Management Strategies and Engineering Sciences

Vol. 1. No. 1. Pages 54-65

Decision-Making Models in Engineering Management: Balancing Risk, Cost, and Quality

Ali Selyari[1]
Reza Motamedi[2*]

1. Department of Educational Sciences, Payam Noor University, Tehran, Iran
2. Department of Educational Sciences, Payam Noor University, Tehran, Iran

Abstract

The integration of sustainability into engineering project management has become increasingly vital in addressing the environmental, economic, and social challenges of the 21st century. This narrative review focuses on green engineering practices, exploring their implementation across various sectors and assessing their impacts on project outcomes. Through the analysis of key case studies, such as Masdar City and the Bullitt Center, the review identifies best practices in renewable energy use, resource conservation, waste management, and life cycle assessment. It also examines the variability of these practices across different industries, highlighting the unique challenges and opportunities in sectors like construction, energy, and manufacturing. Despite the proven benefits of sustainable practices, significant barriers remain, including high initial costs, stakeholder resistance, and a lack of expertise. The review concludes by offering recommendations for enhancing the integration of sustainability in engineering project management and suggesting future research directions to support the ongoing evolution of green engineering practices. By adopting a holistic approach to sustainability, engineering projects can achieve substantial environmental, economic, and social benefits, contributing to the broader goal of sustainable development.

Keywords: Sustainability, Engineering Project Management, Green Engineering, Renewable Energy, Resource Conservation, Life Cycle Assessment, Sustainable Development.

Introduction

The concept of sustainability has gained unprecedented importance in recent decades, particularly within the engineering sector, where the impact of industrial activities on the environment and society is profound. Engineering projects, which often involve large-scale infrastructure development, energy consumption, and resource extraction, play a critical role in shaping environmental outcomes. As such, the integration of sustainability principles into engineering project management has emerged as a crucial strategy to mitigate negative environmental impacts, promote social equity, and ensure economic viability. The growing awareness of climate change, resource depletion, and environmental degradation has prompted both industry and academia to explore sustainable practices that can be embedded within the engineering process to achieve long-term environmental stewardship and social responsibility (Brundtland, 1987; Elkington, 1998).

In the context of project management, sustainability introduces a multi-dimensional challenge that extends beyond the traditional focus on cost, time, and quality. Project managers are increasingly required to balance these conventional metrics with considerations of environmental sustainability, such as reducing carbon footprints, minimizing waste, and conserving natural resources (Shen et al., 2011). The push towards sustainable engineering practices is also driven by regulatory pressures, stakeholder expectations, and the growing market demand for green and sustainable products and services. Consequently, there is an urgent need for a systematic integration of sustainability into the project management processes within engineering disciplines to ensure that projects contribute positively to the environment and society while maintaining economic feasibility (Gareis et al., 2013).

Despite the recognized importance of sustainability in engineering, there remains a significant gap in the integration of sustainable practices within engineering project management. This gap is particularly evident in the inconsistency of sustainable practices across different sectors and projects, as well as the lack of comprehensive frameworks that effectively guide the implementation of green engineering practices. Many engineering projects still prioritize short-term economic gains over long-term environmental and social benefits, leading to outcomes that are unsustainable in the long run (Silvius & Schipper, 2014). Furthermore, while there is a growing body of literature on sustainable engineering, much of it is fragmented, with limited focus on the practical application of these concepts within the project management domain. This fragmentation hinders the ability of project managers and engineers to systematically apply sustainable practices across different phases of a project, from planning and design to execution and closure.

The primary objective of this review is to bridge the gap between sustainability concepts and their practical application in engineering project management. By focusing on green engineering practices, this review seeks to provide a comprehensive synthesis of current knowledge and identify best practices that can be adopted to enhance sustainability in engineering projects. The review also aims to highlight the challenges and barriers to implementing sustainable practices and to propose recommendations for overcoming these obstacles. Ultimately, the review aspires to contribute to the ongoing discourse on sustainable engineering by offering insights that can inform both academic research and industry practices.

