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Artificial intelligence - driven sustainable development: Examining organizational, technical, and processing approaches to achieving global goals

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Abstract

This study presents a comprehensive literature review using a systematic approach to explore the role of artificial intelligence (AI) in promoting sustainable development in line with the United Nations Sustainable Development Goals (SDGs). The systematic review approach was applied to collect and analyze topics, and the literature search was conducted in two stages, encompassing 57 articles that met the research requirements. Our analysis reveals that AI's contribution to sustainability is concentrated within three key areas: organizational, technical, and processing aspects. The organizational aspect focuses on the integration of AI in companies and industries, addressing barriers to implementation and the relationship between companies, partners, and customers. The technical aspect highlights the development of AI algorithms that can address global challenges and contribute to the growth of stability and development in society. The processing aspect emphasizes the internal transformation of companies, their business models, and strategies in response to AI integration. Our proposed conceptual model outlines the essential elements organizations must consider when incorporating AI into their sustainability efforts, such as strategic alignment, infrastructure development, change management, and continuous improvement. By addressing these critical aspects, organizations can harness the potential of AI to drive positive social, environmental, and economic outcomes, ultimately contributing to the achievement of the SDGs. The model serves as a comprehensive framework for organizations seeking to leverage AI for sustainable development, but it should be adapted to individual contexts to ensure its relevance and effectiveness.

KEYWORDS
artificial intelligence, organizational transformation, sustainability strategy, sustainable development goals, technological integration

1 | INTRODUCTION

Addressing pressing global challenges such as climate change, extreme weather events, hunger, and inequality calls for urgent, concerted action from countries and organizations worldwide. In response, the United Nations Sustainable Development Goals (SDGs) aim to improve health, education, and economic growth while tackling climate change and promoting equality. Achieving these goals necessitates a holistic understanding of the complex, interrelated systems that underpin sustainability challenges. Harnessing the potential of artificial intelligence (AI) technologies offers a promising avenue to facilitate system-level changes and promote sustainable development (Jarrahi, 2018; Jeste et al., 2020).

Despite optimism surrounding AI's potential contribution to sustainability, academic literature on the subject remains scattered across various disciplines, with limited cross-pollination between different fields of inquiry. This article addresses this gap by conducting a systematic literature review of business and management studies investigating AI's role in meeting the SDGs. In doing so, it pursues four objectives:

- Identify and compile empirical business and management studies examining AI's role in achieving the SDGs, consolidating disparate research and facilitating interdisciplinary knowledge exchange.
- Categorize identified studies to reveal predominant research themes and foci, providing a comprehensive overview of the field, particularly in the business-to-business (B2B) context.
- Develop a conceptual model based on organizational, technical, and processing aspects, offering a comprehensive understanding of AI's role in promoting sustainable development in a B2B context.
- Uncover research gaps and propose a future research agenda to stimulate interest and catalyze the development of a new research field.

The article is structured as follows: The methodology employed in conducting the systematic literature review, including search strategies, selection criteria, and data extraction procedures, is detailed. Next, findings are presented, discussing emerging research categories and introducing a conceptual model based on organizational, technical, and processing aspects. This model aims to provide a comprehensive understanding of AI's role in promoting sustainable development in a B2B context. Finally, suggestions for future research are offered, highlighting potential avenues for advancing AI's role in promoting sustainable development and the applicability of the proposed conceptual model.

In this study, we conducted a systematic literature review to explore AI's role in sustainable development within a B2B context, resulting in a final sample of 57 articles. By synthesizing the existing literature, we illuminated AI technologies' potential in addressing complex sustainability challenges and proposed a conceptual model derived from organizational, technical, and processing aspects. This model serves as a comprehensive framework for understanding the interplay between these dimensions and provides a foundation for future interdisciplinary collaboration, innovation, and practice. Our findings reveal that AI's contribution to sustainability is concentrated within these three main areas, and the insights form the basis for guiding organizations in incorporating AI into their sustainability efforts, holding practical relevance for businesses, policymakers, and stakeholders.

