastructure that shapes the cities and communities, that affect the daily lives of the people. The construction sector consumes vast amounts of resources, energy, and materials, making its practices influential in environmental sustainability. Adding on to this, construction projects have the potential to contribute to pollution, waste, and carbon emissions if not managed properly (Win, 2021; IEA, 2019). Therefore, improving sustainability practices within the construction industry is crucial for minimizing its negative environmental impact and contributing to a more sustainable future. The Malaysian government established various agencies with direct involvement in implementing sustainable construction policies (Ding et al., 2018). Notably, the Ministry of Energy, Green Technology, and Water (KETTHA) – also known as Ministry of Energy, Science, Technology, Environment and Climate Change (MASTECC) and have been re-structured to Ministry of Science, Technology and Innovation (MOSTI) – took a leading role in this regard. The involvement of JKR, the existence of SW Corp, and the presence of CIDB, which should be spearheading the greening of the construction industry, all contribute to the efforts. These were embedded in several key industry initiatives, notably, in the Construction Industry Master Plan (2006-2015), the Construction Industry Transformation Program (2016-2020), and the subsequent National Construction Policy (2020-2030) programs. This was by prioritizing the integration of sustainable practices, energy-efficient construction techniques, the use of eco-friendly materials, and the introduction of green construction audits, which include GBI, GreenRE, MyCREST, and Low Carbon City Framework (LCCF) (CIDB, 2006; Rostami et al, 2012; CIDB, 2015). Introduction of Green Procurement (GP) through Government Green Procurement (GGP) in 2014 was part of the policy program. The nation 12th National Plan aimed to become linear economic model to the circular economic model in driving the green market of Malaysia (Mohd Sallehuddin, 2019; Mohamed, 2022). MyHijau Directory home to registered green product and services become the platform to accelerate green market including construction industry.

However, fast forward from 2010 to 2020, numerous challenges still persist. Problems related to environmental degradation, water pollution in Selangor (The Straits Times, The star, 2020; New Straits Times, The Star, 2021), noise pollution (New Straits Times, 2017; The Star, 2022; 2023; Malaysia Now, 2023), uncontrolled waste (CNN, 2020; The Star, 2022; New Straits Time, 2022; 2023), construction-related flash floods (The Star, 2018; 2022), insufficient attention to safety and health continue to be reported (Abdul-Rahman et al., 2018; Hassan, 2021; Gupta & Biswas, 2021). (EY, 2022; The Star, 2023; 2024) collectively support the research statement that while Malaysia excels in making promises and pledges regarding sustainability, the execution often falls short of expectations. Clear and substantial outcomes have yet to be evident. This stagnation suggests a regression rather than advancement towards sustainability, underscoring the need for re-learning the strategies for promoting SD in construction projects.

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Sustainability, sustainable Development, and Sustainable Development Goals

Sustainability

Sustainability has become a familiar concept and has gained significant traction in various sectors worldwide, including the construction industry in Malaysia. Governments advocate for sustainable lifestyles among their citizens, and sustainability is embraced across numerous domains (Kates et al., 2005; Wiek et al., 2011). In the late 1970s and early 1980s, sustainability started to garner attention as the construction sector sought ways to minimize environmental impacts and promote sustainable practices (Fowler, 1999). This led to an increasing number of publications and discussions incorporating sustainability into the industry's discourse (WCED, 1987). Prior to the late 1970s, there were relatively few publications explicitly addressing sustainability in the context of the construction industry. However, as environmental concerns grew, there was a surge in literature during the 1980s, highlighting the industry's interest in sustainable development (Clark, 2002). Sustainability has since become a widely embraced ideal in Malaysian society and has expanded its influence across various domains (Hawken et al., 1999).

