Sustainable AI Applied to Project Management: A Literature Review

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Integrating sustainable practices with emerging technologies, such as Artificial Intelligence, has proven crucial to achieving new sustainable development goals. In the industrial context, project management is important in promoting sustainability. This work aims to review the literature on applying sustainable Artificial Intelligence in project management, focusing on optimizing resources and aligning with the SDGs. As a result, the research highlighted the good performance of the technological transformation of project management, combined with sustainability concepts, as an agent capable of generating the necessary transformations to guarantee a more sustainable future.
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In recent years, sustainability has aroused great interest and has been the focus of numerous discussions and global initiatives. Much of the emphasis on the topic is due to the growing concern with maintaining economic, social, and environmental systems in alignment with the Sustainable Development Goals (SDGs).

Sustainability addresses the need to satisfy the current world's needs without compromising future generations' capacity, establishing a balance between economic development and sustainable pillars. Sustainable development, in turn, aims to achieve this balance, promoting economic growth that is inclusive, ecologically correct, and socially fair. Sustainable practices can generate business opportunities, drive innovation, and improve social well-being, contributing to long-term economic and social stability. Linking sustainability to new emerging technologies, such as Artificial Intelligence (AI), is a demand that arises in parallel to discussions on sustainable development and can contribute to achieving the goals established by the United Nations General Assembly.

In the industrial area, another practice emerges as an important ally in promoting the aforementioned changes: project management. Capable of offering the necessary guidance to meet a given scope, project management is a potential tool for ensuring good results and achieving goals. Incorporating new technologies into project management practices and integrating sustainability concepts can result in satisfactory organizational benefits, contributing significantly to the search for sustainable development. The main objective of this work is to carry out a literature review on the concept of sustainable AI applied to project management, focusing on resource optimization. The research is directly related to the Sustainable Development Goals, whose focus is SDG 9: Industry, innovation, and infrastructure, which aims to build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation [1].

Materials and Methods

The method applied in this research is based on a traditional narrative review methodology, which aims to synthesize and interpret existing knowledge on a specific topic through a coherent narrative. Below is a step-by-step guide:

Scope Definition: The research objective was

established, and the review scope delineated, involving selecting key concepts and formulating research questions responsible for guiding the narrative.

Information Sources Identification: Search strategies were defined (keywords and inclusion/exclusion criteria), and the leading scientific databases were identified (ScienceDirect, SciELO, Scopus, etc.).

Study Selection and Inclusion: The criteria were established, and the main works were identified and selected.

Data Extraction and Synthesis: Selected studies were analyzed, and relevant data were extracted and synthesized to highlight key themes, trends, and emerging debates in the literature reviewed. Study Analysis and Interpretation: A critical analysis of selected studies was conducted, discussing their contributions to understanding the topic and highlighting common patterns, discrepancies, and gaps in the literature.

Narrative Structuring: The review text was structured into a coherent narrative, beginning with a clear introduction to the topic, then developing key debate questions, and concluding with a synthesis of findings and future directions. Review and Editing: Finally, the work underwent a review and editing process to ensure clarity, coherence, and academic rigor.

Literature Review

Sustainability and Sustainable Development Goals

In recent years, discussions about sustainable development have grown exponentially due to numerous events highlighting economic, social, and environmental instability [2]. At the same time, as the demand for sustainability grows, the demand for the subsistence of industries in the current market also increases. This is mainly because

the concept of sustainability is directly linked to the idea of survival, and, in the long term, this perspective is translated into the economic capacity of organizations [3]. Sustainable development represents a dimension of sustainability that focuses primarily on promoting economic growth by the constraints of the planet's natural systems, maintaining the balance of the ecosystem [4]. In line with this need, the new technological era has required companies to adapt their development models to incorporate new sustainable approaches to business practices [2].

In this scenario, and to strengthen the search for sustainable development, many initiatives have encouraged the application of new technologies to address sustainability in different domains. Artificial Intelligence (AI), for example, is one of the recent technological advances that represent a potential resource for enabling sustainable growth [5], mainly if applied in alignment with the 17 Sustainable Development Goals (SDG).