2 | METHOD

To conduct a literature review, we followed the basic parameters outlined by Schlegelmilch and Öberseder (2010), including defining the scope of the review, selecting data sources, identifying keywords for search, and establishing criteria for including and excluding data from the selection. The systematic review approach was applied to collect and analyze topics that intersect the study areas (Lim et al., 2022; Tranfield et al., 2003). We conducted our literature search in two stages. In the first stage (October 2021), we searched the Web of Science (WoS) database using the query "sustainability OR sustainable" and "artificial intelligence OR machine learning OR deep learning OR AI" in the title, abstract, and keywords sections (Bocconcelli et al., 2018). The total number of WoS articles was 1317. These broad terms were employed to identify the entire set of studies potentially relevant to our research. We did not impose publication time limits, as our goal was to encompass all empirical insights produced over time. Subsequently, we narrowed down our selection by applying the following filters: Articles Only, Use of English, "Business" and "Management" areas (Calabrò et al., 2019).

In addition to searching the WoS database, we conducted a parallel search in the Scopus database using the same search criteria, including keywords, date range, and other filtering options (Caputo & Kargina, 2022; Kumpulainen & Seppänen, 2022). This approach allowed us to ensure a comprehensive search across two major academic databases. The total results found in the Scopus database amounted to 1298 articles. We made a deliberate decision to exclude the articles found only in the Scopus database based on consistency with previous studies. This decision aligns with our research objectives and the scope of our review. However, we acknowledge that this exclusion may limit the comprehensiveness of our study, and readers should consider this aspect when interpreting our findings.

In selecting the WoS database for our systematic review, we considered several key factors that guided our decision. Our initial comparison with the Scopus database revealed that the results were almost identical, but we recognize the need to elaborate on our rationale for focusing solely on WoS.

- Relevance to Research Objectives: The WoS database offered a collection of journals that were highly pertinent to our specific research objectives. We evaluated the unique articles found in the Scopus database and determined that they were less relevant to the focus of our study (most of them were not from B2B area).
- Quality Control and Consistency: WoS is renowned for its rigorous selection criteria for indexing journals, ensuring a high standard of

quality. By concentrating on WoS, we aimed to maintain consistent quality across the articles included in our review.

- Alignment with Previous Research: Our study builds upon previous research that utilized the WoS database. By maintaining consistency in our database selection, we aimed to create a coherent and comparable body of work.
- Resource Efficiency: Conducting a systematic review is a resource-intensive process. By focusing on the WoS database, where most relevant articles were found, we were able to allocate our resources more efficiently without sacrificing the comprehensiveness of our review.
- Avoidance of Redundancy: Our initial comparison with the Scopus database revealed a high degree of overlap with the WoS database. Including both would have introduced redundancy without significantly enhancing the breadth or depth of our review.

In the second stage, we manually reviewed the abstracts, research methods, and discussions in each article to verify their relevance to our research. At this stage, we excluded all non-empirical studies as well as articles that did not focus on the B2B context. In order to clarify the process of inter-rater agreement when selecting the final sample of articles, we employed a systematic approach (Gioia, 2021; Papaioannou et al., 2016). The three researchers independently assessed each article for its relevance to the research topic and whether it met the inclusion criteria (B2B, empirical research, AI, sustainable development). Discrepancies in the selection process emerged when researchers disagreed on the inclusion of certain articles. To address these discrepancies, we implemented a consensus-based approach to resolve any disagreements (Potapchuk & Crocker, 2017). When a discrepancy arose between researchers, we convened a discussion session where each researcher presented their rationale for either including or excluding the article in question. The article was included in the final sample if at least two out of the three researchers agreed that it met the inclusion criteria (Cole, 2023). This approach to addressing discrepancies and ensuring inter-rater agreement in the selection process enhanced the transparency and reliability of our study (Armstrong et al., 1997). By fostering open communication and seeking consensus, we were able to maintain consistency in our selection process and produce a robust final sample of articles for analysis.

Our final sample comprised 57 articles included in this review spans a time range from 2008 to 2022. These dates represent the earliest and latest publication years within the selected studies, encompassing a diverse and comprehensive view of the research landscape on the subject. We analyzed the final sample by examining the abstracts, results, and discussions, identifying information about sustainability and the role of AI in addressing applied problems facing companies, industries, regions, countries, etc. Relevant quotations were extracted and retained for further discussion among the study participants. We also noted if the article focused on developing and testing an algorithm or method on a specific case. Key information from the articles was entered into a separate Excel spreadsheet to track progress and quickly identify and remove duplicate information.