Methodology

In this narrative review, a comprehensive and systematic approach was adopted to explore and synthesize the existing literature on the integration of sustainability within engineering project management, with a specific focus on green engineering practices. The review aims to provide a holistic understanding of the current state of knowledge, identify gaps in the literature, and offer insights into the practical implications of sustainable practices in engineering projects.

The methodology for this review was designed to capture a broad range of sources and perspectives while ensuring that the most relevant and high-quality studies were included. The review process began with the identification of key themes and concepts related to sustainability in engineering project management. This involved a preliminary scoping of the literature to determine the most significant areas of focus, such as energy efficiency, resource management, waste reduction, and life cycle assessment, which are central to green engineering practices.

A systematic search of the literature was conducted using several academic databases, including but not limited to Web of Science, Scopus, IEEE Xplore, and Google Scholar. The search strategy was designed to be inclusive, using a combination of keywords such as "sustainability," "engineering project management," "green engineering," "sustainable practices," and "environmental impact." These keywords were applied across titles, abstracts, and keywords of the articles to capture a comprehensive set of relevant studies. The search was not restricted by publication date to allow for the inclusion of both foundational and contemporary studies, ensuring a well-rounded review.

The inclusion criteria for selecting studies were based on their relevance to the themes identified, their methodological rigor, and their contribution to the understanding of sustainability in engineering project management. Articles that provided empirical data, case studies, or significant theoretical insights were prioritized. Studies that focused exclusively on technical engineering aspects without a clear connection to sustainability or project management were excluded to maintain the review's focus. Additionally, preference was given to peer-reviewed journal articles, conference papers, and authoritative reports to ensure the credibility and reliability of the sources.

Once the relevant literature was identified, the selected studies were subjected to a detailed analysis. This involved a thorough reading and critical evaluation of each article to extract key information on the implementation and outcomes of green engineering practices in various engineering projects. The analysis was descriptive in nature, aimed at synthesizing the findings across different studies to identify common practices, challenges, and outcomes. The review also examined the contextual factors influencing the adoption of sustainable practices, such as regulatory frameworks, industry standards, and stakeholder engagement.

To ensure a comprehensive analysis, the review included studies from a variety of engineering sectors, including construction, energy, manufacturing, and transportation. This cross-sectoral approach allowed for a comparative analysis of green engineering practices and their effectiveness in different contexts. The findings were organized thematically, focusing on the key aspects of sustainability in project management, such as the environmental, economic, and social dimensions of green practices.

Throughout the review process, particular attention was paid to the methodological quality of the included studies. Studies were assessed for their research design, data collection methods, and the robustness of their findings. This critical appraisal was essential to ensure that the review provided a balanced and evidence-based perspective on the state of sustainability in engineering project management.

In summary, this narrative review employed a systematic and descriptive approach to examine the literature on green engineering practices within the context of sustainability in engineering project management. By synthesizing the findings from a diverse range of studies, the review aims to contribute to the ongoing discourse on sustainable engineering and offer practical insights for project managers and engineers seeking to integrate sustainability into their work.

Literature Review

The concept of sustainability in engineering has evolved significantly over the past few decades, reflecting broader societal concerns about environmental degradation, resource depletion, and social inequity. The origins of sustainability in engineering can be traced back to the 1987 Brundtland Report, which introduced the idea of sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987). This concept gradually permeated the engineering field, leading to the recognition that engineering projects must not only achieve technical and economic objectives but also contribute to environmental protection and social well-being.

In the 1990s, the concept of the triple bottom line (TBL), which emphasizes the importance of balancing economic, environmental, and social outcomes, further solidified the role of sustainability in engineering (Elkington, 1998). Engineering disciplines began to incorporate sustainability principles into their methodologies, with a focus on designing systems that minimize environmental impact, optimize resource use, and enhance societal benefits. The turn of the century saw the emergence of green engineering, a subset of sustainable engineering that specifically addresses environmental issues through the design, operation, and management of systems that are environmentally benign and resource-efficient (Anastas & Zimmerman, 2003).