Sustainability involves responsibly using resources to meet current needs while safeguarding the well-being of future generations (Portney, 2015). It encompasses a balanced approach to economic, social, and environmental aspects to ensure a harmonious coexistence between people, the planet, and prosperity. On the other hand, SD goes beyond sustainability by aiming to improve human life across economic, social, and environmental dimensions. It seeks to create a resilient and equitable society by integrating economic growth, social well-being, and environmental protection, whilst addressing challenges like poverty and environmental degradation to ensure a better future for all. Most early definitions of sustainability tend to emphasize the ecological perspective, but the recognition of the interconnectedness of the environment, economy, and social equity soon grew over time (Wheeler, 2013; Haughton, 2021). Despite the widespread use of the term, there is ongoing debate and no universally agreed-upon definition of sustainability and SD (Adams, 2006). The widely accepted definition of sustainable development, provided by the United Nations World Commission on Environment and Development in the "Brundtland Report" of 1987, states that sustainability is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). This definition has been widely adopted and is also reflected in the ISO 26000 standard (ISO, 2010).

Sustainable Development (SD)

SD is a comprehensive concept that integrates economic, environmental, and social dimensions to ensure long-term well-being for present and future generations (United Nations, 2015). The economic dimension emphasizes balanced growth, equity, and resource efficiency to support current and future generations. The environmental dimension focuses on preserving natural resources, reducing pollution, and promoting sustainable resource management. The social dimension aims to improve quality of life, ensure basic needs, and promote inclusivity and human rights (Gupta and Vegelin, 2016; Russo, 2023). These dimensions are interdependent, requiring a holistic approach to decision-making that optimizes benefits across all areas for long-term well-being and prosperity. SD is considered attained when the three dimensions of economic sustainability, social sustainability, and environment sustainability are harmoniously balanced, a principle often referred to as the "triple bottom line" (Hanan, 2015). This approach integrates economic progress, societal welfare, and environmental conservation as equally important components to ensure lasting sustainability and human well-being.

Sustainable Development Goals (SDGs)

SDGs are a new, universal set of goals, targets, and indicators that United Nations (UN) member states are expected to use to frame their agenda and political policies from 2016 to 2030 (Pia et al., 2019). With 17 Goals, 169 Targets, and more than 200 Indicators, the SDGs encompass five dimensions: People, Planet, Prosperity, Peace, and Partnership. They serve as a global call to action to end poverty, protect the environment address climate change, and promote peace and prosperity for all (Morton et al, 2019). In 2015, Malaysia joined 192 other global leaders in adopting the 2030 Agenda for SD during the United

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Nations General Assembly, committing to a collective effort for enhanced sustainable, resilient, and inclusive development. The United Nations in Malaysia, represented by 21 agencies led by the UN Resident Coordinator, collaborates in harmony with national priorities, plans, and requirements to amplify the impact of the 2030 Agenda and its SDGs. These 17 SDGs and their 169 corresponding targets aspire to be accomplished by 2030, as outlined by the Economic Planning Unit of the Prime Minister's Department and the Department of Statistics Malaysia (EPU, 2021; DOS, 2021). The implementation of the SDGs in Malaysia follows a three-phase approach aligned with the five-year Malaysia Development Plans:

(i) Phase 1: Eleventh Malaysia Plan (2016-2020),

(ii) Phase 2: Twelfth Malaysia Plan (2021-2025); and

(iii) Phase 3: Thirteenth Malaysia Plan (2026-2030)

Significance of Portfolio Management, Program Management, and Project Management for Managing Sustainable Development Projects

Successful implementation of a construction project is significantly dependent on effective portfolio management, program management, and project management (Morris and Pinto, 2007; Kaiser et al, 2015). Portfolio management involves the strategic selection and adept management of a collection of SD programs geared toward achieving national policy objectives. This is by ensuring that policy and initiatives align with the right mix of projects for a SBE. Program management operates within the framework of portfolio management, focusing on orchestrating the interconnected projects identified through portfolio management, ensuring they work cohesively to achieve common objectives (Stettina and Horz, 2015). Project management is a subset of program management, centering on the delivery of projects pinpointed by the program management process (Pellegrinelli et al, 2007). In essence, Project Management focuses on overseeing tasks and deliverables to achieve specific project objectives, serving as the foundation for executing individual projects. Meanwhile, Program Management integrates and coordinates multiple related projects to achieve broader organizational goals by managing dependencies, optimizing resources across projects, and aligning these projects towards strategic objectives. Additionally, Portfolio Management provides strategic oversight across all projects and programs, ensuring they align with organizational strategies, maximize overall value, and optimize resources across the organization's entire project landscape.