Following the formation of our final sample, we applied a thematic analysis to categorize studies into SDG categories based on their focus (Starbird et al., 2016; Tremblay et al., 2020). Recent studies (Carlsen & Bruggemann, 2022; Mensah, 2019; Tremblay et al., 2020) have identified five key SDG topics: People (no poverty, zero hunger, good health and well-being, quality education, gender equality), Planet (clean water and sanitation, responsible consumption and production, climate action, life below water, life on land), Prosperity (affordable and clean energy, decent work and economic growth, industry innovation and infrastructure, reduced inequalities, sustainable cities and communities), Peace (peace, justice, and strong institutions), and Partnership (partnerships for the goals). The study authors independently examined notes and findings to minimize exploratory bias (Creevey et al., 2022). This stage was also conducted in parallel and independently among the authors, with regular consultations and verification of a unified approach to research.

A PRISMA diagram illustrating the systematic literature review and thematic analysis process can be found in Figure 1 (Page et al., 2021). This visual representation provides a clear overview of the steps taken to ensure rigor and transparency in our study, from the initial search to the final categorization and analysis of articles.

3 | JOURNAL TRENDS

Our study identified nine journals that accounted for fifty percent of the publications in our sample, contributing 28 out of the 57 publications: Business Strategy and the Environment (3 publications), European Journal of Operational Research (2 publications), Information Technology & Management (2 publications), International Journal of Human Resource Management (2 publications), Journal of Business Research (4 publications), Journal of Enterprise Information Management (2 publications), Journal of Intellectual Capital (2 publications), Technological Forecasting and Social Change (9 publications), and Tourism Management (2 publications). All other journals in our sample were represented by a single publication.

The selection of the journals and the analysis of publication trends in this study are not arbitrary but rather strategically aligned with the emerging interest in the intersection of AI and sustainable development. The identified journals, such as Business Strategy and the Environment, Technological Forecasting and Social Change, and Journal of Business Research, are renowned for their focus on innovation, technology, and sustainability, making them highly relevant to our research theme.

Similar to many other research areas, the number of published papers focusing on a specific topic increased gradually over time. However, a significant growth in the number of publications occurred in 2020 and 2021. Our study found one article published in 2008 (1.7%), two articles in 2017 (3.5%), three articles in 2018 (5.2%), eight articles in 2019 (14%), 13 articles in 2020 (22.8%), 29 articles in 2021 (50.8%), and one article dated 2022 (1.7%).

The significant growth in publications in 2020 and 2021 underscores the burgeoning interest in AI's role in sustainability, reflecting