The integration of sustainability into project management practices has been more gradual, reflecting the challenges of balancing traditional project management objectives with broader sustainability goals. Project management, traditionally concerned with delivering projects on time, within budget, and to the required quality, began to expand its scope to include sustainability considerations in the early 2000s. This shift was driven by growing recognition of the environmental and social impacts of engineering projects, as well as the increasing importance of corporate social responsibility and stakeholder engagement in project success (Silvius et al., 2012). However, the adoption of sustainability in project management practices remains inconsistent, with varying levels of integration across different sectors and regions.

Green engineering is a term that encompasses a wide range of practices aimed at reducing the environmental impact of engineering activities. It is rooted in the principles of sustainability, focusing on the design, operation, and management of systems that minimize negative environmental impacts while maximizing resource efficiency and societal benefits. Green engineering practices include the use of renewable energy sources, the implementation of energy-efficient technologies, waste reduction and recycling, water conservation, and the design of products and processes that are inherently less harmful to the environment (Anastas & Zimmerman, 2003).

The scope of green engineering extends beyond mere compliance with environmental regulations; it involves a proactive approach to sustainability that seeks to innovate and improve environmental performance continuously. This includes the adoption of life cycle assessment (LCA) techniques to evaluate the environmental impact of products and processes from cradle to grave, the use of green materials and sustainable design principles, and the incorporation of environmental considerations into every stage of the project lifecycle, from planning and design to execution and decommissioning (Cabezas et al., 2003).

Green engineering also emphasizes the importance of interdisciplinary collaboration, recognizing that sustainability challenges often require solutions that span multiple fields of expertise. This interdisciplinary approach is reflected in the growing trend towards systems thinking in engineering, where complex systems are designed and managed with an understanding of their interactions with the environment, society, and economy (Allenby, 2006). By integrating sustainability into the engineering process, green engineering practices aim to achieve not only environmental protection but also economic efficiency and social equity.

Several frameworks and models have been developed to guide the integration of sustainability into project management practices. One of the most widely recognized frameworks is the Project Management Institute’s (PMI) Project Management Body of Knowledge (PMBOK), which has gradually incorporated sustainability principles into its guidelines. The PMBOK framework emphasizes the importance of considering environmental and social impacts throughout the project lifecycle, from initiation and planning to execution, monitoring, and closure (PMI, 2017). However, the application of sustainability within this framework is often left to the discretion of the project manager, leading to varying levels of integration across different projects.

The GPM Global’s PRiSM (Projects Integrating Sustainable Methods) methodology is another framework that explicitly integrates sustainability into project management. PRiSM focuses on six key elements: project management, organizational governance, environmental sustainability, social sustainability, economic sustainability, and stakeholder engagement (Gareis et al., 2013). This framework provides a more structured approach to sustainability, offering tools and techniques to ensure that sustainability considerations are systematically integrated into project planning, execution, and evaluation.

Other frameworks, such as the Sustainable Project Management Maturity Model (SPM3), provide organizations with a tool to assess and improve their sustainability performance in project management. The SPM3 framework evaluates an organization’s maturity in integrating sustainability into its project management practices across five levels, ranging from initial awareness to full integration and continuous improvement (Silvius & Schipper, 2014). These frameworks underscore the importance of adopting a holistic approach to project management that goes beyond traditional metrics to include environmental, social, and economic considerations.

The integration of sustainability into engineering project management is also guided by a range of regulations, standards, and certifications designed to promote environmentally responsible practices. One of the most widely recognized standards is ISO 14001, which provides a framework for environmental management systems (EMS) that can be applied to any organization, regardless of its size or sector. ISO

14001 focuses on the identification and management of environmental impacts, compliance with environmental regulations, and continuous improvement in environmental performance (ISO, 2015).

Another important certification in the context of sustainable engineering is the Leadership in Energy and Environmental Design (LEED) certification, which is widely used in the construction industry. LEED provides a framework for designing, constructing, and operating buildings that are environmentally responsible and resource-efficient (USGBC, 2016). The certification covers a wide range of sustainability criteria, including energy and water efficiency, materials selection, indoor environmental quality, and site sustainability.