Identifying key stakeholders for portfolio, program, and project management is crucial in SD (Bringer et al., 2013; Wang et al, 2017). These three management components must integrate effectively for comprehensive and cohesive strategies, leading to holistic outcomes. Key stakeholders, including governments, private developers, NGOs, communities, financiers, and more, play a vital role in ensuring an environmentally SBE. Their collaboration influences policies, fosters innovation, and enhances project viability. While related, SBE, SPM, and SC focus on different aspects within the broader field of sustainability, collectively contributing to a sustained built environment.

Sustainable Built Environment (SBE)

SBE encompasses a holistic view of the entire built environment, including buildings, infrastructure, landscapes, and urban areas. It considers the long-term sustainability of cities and regions. It is focused on developing built environments that are environmentally responsible (Graham, 2009; Kilbert, 2002; Yao, 2013), which contribute to social equitability, and economically viable places where people live, work, and interact. This includes sustainable urban planning, transportation systems, green spaces, and energy-efficient buildings. Its primary goal is to promote sustainability at the urban and regional scale, addressing issues like urban sprawl, transportation efficiency, energy use, and community well-being (Knight and Riggs, 2010).

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The importance of portfolio, program management, and project management in advancing SBE projects varies based on the industry or organization's context drawn from Morris and Pinto (2007). In the main, effective portfolio and program management tend to be the more important components of the built environment at the construction industry 'macro' level. Portfolio management takes the lead by setting strategic policy directions and prioritizing implementation initiatives that are aligned with the overarching aim of achieving environmental sustainability (Roberts and Hamilton, 2023). It ensures resource allocation to impactful sustainability projects and informs strategic decisions. Program management which follows suit becomes crucial when multiple related sustainability projects require coordination for meeting the targeted SBE outcomes. It ensures efficient project collaboration, resource sharing, and collective contributions to industry sustainability goals.

At the construction industry level, several stakeholders are central in advancing SBE. They include the government, regulatory bodies, industry professional bodies, construction-related associations and organizations, the construction industry supply chain, financial institutions, environmental organizations, local communities, educational institutions, environmental non-government organizations (NGOs), and utility providers. Each plays a crucial role, from shaping sustainability standards and providing guidance to implementing eco-friendly design principles, adhering to green construction standards, and offering sustainable materials and financing options.

Sustainable Project Management (SPM)

Project management encompasses the planning, organization, and supervision of all construction project phases to ensure they meet their objectives within specified constraints like time, budget, and quality (PMI, 2021). In the context of the Malaysian construction industry, CICS (2019) defines it as overseeing activities during the project's design and construction stages. The design process covers inception, design development, and tendering, while the construction phase manages activities during construction and project closeout. Effective construction project management is crucial for the successful execution of construction projects. Conversely, "SPM" involves integrating environmentally sustainable principles and practices across the entire project life cycle (Robichaud and Anantatmula, 2011) spanning initiation, design development, tendering, construction, and handover stages (CICS, 2019). Its broader goal is to support economic, environmental, and social sustainability achievements.

Program and project management plays a more significant role in promoting SPM practices (Gareis et al,2013). Program management is very significant in ensuring that projects are aligned with strategic sustainability goals, outlined from the portfolio management process by ensuring that the resources allocated, and coordination of the inter-related projects are optimized. Project management, on the other hand, is a subset of program management that focuses on executing specific sustainability projects within the program, ensuring that they meet environmental and social objectives (Todorov, 2014; El Khatib et al, 2022). Together, program and project management provide the structure and methodology needed to effectively plan, execute, and monitor sustainability initiatives, making them essential for achieving long-term sustainability objectives.