The 17 Sustainable Development Goals were proposed in 2015 by the United Nations (UN) and include 169 targets to achieve the sustainable development agenda by 2030 [6]. These objectives cover issues that encompass different challenges, ranging from combating climate change to eradicating hunger, and the application of AI in this scenario has aroused the interest of several researchers. Analyzing and understanding the impact of AI on sustainable development has been a topic of growing interest in recent years [7]. The World Economic Forum reinforced the need to direct the use of Artificial Intelligence to contribute to the Sustainable Development Goals [8]. At the same time, the European Commission highlighted the fundamental role in AI's transformation, being a source of change towards a fairer, more prosperous, and sustainable future [9]. All of these factors reinforce the importance of understanding the concept of AI and the possible implications of its use.

AI and Sustainable AI

The most widespread definition of AI today

consists of the relationship between the application of generative algorithms and the direct impact of this application on the efficiency of processes [10].In the field of research, the application of AI focuses on optimizing processes, emphasizing reducing costs and increasing productivity [11]. Exploring the use of AI to optimize solutions for complex contemporary problems is one of the leading development paths in alignment with the SDGs [2]. According to Sulich and colleagues [10], Artificial Intelligence can drive innovation by addressing the priority dimensions of the Sustainable Development Goals, and it is crucial to understand the mutual relationship between the SDGs and ethical paradigms for technology implementation. Recognizing the role of Artificial Intelligence in building a sustainable future through its capacity for data analysis, expansion of the quantitative knowledge base, and optimization of human activities in terms of energy efficiency and costs is essential for disseminating technology [4]. Given the discussions presented, it is possible to affirm that the growing interest in sustainability issues has driven the demand for studies on integrating AI into sustainable business practices [12]. Sustainable AI emerges against this scenario based on the policies and practices associated with the Sustainable Development Goals [13].

Sustainable AI has been the subject of study by many researchers, and applying this technology to promote sustainability has become increasingly common, often in association with the SDGs [11]. Recent studies highlight the effectiveness of Artificial Intelligence in achieving sustainable development, especially in economics, agriculture, and business management, supporting the achievement of sustainable goals and the decision-making process [10]. Exploring AI's impact on a sustainable level is extremely important, especially from an economic point of view [14]. For this reason, the topic has been of interest in science and marketing [10]. Due to its ability to process and learn from large volumes of information, AI can be applied across various fields to optimize resource utilization [15]. If applied to the management field, the technology can resolve managerial problems [16]. In the innovation sector, the application of Artificial Intelligence proves highly efficient, mainly due to its ability to work with large sets of data [14].

Reinforcing the aspects already highlighted, Li and Xu [16] point out that enterprises must adapt to the evolution of AI and the consequent emergence of new businesses to guarantee their survival. For Sipola and colleagues [12], the use of Artificial Intelligence can allow faster extraction of information and assist in the decision-making process, strengthening the competitive position of organizations, and Waltersmann and colleagues [17], in turn, reinforces that the application of sustainable AI in the search for resource efficiency has grown as the importance of sustainable values increases in manufacturing industries. The new needs that arise from the aspects mentioned so far reinforce the importance of disseminating the application of AI in the search for cost reduction and resource optimization [12]. In this way, sustainable AI can be understood as a potential tool for achieving the SDGs in different sectors of the world economy, contributing to advancing socioeconomic aspects in underdeveloped countries [18]. Organizations can employ AI to utilize available assets more efficiently, often allocating limited resources more effectively and improving oversight and data sharing. They will also focus on investigating key application-related aspects of sustainable AI in the field of project management.

Sustainability AI in Project Management

In recent years, project management has gained significant notoriety, receiving attention for its essential role in different sectors of the global market, offering the structure and guidelines necessary to achieve good results. With the advent of AI, interest also arose in using new technologies available to improve project management practices [19]. As interest in the topic grows, the need to understand the concept of project management and

its different application possibilities also increases, with the main focus being the search for the satisfaction of interested parties and ensuring the expected financial return [20]. Despite this, recent data show that only 35% of projects executed are successful, and, in most cases, this low performance is attributed to the lack of technologies applied to project management [21]. Given this scenario, the application of Artificial Intelligence in this field of study emerged as a key factor in enabling the development of a management structure based on the historical experience of past projects, supporting the development of proactive strategies throughout the execution of new projects [18].

