



THE ROLE OF ARTIFICIAL INTELLIGENCE IN SUSTAINABLE PROJECT MANAGEMENT (SPM)

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Abstract

Artificial Intelligence (AI) is among the revolutionary innovations of the modern day, restructuring industries and professional practices using automation, predictive analytics, and data-driven decision-making (Nenni, 2024). In project management, a subject involved with cost, scope and schedule, the rising importance of sustainability is restructuring priorities. The subject is progressively needed to consider wider outcomes, including environmental protection, social responsibility and long-term economic value (Silvius & Schipper, 2020). AI and sustainability are mostly examined in isolation. AI is mainly referred to as the catalyst of efficiency, while sustainability is referred to as an ethical or strategic imperative. However, the connection between these two domains remains relatively unexplored. An understanding of how AI can be used to support sustainable project management is critical for both academics and practitioners.

This essay reviews the role of AI in sustainable project management. Its aim is to assess how AI supports sustainability in projects by analyzing opportunities, risks and gaps in the current literature. The objectives are threefold: first, to examine AI applications in project management; second, to evaluate their involvement to sustainability objectives; and third, to distinguish challenges and areas for more research. The discussion begins by outlining the theoretical background of sustainable project management before turning to AI applications, their pivotal position in advancing sustainability, the risks and challenges associated with the adoption of AI in sustainable project management (SPM), and opportunities for future research.

Keywords

Artificial Intelligence, Project Management, Sustainability

1. Introduction

Artificial Intelligence (AI) is among the revolutionary innovations of the modern day, restructuring industries and professional practices using automation, predictive analytics, and data-driven decision-making (Nenni, 2024). In project management, a subject involved with cost, scope and schedule, the rising importance of sustainability is restructuring priorities. The subject is progressively needed to consider wider outcomes, including environmental protection, social responsibility and long-term economic value (Silvius & Schipper, 2020). These advances have made possible sustainable project management (SPM), which incorporates sustainability principles into the management of projects to make sure that alignment with global agendas such as the United Nations Sustainable Development Goals (Aarseth et al., 2017).

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2. Sustainable Project Management (SPM): Theoretical Background

SPM is premised on the idea that projects are not secluded activities but part of wider socio-economic and ecological systems. Elkington's (1997) Triple Bottom Line (TBL) framework, which assesses performance in terms of people, planet and profit, remains one of the most influential concepts sustaining SPM. Silvius & Schipper (2020) claim that fostering sustainability in project management necessitates a change from short-term efficiency to long-term value creation. Projects also need to positively support environmental and social systems.

Aarseth et al. (2017) believe that despite its worldwide recognition, most organizations continue to treat sustainability as a peripheral concern. Martens & Carvalho (2017) likewise state that the lack of robust tools and clear metrics makes it tough for project managers to operationalize sustainability. Certain improvements have been made due to the usage of sustainability indicators, namely carbon footprint assessments, social impact analyses, and lifecycle costing. However, these tools continue to be inappropriately applied, especially outside developed economies (Marnewick, 2020).

Adaptive management, introduced by Holling (1978), offers a complementary method to incorporating sustainability. It accentuates on iterative cycles of planning, action, and reflection, allowing projects to acclimatize to uncertainty and complexity. Allen and Gunderson (2011) claim that adaptive management is especially valuable where stakeholder requirements and environmental conditions change swiftly. The incorporation of adaptive principles into project management fits well with sustainability goals, and AI can further fortify this by adding real-time data and predictive analytics to allow for adaptive decision-making.

In summary, SPM delivers a theoretical framework, but lack of implementation is a significant drawback. AI, with its ability to process complex datasets and generate predictive insights, has the capability to fill this gap by incorporating sustainability considerations into regular project inputs.

3. AI in Project Management

The incorporation of AI into project management has been enhanced in recent times, with usage extending from routine automation to advanced decision-support systems. Davahli et al. (2020) distinguishes its most regular uses in scheduling, cost estimation, and risk management. Machine learning models, for instance, can examine historical data to forecast cost overruns or delays, usually with better accuracy than traditional methods.

Felicetti et al. (2024) discuss the growing use of natural language processing (NLP) in project environments. NLP can scan and examine project documentation, stakeholder communications and contracts to spot risks and uncover hidden patterns of conflict. Likewise, neural networks have been utilized to enhance resource allocation and scheduling, creating more consistent outcomes than conventional project planning tools (Nenni, 2024).

However, Salimimoghadam (2025) warns that the reports remain divided, with most studies examining narrow applications in isolation. This seems to support the idea that AI is merely a tool for efficiency, overlooking its prospect as a transformative facilitator of sustainability.

The discussion about AI's role in decision-making is ongoing. Alevizos et al. (2023) claim that AI should supplement rather than substitute human expertise. Although AI can process large volumes of data accurately, human judgment continues to be crucial for interpreting results and balancing competing objectives. This caution is especially applicable in sustainability contexts, where decisions usually comprise of ethical considerations, stakeholder values and long-term impacts that go far beyond numerical optimization.

In summary, AI is increasingly incorporating into concrete uses in project management, but there is still a requirement to move beyond efficiency narratives to identify how these tools can systematically improve sustainability outcomes.

4. AI and Sustainability in Projects

The possibility of AI supporting sustainability in project management is increasingly becoming a reality. Demeke (2025) emphasizes its role in automating sustainability reporting, monitoring compliance with environmental regulations, and identifying sustainability risks early in the project lifecycle. AI's predictive analytics can be especially powerful in reducing waste, improving resource efficiency, and allowing lifecycle assessments.