The key stakeholders who are primarily responsible for delivering SPM involve the building team i.e., client, project managers, contractors, consultants, sustainability experts, suppliers, local communities, industry associations, NGOs, financial institutions, and certification bodies. These stakeholders collectively contribute to integrating sustainability principles into project planning, execution, and monitoring (Robichaud and Anantatmula, 2011). They set sustainability objectives, enforce regulations, provide specialized expertise, engage with local communities, offer eco-friendly materials and financing options, advocate for sustainable practices, and educate future professionals. The collective participation of the stakeholders is key in not only attaining project goals but also advancing the attainment of environmental, social, and economic sustainability objectives established during the program management phase.

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Sustainable Construction (SC)

SC specifically relates to the methods, materials, and practices used in the construction process itself, particularly at the project site. This is regardless of the scale of the project or the broader built environment (Marhani et al, 2013). It is focused on minimizing the environmental impact of construction activities, reducing waste, using eco-friendly materials, and implementing energy-efficient construction techniques. To promote this the Malaysian construction industry has introduced several sustainable "Green" audits in the form of Green Building Index, Green Real Estate, and MyCREST (Siew, 2017).

SC, which is also commonly referred to as "green building" or "sustainable building", is the approach to designing, constructing, and operating buildings and infrastructure in an environmentally responsible and resource-efficient manner (Neyestani, 2017). The aim is to minimize the negative environmental impacts of the construction project on its surrounding environment by maximizing its positive contributions to sustainability. Recognition of a project's construction sustainability is based on its capacity to make contributions in terms of innovative design, water efficiency, energy efficiency, air quality enhancement, pollution control, waste management, adoption of environmental technologies, safety and health considerations, and engagement with end-users.

The key stakeholders in implementing construction sustainability include clients, consultants, the construction team (contractors, suppliers, subcontractors, labourers), approving authorities, and service providers. The client's primary role is to define the environmental sustainability goals of the project, consultants offer expertise in designing and monitoring their construction, and the construction team's role is to implement sustainable practices in the project. The approving authorities' roles are to enforce regulations, while service providers offer eco-friendly solutions for the project. The cooperation among these stakeholders is essential for reaching the project's environmental goals established within the project management framework (Fliaster and Kolloch, 2017; Koc et al, 2023).

To summarize the relationships between portfolio management, program management, and project management in the context of SBE, SPM, and SC, Portfolio Management plays a pivotal role in setting strategic directions and prioritizing initiatives that align with overarching sustainability goals across all built environment projects. Meanwhile, Program Management operates within this strategic framework, coordinating interconnected sustainability projects to achieve synergistic benefits and efficient resource allocation. In addition, Project Management, as a subset of program management, focuses on executing specific sustainability initiatives to meet environmental and social objectives within defined constraints. These management disciplines collaborate closely to ensure seamless integration of sustainability principles from strategic planning through project execution and monitoring, thereby enhancing the overall impact and effectiveness of sustainability efforts. Key stakeholders from government, industry, and communities play crucial roles in driving these initiatives forward, shaping policies, fostering innovation, and ensuring long-term environmental, social, and economic sustainability in the built environment.

RESEARCH METHODOLOGY

Initially, the identification of SD, SBE, SPM, and SC was conducted through a rigorous literature review employing a multi-layered thematic (MLT) process. MLT is akin to qualitative analysis undertaken when analysing a large volume of information gathered from document analysis. Essentially, during qualitative analysis, emerging themes are captured, and MLT is employed to refine initially identified themes into more nuanced ones (Creswell, 2008). However, as depicted in Fig. 1, the authors utilized MLT for predetermined themes identified in the literature and facilitated by a loop for the data gathering process (Kariya et al., 2016). Themes were organized according to their scopes and served as screening filters. This approach was deemed sufficient to yield exhaustive and holistic results, ensuring the reliability of the literature analysis. Furthermore, considering the subjective definitions provided by past researchers for certain keywords, which are crucial for explanation in the form of examples, MLT is viewed as a valuable aid.