Faced with the competitiveness of the current market, organizations have been faced with new demands linked to project management, ranging from planning and effective control of trivial elements involved in conducting a project, such as scope, deadline, and cost, to other aspects focused on sustainable practices, covering the economic, social and environmental dimensions [20]. In this context, disseminating new technologies applied to project management, combined with adopting sustainability criteria, can represent a competitive differentiator capable of guaranteeing the prominence of organizations in the current market by increasing the probability of success of the projects developed [19]. To ensure sustainable development and strengthen the balance between the pillars of sustainability, organizations need to adapt their processes to enable risk reduction and cost optimization, adding value to the business [3]. This adaptation must require the adaptation and/or replacement of many production and management processes combined with implementing environmental and safety guidelines [22]. Seeing new sustainability challenges as opportunities for innovation is crucial for maintaining business competitiveness, and disseminating the application of sustainable AI in project management in large organizations is the first step towards this new scenario.

Project management plays a fundamental role in disseminating sustainability criteria within organizations, and there are several possibilities for integrating sustainable aspects throughout project development, especially in promoting the optimization of available resources and ensuring projects' economic performance [23]. Considering that part of defining a project concept involves constraining time, cost, and resources [3], promoting conscientious use of these components is crucial for preventing failures and ensuring successful outcomes [22]. In this scenario, AI applied to project management may be able to increase task performance through the automation of operational functions, in addition to optimizing the allocation of available resources through the analysis of historical data and the establishment of standards that enable the targeting of resources based on demand forecast, allowing the implementation of a flexible and adaptable management model [24]. For Nieto-Rodriguez e Vargas [21], AI should be used with a focus on creating personalized project plans capable of directing efforts and available resources in an optimized and precise manner, ensuring the best use of resources and a balance between environmental, social, and economic dimensions. In this way, by incorporating AI techniques into project management, organizations can improve their internal processes by directing efforts, reducing costs, optimizing resources, and increasing the performance of their processes in alignment with the concept of sustainable development [20]. Combined with the sustainability criterion, the restructuring of project management practices may be capable of boosting new economic scenarios and promoting the modernization of the industry, contributing to the strengthening of the pillars of sustainability and the search for achieving the SDGs, especially SDG 9 (Industry, Innovation, and Infrastructure), which aims to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation [1,25].

Prioritizing the efficient control of resources, which are almost always limited, must be understood as a strategic project management approach, an essential factor for sustainable growth

[20]. Therefore, capitalizing on all the knowledge already established in project management, incorporating additional concepts and attributes related to sustainability, and integrating new technologies can be the principal transformative agent for the future of organizations [3]. The dissemination of the use of Artificial Intelligence applied to project management, with a focus on optimizing resources, can be understood as an advance of great importance for the transformation of organizational processes, not only boosting the economic efficiency of businesses but also promoting the development sustainability and the subsistence of institutions [25].

Conclusion

Promoting the development of countries without compromising the future of humanity is the great challenge of the 21st century, and investing in sustainable practices, aiming not only to preserve natural resources but also economic stability and social well-being, is a decisive factor capable of driving innovation and the creation of new business opportunities. As the demand for sustainability grows, the advancement of emerging technologies also intensifies, awakening the need for technological transformation of current processes. These discoveries represent opportunities for transformation, increasing the efficiency and quality of processes and fostering innovation. Organizations can stay competitive and ensure their continuity by adopting emerging technologies like AI.

In this scenario, the discussions presented throughout this work show that project management is a cross-sectional research field capable of encompassing different approaches. In the corporate world, project management plays an essential role, providing the necessary structure to achieve goals and enabling the appropriate allocation of resources and compliance with deadlines. This results in successful deliveries and greater competitiveness for organizations. Linking sustainability concepts to project

management through Artificial Intelligence with a focus on optimizing resources, reducing costs, and strategically directing efforts may generate the necessary transformations to guarantee a more sustainable future and alignment with SDG 9. Finally, the aspects discussed throughout this work are not just ethical recommendations but fundamental concepts for maintaining the economic, social, and environmental spheres. The main limitation found throughout this research is the scarcity of work related to AI and project management with practical applications.

Finally, future research will focus on developing and applying an AI model in a pilot project, focusing on planning and optimizing resources, including analyzing results and mapping the main benefits obtained.