In the infrastructure sector, which is resource-intensive and environmentally impactful, AI has been used to tackle sustainability challenges. Laissy & Dakhil (2025) report on AI tools that estimate project delays while incorporating environmental performance metrics at the same time. Their results demonstrated a 15% improvement in forecasting accuracy, together with considerable reductions in carbon emissions and material waste. These results show how AI can align efficiency with sustainability.

Bolón-Canedo (2024) presents the concept of 'green AI', which emphasizes that AI systems must be designed sustainably. Training large AI models needs substantial energy consumption, and without energy-efficient designs AI risks undermining the very sustainability goals it is intended to support. This perspective shifts the discussion from how AI can contribute to sustainability outcomes to how AI can itself be sustainable.

AI's sustainability contributions are not only limited to construction. In aviation for instance, route optimization algorithms decrease fuel consumption and emissions, accomplishing both cost savings and environmental benefits (Reuters, 2025). In food services, software tools such as Winnow have decreased food waste by monitoring consumption patterns and recommending adjustments, creating simultaneous financial and ecological gains (The Times, 2024). Microsoft's Planetary Computer provides a comprehensive example of AI supporting environmental monitoring by combining and analyzing global data on ecosystems and biodiversity (HBR, 2023).

Notably, AI can also aid social sustainability. Jariwala (2024) underlines how predictive analytics can find communities at risk of exclusion from project benefits, making sure more of inclusive stakeholder engagement. Emotional analysis of stakeholder communications gives details into perceptions and trust, enabling managers to carefully take care of social concerns. This proves that AI's role in sustainability is not limited to environmental dimensions but expands to social equity and participation.

5. Challenges and Risks

AI adoption in SPM comes along with its fair share of significant risks and challenges. Ethical concerns are obvious. Algorithms are vulnerable to partiality in their training data, leading to outcomes that can preserve inequalities (Alevizos et al., 2023). For instance, if historical data replicates systemic biases in resource allocation or stakeholder engagement, AI may emphasize these models instead of challenging them. Transparency is also another issue. Many AI models work as opaque 'black boxes' producing outputs without clear explanations, which undermines accountability and stakeholder trust (Financial Times, 2024).

Furthermore, skill gaps and shortages complicate AI adoption. Reuters (2024) reports that sustainability professionals don't usually have technical expertise in AI, while data scientists may lack understanding of sustainability principles. This skills gap and mismatch create challenges to effective incorporation. Organizations should foster training, workshops and interdisciplinary collaboration to nullify this gap.

Also, AI's environmental footprint is another area of concern. Vinuesa et al. (2020) record that large AI models utilize substantial energy during training and operation. Unless this is counterbalanced by using renewable energy or energy-efficient models, this substantial energy use can challenge sustainability outcomes. The concept of 'green AI' therefore becomes crucial in making sure that AI contributes to sustainability holistically (Bolón-Canedo, 2024).

6. Research Gaps and Future Directions

The previous discussion has identified numerous major research gaps. First, factual evidence on AI's direct contribution to sustainability results is not common. Although studies like the one by Laissy & Dakhil (2025) deliver promising instances, systematic analyses across multiple industries are lacking (Demeke, 2025). Longitudinal studies which evaluate sustainability impacts through the lifecycle of projects could deliver stronger evidence of AI's role.

Secondly, there is a requirement for incorporated frameworks which merge AI with sustainability principles. Bolón-Canedo (2024) advocates for the development of standardized 'green AI' frameworks, while Allen & Gunderson (2011) propose adaptive management as a conceptual ground for incorporating AI into sustainability-oriented project practices. Such frameworks could offer practitioners a more comprehensible direction in aligning AI applications with sustainability goals.

Thirdly, inclusive AI design remains unexplored and unknown. Alevizos et al. (2023) emphasize the risks of bias in AI systems and highlights the significance of inclusive design to encourage fairness and equity in project outcomes. This is especially relevant in global projects that include diverse stakeholders and contexts.

Finally, interdisciplinary collaboration is crucial for expanding research. Vinuesa et al. (2020) believe that AI has the potential to support all the 17 Strategic Development Goals outlined by the UN, but this is possible only if experts from sustainability, project management, and computer science collaborate and work together. Interdisciplinary research would allow for the creation of models that are both technically robust and socially responsive.

7. Conclusion

This essay has assessed the role of AI sustainable project management. The report shows that AI has substantial ability to improve sustainability by optimizing resource allocation, improving forecasting accuracy, facilitating automated compliance reporting, and incorporating environmental and social metrics into project planning and delivery. Case studies in construction, aviation, food services, and environmental monitoring emphasize the extensiveness of AI applications in advancing sustainability objectives.

However, this doesn't come without its fair share of challenges which are significant to say the least. Ethical concerns such as algorithmic bias and lack of transparency, combined with skills shortages and the environmental costs of AI, complicate adoption. The risk of over-reliance on algorithms also highlights the requirement for continuous human supervision, ethical reasoning, and stakeholder engagement in sustainability-oriented projects.

Research gaps persist, especially in terms of empirical evidence, incorporated frameworks, and inclusive AI design. Future efforts must be focused on developing green AI standards, conducting longitudinal studies of AI's sustainability impacts, and fostering interdisciplinary partnership.

In conclusion, AI embodies both an opportunity as well as a challenge for SPM. If incorporated sensibly, with ethical safeguards and robust frameworks, AI could transform project management into a discipline that delivers efficiency and contributes to long-term sustainability and social well-being.

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