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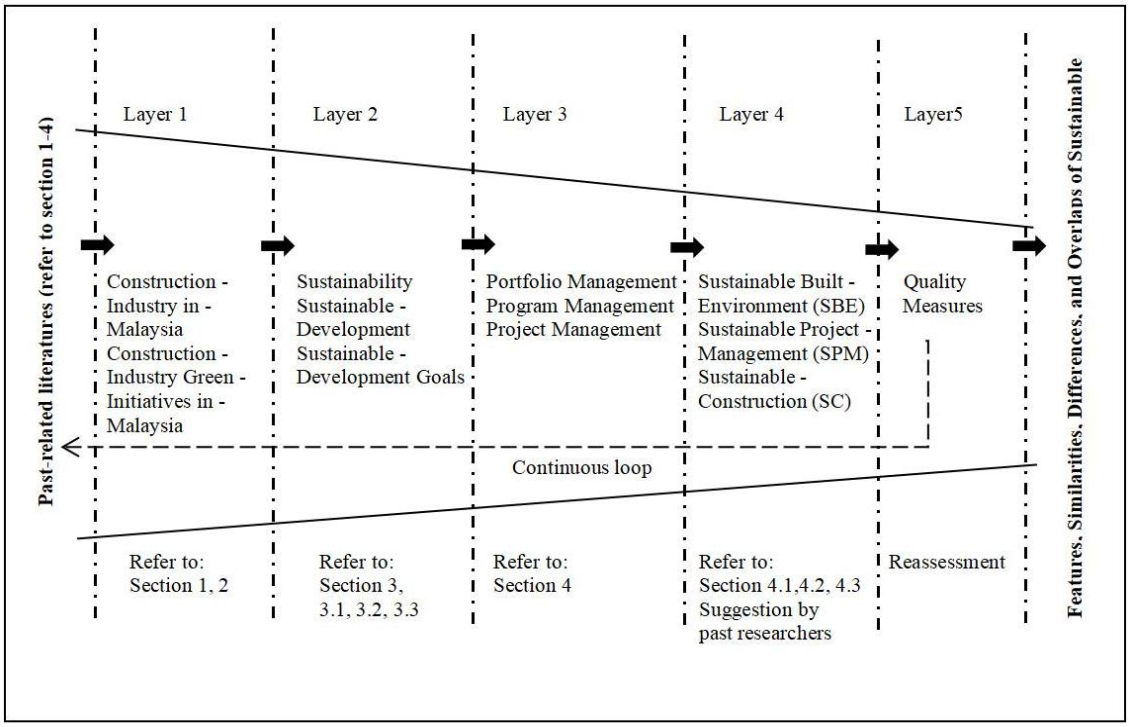

Fig. 1. Multi-Layered Thematic Process (MLTP) Diagram

Source: Author (2024)

The layers depicted in Fig. 1 serve as a guide for filtering through past researchers' documents to identify features, similarities, differences, and overlaps of SBE, SPM, and SC. There were no restrictions on the documents used, but a combination of keywords was employed during the search process (e.g., Construction Industry and Green Initiatives in Malaysia + Sustainability + SD + SDGs + Portfolio Management + Program Management + Project Management + SBE + SPM + SC). Layer 1 utilized themes generated from Section 1 and 2, particularly concerning the boundaries of the Construction Industry and Green Initiatives in Malaysia. Thus, any differences beyond these boundaries were disregarded. Subsequently, Layer 2 focused solely on sustainability, SD, and SDGs themes. Later, Layer 3 encompassed Portfolio Management, Program Management, and Project Management. This step aimed to reinforce previous findings and clarify their interconnection between SBE, SPM, and SC. Layer 4 was dedicated to clustering prior research on SBE, SPM, and SC into meaningful groups, guided by suggestions from past researchers. Quality measures were then applied to the data within each loop iteration (i.e., for each literature) and at the conclusion of the entire process. Actions such as reassessment based on layers and refinement of cluster paradigms were undertaken in Layer 5.