In addition to these standards, various industry-specific regulations and guidelines also influence the integration of sustainability into engineering project management. For example, the European Union's directives on energy efficiency and renewable energy set targets for reducing greenhouse gas emissions and increasing the use of renewable energy sources in engineering projects (European Commission, 2018). Similarly, national and regional regulations, such as the U.S. Green Building Council's guidelines and the United Kingdom's BREEAM (Building Research Establishment Environmental Assessment Method) certification, provide frameworks for integrating sustainability into construction and infrastructure projects (BREEAM, 2019).

These regulations and standards play a crucial role in shaping the adoption of green engineering practices by providing a structured approach to sustainability and encouraging organizations to adopt best practices that go beyond mere compliance.

Analysis of Green Engineering Practices

The analysis of green engineering practices within engineering project management is best understood through specific case studies that exemplify the successful implementation of sustainable practices. One notable example is the Masdar City project in Abu Dhabi, which is one of the world's most renowned sustainable urban developments. Designed to be a carbon-neutral and zero-waste city, Masdar City integrates a range of green engineering practices, including the use of renewable energy, advanced water conservation techniques, and sustainable construction materials (Reiche, 2010). The city's design emphasizes the use of solar energy, which is abundant in the region, and includes a 10 MW photovoltaic power plant that supplies energy to the city (Reiche, 2010). Additionally, Masdar City incorporates passive design strategies such as wind towers and shaded walkways to reduce the need for artificial cooling, significantly lowering energy consumption.

Another exemplary project is the Bullitt Center in Seattle, which has been described as the greenest commercial building in the world. The Bullitt Center was designed to meet the Living Building Challenge, a rigorous standard for sustainable construction. The building features a rooftop photovoltaic array that generates more energy than the building consumes, making it a net-positive energy building. Furthermore, the Bullitt Center uses a rainwater harvesting system that collects and treats rainwater for all potable and non-potable uses, eliminating the need for municipal water supply (Chiras, 2013). The building's construction materials were carefully selected to avoid toxic substances and to minimize environmental impact, contributing to a healthier indoor environment and reduced lifecycle impacts.

The selection of these case studies was based on several criteria, including the size and complexity of the project, the industry sector, and the geographical location. Both Masdar City and the Bullitt Center are large-scale projects in the construction sector, which is one of the most resource-intensive industries. These projects were also selected because they are located in regions with different climatic conditions and regulatory environments, providing insights into how green engineering practices can be adapted to various contexts.

The success of these projects can be attributed to the implementation of specific green engineering practices that are central to achieving sustainability goals. In the case of Masdar City, the use of renewable energy, particularly solar power, is a key sustainable practice. The city's photovoltaic power plant and solar thermal cooling systems demonstrate how renewable energy can be harnessed to meet the energy demands of large urban developments (Reiche, 2010). Additionally, Masdar City's water conservation measures, such as the use of treated wastewater for irrigation and the deployment of low-flow fixtures, significantly reduce water consumption in an arid environment where water is a scarce resource.

The Bullitt Center, on the other hand, exemplifies the integration of energy efficiency and resource conservation practices. The building's net-positive energy performance is achieved through the use of high-performance insulation, triple-glazed windows, and advanced building automation systems that optimize energy use. The rainwater harvesting system and composting toilets contribute to the building's water independence and waste reduction, further enhancing its sustainability credentials (Chiras, 2013). Both projects also emphasize the importance of using sustainable materials, with the Bullitt Center employing materials that are free of harmful chemicals and have a low environmental impact.

These practices, while varied in their specific applications, share common principles of sustainability: reducing resource consumption, minimizing environmental impact, and enhancing the resilience of the built environment. By implementing these practices, both Masdar City and the Bullitt Center have set new benchmarks for sustainable engineering and demonstrated the potential for green engineering to transform traditional approaches to project management.