References

1. Instituto de Pesquisa Econômica Aplicada (IPEA). (s.d.). Objetivo de Desenvolvimento Sustentável 9 - Indústria, Inovação e Infraestrutura. Available at https://www.ipea.gov.br/ods/ods9.html.
2. Satornino CB, Du S, Grewal D. Using artificial intelligence to advance sustainable development in industrial markets: A complex adaptive systems perspective. Industrial Marketing Management, 2024;116:145-157.https://doi.org/10.1016/j.indmarman.2023.11.011.
3. Morioka SN, Carvalho MM. Sustentabilidade e gestão de projetos: um estudo bibliométrico. Production 2016;26(3):656–674.https://doi.org/10.1590/0103-6513.058912.
4. Francisco M, Linnér B. AI and the governance of sustainable development. An idea analysis of the European Union, the United Nations, and the World Economic Forum. Environmental Science & Policy 2023;150:103590. https://doi.org/10.1016/j.envsci.2023.103590.
5. Davenport T, Guha A, Grewal D, Bressgott T. The impact of AI on marketing. Journal of the Academy of Marketing Science 2020;48(1):24–42.
6. United Nations. The 17 goals. Department of Economic and Social Affairs 2015. Accessed 02/2024 at: https://sdgs.un.org/goals.
7. Briscoe E, Fairbanks J. Artificial scientific intelligence and its impact on national security and foreign policy. Orbis2020;64:544–554.https://doi.org/10.1016/j.orbis.2020.08.004.

8. World Economic Forum. Harnessing Artificial Intelligence for the Earth 2018:3– 27.

9. European Commission. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: Artificial Intelligence for Europe. 2018:1–20.

10. Sulich A et al. Artificial intelligence and sustainable development in business management context – Bibliometric review. Procedia Computer Science 2023;225:3727-3735.https://doi.org/10.1016/j.procs.2023.10.368.

11. Nasi O et al. Artificial intelligence and sustainable development goals nexus via four vantage points. Technology in Society 2023;72:102171. https://doi.org/10.1016/j.techsoc.2022.102171.

12. Sipola J, Saunila M, Ukko J. Adopting artificial intelligence in sustainable business. Journal of Cleaner Production 2023;426:139197, ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2023.139197.

13. Wilson C, Van der Vellen M. Sustainable AI: An integrated model to guide public sector decision-making. Technology in Society 2022;68:101926. ISSN 0160-791X. https://doi.org/10.1016/j.techsoc.2022.101926.

14. Kar et al. How can artificial intelligence impact sustainability: A systematic literature review. Journal of Cleaner Production 2022;376:134120. ISSN 0959-6526. https://doi.org/10.1016/j.jclepro.2022.134120.

15. Rolnick D et al. Tackling climate change with machine learning. ACM Computing Surveys (CSUR) 2022;55(2):1–96.

16. Li F, Xu G. AI-driven customer relationship management for sustainable enterprise performance. Sustainable Energy Technologies and Assessments 2022;52(Part B):102103. ISSN 2213-1388. https://doi.org/10.1016/j.seta.2022.102103.

17. Waltersmann L, Kiemel S, Stuhlsatz J, Sauer A, Miehe R. Artificial intelligence applications for increasing resource efficiency in manufacturing companies—a comprehensive review. Sustainability 2021;13:6689.

18. Van Wynsberghe A. Sustainable AI: AI for sustainability and the sustainability of AI. AI and Ethics 2021;1(3):213–218.

19. Barcaui A, Monat A. Who is better in project planning? Generative artificial intelligence or project managers? Project Leadership and Society 2023;4: 100101. ISSN 2666-7215. https://doi.org/10.1016/j.plas.2023.100101.

20. Lourenço N, Zambon MZ. Otimização de recursos de gerenciamento de projetos nas organizações. Caderno Técnico de Administração Contemporânea 2021;3.

21. Nieto-Rodriguez A, Vargas RV. How AI will transform project management. Harv Bus Rev 2023. Available at:https://hbr.org/2023/02/how-ai-will-transform-project-management.

22. Cavalcanti CT de A, Silva IRM. Contribuições e Desafios da Sustentabilidade na Gestão de Projetos. Revista de Gestão e Projetos [S. l.] 2016;7(3):20–28. doi: 10.5585/gep.v7i3.358. Available at https://periodicos.uninove.br/gep/article/view/9649.

23. Bocchini P et al. Resilience and sustainability of civil infrastructure: toward a unified approach. Journal of Infrastructure Systems 2014;20:1-16.

24. Prifti V. Optimizing project management using artificial intelligence. European Journal of Formal Sciences and Engineering 2022;5(1):29–37.

25. Wang Z et al. Achieving sustainable development goal 9: A study of enterprise resource optimization based on artificial intelligence algorithms. Resources Policy 2023;80:103212. ISSN 0301-4207. https://doi.org/10.1016/j.resourpol.2022.103212.