RESULTS AND ANALYSIS

The research methodology provides a robust and systematic approach to understand the complex and interconnected nature of SD, SBE, SPM, and SC in Malaysia. It allows for the synthesis of existing knowledge, the identification of research gaps, and the generation of insights that can inform future research, policy formulation, and industry practices in the pursuit of sustainability in Malaysia's built environment sector.

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Result and Analysis - Multi-layered Thematic (MLT)

The authors have meticulously selected and analysed a significant number of closely related 82 literatures. Each literature was individually scrutinized through a previously constructed MLT process and distilled into three distinct clusters. Subsequently, these clusters were further categorized into 18 items at the macro level and then clustered under six elements at the macro level. These clusters revolve around SBE, SPM, and SC. As a result of this process, Table 1 succinctly summarizes the identified features, commonalities, variations, and intersections among SBE, SPM, and SC.

SPM and SC are interrelated concepts that collectively contribute to SD, and while their similarities exist, drawing clear lines of differentiation can be vexing. This is because these concepts overlap in various ways and often complement each other, making it challenging to distinguish their similarities and differences precisely. To comprehend this, an appropriate approach is to examine their features, the management approach that is most suitable for the application, and the key stakeholders involved.

Table 1. Summary of Features, Similarities, Differences, and Overlaps Among Sustainable Built Environment, Sustainable Project Management, and Sustainable Construction.

	Sustainable Built Environment	Sustainable Project Management	Sustainable Construction
Macro Level		Meso Level	
	(Puppim de Oliveira & Doll (2023); De Gregorio Hurtado & Li (2023); Lützkendorf & Lorenz (2023); Roberts & Hamilton (2023); Stettina & Horz (2022); Marhani et. al. (2022); Neyestani (2021); Fliaster & Kolloch (2021); Koc et al., (2021); Bringer, et al., (2021)	(Robichaud & Anantatmula (2023); El Khatib et al. (2023); Todorov (2022); Wang et al., (2022); Pellegrinelli & Partington (2022); Gareis & Huemann (2021); Kaiser, et al., (2021); Fliaster & Kolloch (2021); Koc, et al., (2021); Bringer, et al., (2021))	(Neyestani (2023); Marhani, et al. (2023); Graham (2022); Yao (2022); Knight & Riggs (2022); Kilbert (2021); Roberts & Hamilton (2021); Siew (2021); Wang, et al. (2021); Li & Chen (2021))
Definition	A holistic view of built environment sustainability, including urban areas, infrastructure, and landscapes. Focused on long-term sustainability at the macro-industry and urban scale.	Integration of environmentally sustainable principles and practices throughout the project life cycle. Aims to achieve economic, environmental, and social sustainability.	Approach to designing, constructing, and operating buildings and infrastructure in an environmentally responsible manner. Minimizes negative environmental impacts and maximizes positive contributions to sustainability.
Methodologies for Handling - Portfolio, Program, and Project Management Relationships	Portfolio management generally takes precedence, followed by program and project management, in terms of importance; their integration is critical for accomplishing comprehensive sustainability goals.	Connected with program and project management, as they facilitate the integration of sustainable practices into individual projects.	Overlaps with program and project management, as they contribute to the implementation of sustainable construction practices within the project life cycle.
Parties involved - Key Stakeholders	Governments, private developers, urban planners, communities, NGOs, academic institutions, financiers, suppliers, utilities, professional organizations, and the public.	Building teams (clients, project managers, contractors, consultants, sustainability experts, suppliers), local communities, industry associations, NGOs, financial institutions, and certification bodies.	Clients, consultants, construction team (contractors, suppliers, subcontractors, laborers), approving authorities, and service providers.