The outcomes of these projects have been significant in terms of their environmental, economic, and social impacts. Environmentally, both Masdar City and the Bullitt Center have achieved substantial reductions in energy and water use, contributing to lower greenhouse gas emissions and reduced pressure on local water resources. Masdar City's reliance on solar energy has led to a reduction in carbon emissions by avoiding the use of fossil fuels, while the Bullitt Center's energy-positive design contributes to the city's renewable energy targets and reduces the building's carbon footprint (Reiche, 2010; Chiras, 2013).

Economically, the initial investment in green technologies and sustainable practices has been offset by long-term savings in operational costs. For instance, the energy savings achieved through the Bullitt Center's net-positive energy design result in lower utility bills, while the use of durable and sustainable materials reduces maintenance and replacement costs over the building's lifecycle (Chiras, 2013). Moreover, these projects have generated economic benefits through the creation of green jobs and the stimulation of local industries involved in the supply of sustainable materials and technologies.

Socially, these projects have enhanced the quality of life for their occupants and the surrounding communities. Masdar City, with its pedestrian-friendly design and emphasis on public spaces, promotes social interaction and a sense of community. The Bullitt Center's healthy indoor environment, achieved through the use of non-toxic materials and natural ventilation, contributes to the well-being of its occupants. Furthermore, both projects serve as educational platforms, raising awareness about sustainability and inspiring other developments to adopt similar practices (Chiras, 2013).

The green engineering practices implemented in Masdar City and the Bullitt Center, while successful, are not universally applicable across all sectors. The construction sector, with its focus on buildings and infrastructure, has a different set of sustainability challenges and opportunities compared to other industries such as energy or manufacturing. For instance, the energy sector's sustainability efforts often center around the transition to renewable energy sources and the decarbonization of energy production. Projects in this sector, such as wind and solar farms, prioritize the optimization of energy efficiency and the integration of energy storage solutions to enhance the reliability and stability of renewable energy systems (Delucchi & Jacobson, 2011).

In contrast, the manufacturing sector focuses on reducing resource consumption and waste generation through practices such as lean manufacturing, circular economy principles, and the use of sustainable materials. The application of life cycle assessment (LCA) in manufacturing is particularly important, as it allows companies to identify opportunities for reducing the environmental impact of their products from raw material extraction to end-of-life disposal (Hauschild, Rosenbaum, & Olsen, 2018).

These sector-specific differences highlight the need for tailored approaches to sustainability that address the unique challenges and opportunities of each industry. While the principles of green engineering—such as energy efficiency, resource conservation, and waste minimization—are universally relevant, their application must be adapted to the specific context of each sector to achieve the best outcomes.

Despite the successes of green engineering practices, their implementation is not without challenges. One of the most significant barriers is the cost associated with adopting sustainable technologies and practices. The initial investment required for renewable energy systems, high-performance materials, and advanced water conservation technologies can be prohibitive, particularly for smaller projects or organizations with limited budgets. This challenge is often compounded by the longer payback periods associated with some sustainable technologies, which can deter investment despite the long-term savings they offer (Häkkinen & Belloni, 2011).

Stakeholder resistance is another common barrier to the implementation of green engineering practices. In many cases, stakeholders, including project owners, investors, and even end-users, may be reluctant to adopt sustainable practices due to a lack of understanding of their benefits or concerns about potential disruptions to traditional project workflows. This resistance can be particularly strong in sectors where sustainability is not yet widely recognized as a priority, or where there is a perception that sustainability efforts are at odds with economic objectives (Shen, Zhang, & Zhang, 2017).

Additionally, the lack of expertise in sustainable engineering practices can hinder their adoption. Many project teams may not have the necessary knowledge or experience to effectively implement green practices, leading to suboptimal outcomes or even project failures. This skills gap underscores the importance of education and training in sustainable engineering and the need for industry-wide initiatives to build capacity in this area (Jones, Shan, & Goodrum, 2010).