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Focus	Focuses on the entire built environment at the regional and urban scale, emphasizing sustainable urban planning, transportation, green spaces, and energy-efficient built infrastructure facilities.	Focuses on integrating sustainable principles into the entire project life cycle, with a primary emphasis on individual construction projects.	Focuses on sustainable construction practices, including eco-friendly materials, energy-efficient techniques, and minimizing environmental impact at the project site.
Goals	Aims to promote sustainability at the urban and regional scale, addressing issues like urban sprawl, transportation efficiency, energy use, and community well-being.	Aims to achieve economic, environmental, and social sustainability within individual construction projects.	Aims to minimize the negative environmental impact of construction activities and maximize positive contributions to sustainability.
Overlaps and Differences	Overlaps with program and project management in their role in achieving sustainable built environments. Differences lie in the scale and focus.	Overlaps with sustainable construction in terms of integrating sustainability into project execution. Differences include the broader scope of sustainable built environments.	Overlaps with program and project management in the context of implementing sustainable practices within construction projects. Differences include the focus on construction methods and materials.

Source: Author (2024)

The Features

The features outlined for SBE, SPM, and SC highlight distinct yet interconnected aspects of sustainability in the built environment. SBE's comprehensive perspective on urban areas, infrastructure, and landscapes underscores the necessity of a broad, macro-level approach. This is critical for long-term sustainability but may face challenges in balancing diverse urban elements. SPM's integration of sustainable principles across the project life cycle is essential for ensuring that sustainability is embedded from inception to completion. However, the success of this approach depends heavily on the commitment and expertise of project managers. SC's focus on methods, materials, and practices at the micro-implementation level is vital for practical, on-the-ground sustainability but might struggle with broader systemic impacts without alignment with SBE and SPM.

The Definitions

The definitions provided for SBE, SPM, and SC clarify the scope and intent of each concept. SBE's holistic view emphasizes long-term sustainability at a macro scale, which is crucial for addressing broad environmental challenges but may be difficult to implement uniformly across diverse regions. SPM's focus on integrating sustainable principles throughout the project life cycle aims to balance economic, environmental, and social goals, a comprehensive approach that can be demanding in terms of resources and expertise. SC's definition highlights environmentally responsible practices in construction, which are essential for minimizing negative impacts but require continuous innovation and adherence to evolving standards.

The Parties Involved

Identifying and engaging stakeholders is rightly emphasized as crucial across SBE, SPM, and SC. The roles of governments, developers, and NGOs in SBE reflect the need for policy and planning frameworks that support sustainable development. In SPM, the involvement of building teams, consultants, and financial institutions points to the necessity of cross-functional collaboration for project success. SC's emphasis on clients, suppliers, and approving authorities underlines the importance of aligning supply chain and regulatory aspects with sustainability goals. However, stakeholder engagement can be complex, requiring effective communication, negotiation, and consensus-building.

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Methods of Handling

The methodologies for handling sustainability in SBE, SPM, and SC indicate a structured approach to integrating sustainability at various levels. SBE's prioritization of portfolio management, followed by program and project management, suggests a top-down approach that can ensure alignment with overarching sustainability goals. SPM's methodologies, linked to program and project management, emphasize the need for detailed planning and execution to achieve sustainable outcomes. SC's overlap with program and project management highlights the necessity of operationalizing sustainability within the project lifecycle. The integration of these methodologies is critical but can be resource-intensive and require significant coordination.

Focus

The focus areas of SBE, SPM, and SC are distinct yet complementary. SBE's emphasis on the regional and urban scale addresses broad sustainability issues such as urban sprawl, transportation, and energy use, essential for systemic change but potentially challenging to manage at a granular level. SPM's focus on integrating sustainable principles into the project life cycle ensures that sustainability is considered at every stage, a detailed approach that can drive significant improvements but demands robust project management capabilities. SC's focus on sustainable construction practices addresses immediate environmental impacts at the project site, crucial for tangible sustainability outcomes but requiring continuous updates to practices and materials.

Goals

The goals outlined for SBE, SPM, and SC are aligned with their respective focuses. SBE aims to promote sustainability at the urban and regional scale, addressing issues like urban sprawl, transportation efficiency, energy use, and community well-being. This broad goal is essential for long-term sustainability but can be difficult to achieve uniformly. SPM's goal of achieving economic, environmental, and social sustainability within individual projects reflects a balanced approach but requires meticulous planning and execution. SC's goal of minimizing negative environmental impacts and maximizing positive contributions is practical and necessary for on-the-ground sustainability but may need continuous innovation and adherence to best practices.

Overlaps and Differences

The overlaps and differences between SBE, SPM, and SC highlight their interconnections and distinct focuses. SBE overlaps with program and project management in achieving sustainable built environments, but the scale and focus differ, with SBE addressing macro-level issues. SPM overlaps with SC in integrating sustainability into project execution, but SPM has a broader scope encompassing the entire project life cycle, whereas SC focuses on construction methods and materials. These overlaps indicate opportunities for collaboration and integration, while the differences underscore the need for tailored approaches at different levels of implementation. However, achieving seamless integration and avoiding siloed efforts can be challenging, requiring robust coordination and communication mechanisms.

DISCUSSIONS

In culminating the findings, SBE, SPM, and SC are interconnected concepts that share sustainability principles but differ in their scope, scale, and focus. They complement each other in creating a more SBE, with SBE guiding overarching planning, SPM applying sustainable practices to individual projects, and SC ensuring eco-friendly building practices during construction. When considering the extent to which SBE, SPM, and SC are similar and different, SBE aligns more closely with Portfolio Management and Program Management, all aiming to attain sustainability within the built environment. However, differences become apparent when considering the extent and depth of their engagement. SPM aligns more with the provision for SC. Both Project Management and SC play roles in integrating environmental sustainability into project

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execution, but SPM has a wider scope, encompassing the design and construction phases of a project. SC aligns more with Project Management, emphasizing the implementation of sustainable practices within construction projects at the project site, with a specific emphasis on environmentally sustainable construction methods and materials.

The narratives and nuances of SBE, SPM, and SC demand careful attention due to their multidisciplinary nature, contextual variability, evolving standards, and the need to balance complex trade-offs. Practitioners and learners must approach these concepts with a critical, informed, and adaptable mindset to effectively contribute to effective SD knowledge and practices.

CONCLUSION

This paper provides a comprehensive analysis that distinguishes between various clusters within the Malaysian construction sector, offering clear features, commonalities, variations, and intersections among SBE, SPM, and SC based on multiple factors such as definition, methodologies of handling, parties involved, focus, goals, overlaps and differences.

The research emphasizes the need to be mindful when applying the principles of SBE, SPM, and SC to support Environmental Sustainability. A comprehensive understanding of these concepts is essential, as it significantly influences how information is collected, interpreted, shared, and conveyed to the community. Without a clear and accurate grasp of these concepts, the effectiveness of sustainability initiatives and the positive impact on the environment can be compromised. Therefore, practitioners especially must prioritize acquiring a solid foundation in these principles to ensure their meaningful application. Additionally, the findings can inform the development of policies, regulations, and standards aimed at promoting sustainability within the industry, ultimately catalysing the transition toward a more sustainable and resilient construction sector in Malaysia.

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CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

AUTHORS' CONTRIBUTIONS

Hasmawiah Mad Kaidi designed the research, carried out the research, wrote and revised the article. Fadzil Padzil Hassan conceptualised the central research idea and provided the theoretical framework. Noor Akmal Adillah Ismail and Mohd Dhiya Hafreez Kamil supervised the research progress; Hairuddin Mohamed anchored the review, revisions and approved the article submission

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