Discussion

The analysis of green engineering practices across different projects and sectors reveals several key findings that are critical to advancing sustainability in engineering project management. First, the successful implementation of green engineering practices requires a holistic approach that integrates sustainability into every stage of the project lifecycle. This includes not only the adoption of specific technologies and practices but also the consideration of sustainability in project planning, design, execution, and evaluation. The case studies of Masdar City and the Bullitt Center demonstrate that when sustainability is embedded in the project's core objectives, it can lead to significant environmental, economic, and social benefits.

Second, the variability of green engineering practices across different sectors highlights the need for tailored approaches to sustainability. While the principles of green engineering are universally applicable, their specific implementation must be adapted to the unique challenges and opportunities of each sector. This suggests that sector-specific guidelines and frameworks are necessary to support the widespread adoption of sustainable practices.

Third, the challenges and barriers identified in the analysis underscore the importance of addressing the financial, stakeholder, and expertise-related obstacles to sustainability. Overcoming these challenges will require a concerted effort from all stakeholders involved in the project, including project managers, engineers, policymakers, and the wider community. This includes not only providing the necessary financial resources and incentives but also fostering a culture of sustainability through education, training, and stakeholder engagement.

The findings of this review have significant implications for engineering project management. Project managers play a crucial role in the successful implementation of green engineering practices, as they are responsible for integrating sustainability into the project's objectives, managing stakeholder expectations, and ensuring that the project stays within budget and on schedule. To effectively manage sustainable projects, project managers must be equipped with the necessary knowledge and skills to understand the environmental, economic, and social impacts of their projects and to make informed decisions that balance these considerations.

Moreover, the review suggests that project management frameworks and methodologies need to evolve to better support the integration of sustainability. This includes the development of new tools and techniques for assessing the sustainability performance of projects, as well as the inclusion of sustainability criteria in project evaluation and reporting processes. By embedding sustainability into the core of project management practices, organizations can ensure that their projects contribute positively to the environment and society while achieving their economic objectives.

Looking to the future, several emerging trends and directions are likely to shape the evolution of green engineering practices in engineering project management. One of the most significant trends is the increasing use of digital technologies, such as Building Information Modeling (BIM), Internet of Things (IoT), and Artificial Intelligence (AI), to enhance the sustainability of engineering projects. These technologies offer new opportunities for optimizing resource use, reducing waste, and improving the efficiency of project management processes (Jalaei, Jrade, & Nassiri, 2015). For example, BIM can be used to simulate the environmental performance of buildings during the design phase, allowing project teams to identify and address potential sustainability issues before construction begins.

Another important direction for future research and practice is the development of more robust and comprehensive sustainability assessment frameworks. While existing frameworks provide a useful starting point, there is a need for more sophisticated tools that can capture the full range of environmental, economic, and social impacts of engineering projects. This includes the integration of life cycle assessment (LCA) and other sustainability assessment methods into project management processes, as well as the development of new metrics and indicators for measuring sustainability performance (Hauschild et al., 2018).

Finally, the ongoing shift towards a circular economy presents both challenges and opportunities for green engineering practices. The circular economy model, which emphasizes the reuse, recycling, and regeneration of resources, requires a fundamental rethinking of how engineering projects are designed, managed, and evaluated. Project managers and engineers will need to develop new skills and competencies to navigate this transition and to design projects that contribute to the circular economy (Geissdoerfer, Savaget, Bocken, & Hultink, 2017).

Based on the findings of this review, several recommendations can be made to enhance the integration of sustainability in engineering project management. First, organizations should prioritize the development of sector-specific guidelines and frameworks that support the adoption of green engineering practices. This includes the creation of industry-wide standards and best practices that can be used to guide the implementation of sustainability across different sectors.

Second, education and training programs should be expanded to build capacity in sustainable engineering practices. This includes not only formal education programs at universities and technical institutes but also professional development opportunities for practicing engineers and project managers. By equipping the workforce with the necessary skills and knowledge, organizations can better position themselves to meet the growing demand for sustainable engineering solutions.

Finally, policymakers and industry leaders should work together to create financial incentives and regulatory frameworks that encourage the adoption of sustainable practices. This could include tax credits, grants, and other forms of financial support for projects that demonstrate a commitment to sustainability, as well as the introduction of mandatory sustainability reporting requirements for large-scale engineering projects.

Conclusion

This review has provided a comprehensive analysis of green engineering practices within the context of engineering project management. Through the examination of case studies, the review has highlighted the successful implementation of sustainable practices in projects such as Masdar City and the Bullitt Center. These projects demonstrate the significant environmental, economic, and social benefits that can be achieved when sustainability is integrated into the core of project management processes.

The analysis has also underscored the variability of green engineering practices across different sectors and the need for tailored approaches to sustainability. The challenges and barriers identified in the review, including cost, stakeholder resistance, and lack of expertise, highlight the importance of addressing these issues to promote the widespread adoption of sustainable practices.

As the global demand for sustainable development continues to grow, the integration of green engineering practices into engineering project management will become increasingly important. The findings of this review suggest that while significant progress has been made, there is still much work to be done to fully realize the potential of sustainable engineering. By continuing to develop and refine green engineering practices, and by addressing the challenges that hinder their adoption, the engineering profession can play a leading role in shaping a more sustainable future.

References

Brundtland, G. H. (1987). *Report of the World Commission on Environment and Development: Our Common Future.* United Nations.

Chiras, D. D. (2013). The Bullitt Center: Setting the standard for sustainable construction. *The Sustainable City*, 19(4), 15-23.

Delucchi, M. A., & Jacobson, M. Z. (2011). Providing all global energy with wind, water, and solar power, Part II: Reliability, system and transmission costs, and policies. *Energy Policy, 39*(3), 1170-1190.

Elkington, J. (1998). *Cannibals with forks: The triple bottom line of 21st century business.* New Society Publishers.

European Commission. (2018). Energy efficiency directive 2012/27/EU. *Official Journal of the European Union.*

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The circular economy–A new sustainability paradigm? *Journal of Cleaner Production, 143*, 757-768.

Gareis, R., Huemann, M., Martinuzzi, A., Weninger, C., & Sedlacko, M. (2013). Project Management and Sustainable Development Principles. *Project Management Institute.*

Häkkinen, T., & Belloni, K. (2011). Barriers and drivers for sustainable building. *Building Research & Information, 39*(3), 239-255.

Hauschild, M. Z., Rosenbaum, R. K., & Olsen, S. I. (2018). *Life cycle assessment: Theory and practice.* Springer.

ISO. (2015). ISO 14001:2015 Environmental management systems—Requirements with guidance for use. *International Organization for Standardization.*

Jalaei, F., Jrade, A., & Nassiri, M. (2015). Integrating decision support system (DSS) and building information modeling (BIM) to optimize the selection of sustainable building components. *Journal of Information Technology in Construction, 20*(3), 399-420.

Jones, S. W., Shan, M., & Goodrum, P. M. (2010). A systematic approach for assessing green building products. *Journal of Green Building, 5*(1), 132-145.

PMI. (2017). *A guide to the project management body of knowledge (PMBOK® guide).* Project Management Institute.

Reiche, D. (2010). Renewable energy policies in the Gulf countries: A case study of the carbon-neutral "Masdar City" in Abu Dhabi. *Energy Policy, 38*(1), 378-382.

Shen, L. Y., Tam, V. W., Tam, L., & Ji, Y. B. (2011). Project feasibility study: The key to successful implementation of sustainable and socially responsible construction management practice. *Journal of Cleaner Production, 19*(4), 460-467.

Shen, L. Y., Zhang, Z., & Zhang, H. (2017). Key factors affecting green procurement in real estate development: A China study. *Journal of Cleaner Production*, *135*(1), 78-86.

Silvius, A. G., & Schipper, R. (2014). Sustainability in project management: A literature review and impact analysis. *Social Business, 4*(1), 63-96.

Silvius, A. J. G., Schipper, R., Planko, J., Van den Brink, J., & Kohler, A. (2012). *Sustainability in project management.* Gower Publishing.

USGBC. (2016). LEED v4 for Building Design and Construction. *U.S. Green Building Council.*