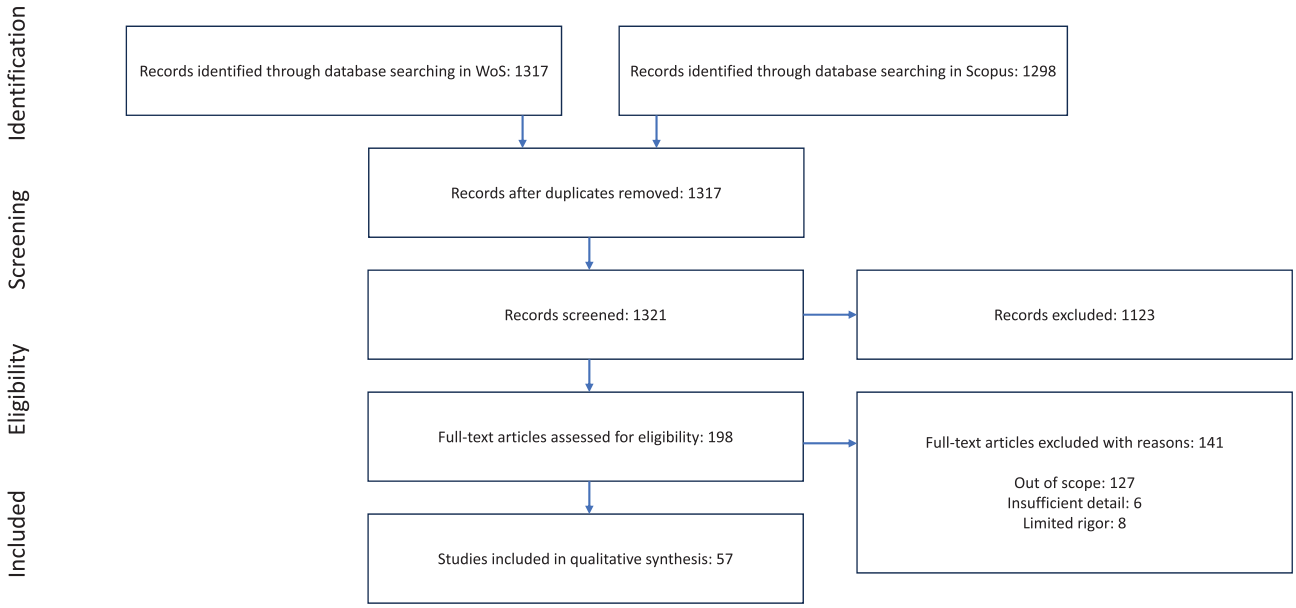

FIGURE 1 PRISMA flow diagram for the study.

the global urgency to address SDGs. By concentrating on these specific journals and trends, we have captured the pulse of academic and industrial advancements in AI-driven sustainability, providing a comprehensive and timely overview of the field. This focus ensures that our analysis is rooted in the most relevant and influential sources, offering valuable insights into the current state of research and future directions.

4 | EMPHASIS ON QUALITATIVE RESEARCH

Qualitative research constitutes approximately 70% of the articles in our sample. The majority of researchers in our sample focus on studying the utilization of AI capabilities for the sustainable development of companies, industries, countries, regions, and other entities, using one or several implemented cases as examples. In contrast, quantitative studies make up about 30% of the sample and tend to concentrate on identifying implicit trends and characteristics of specific industries (Creswell, 2013; Mayring, 2004). The use of case studies enables a more comprehensive understanding of a multifaceted research field, particularly at the intersection of several domains, compared to a superficial examination (Beverland, 2005). Moreover, case studies facilitate a deeper understanding of the subject area, especially within the context of an emerging phenomenon and a scarcity of knowledge (Essamri et al., 2019).

Studies that have employed interviews as a primary information source have used them to investigate human and organizational perspectives. Human-centered research primarily aimed to explore the future of jobs under the influence of AI, the adaptation of different generations to new opportunities and challenges (Grønsund & Aanestad, 2020; Nam et al., 2020), and the role of humans in the deployment of AI (Ogbeibu et al., 2022; Prem, 2019). On the organizational side, interviews provided extensive data on changes at the company level (business model, business processes, strategy), industry level (trends, opportunities, development specifics), and country level (competitive advantages, required resources, and changes). The majority of the research was conducted as qualitative studies using questionnaires, online or offline meetings, and semi-structured interviews.

Cases from the manufacturing sector (automotive, additive manufacturing, and various types of digital and smart production) were represented in 45.6% or 26 articles. The service sector (mainly finance, education, health, and logistics) was represented in 40.3% or 23 articles. A mix of industries was represented in 8.7% or five articles, and studies without a specific industry were represented in 4.6% or four articles.

5 | FINDINGS

In this chapter, we present the results of our sample analysis. Based on the previous literature (Carlsen & Bruggemann, 2022; Mensah, 2019; Tremblay et al., 2020), we have categorized the articles into five key SDG topics: People, Planet, Prosperity, Peace, and Partnership (see Table 1).

5.1 | People

The People theme is divided into three key parts: 1. The use of AI in global hunger eradication (Flores & Villalobos, 2020; Lachman & López, 2019; Stehel et al., 2019); 2. Changes in employee roles within the new organizational structure of companies (Froehlich, 2017; Grønsund & Aanestad, 2020); 3. Transformation of mature industries

TABLE 1 Categorization of sampled articles by key SDG topics: People, planet, prosperity, peace, and partnership.

SDGs					
People	**Planet**	**Prosperity**		**Peace**	**Partnership**
Vinichenko et al., 2020	Goralski & Tan, 2020	Araujo & Kollat, 2018	Nam, 2020	Sly & María, 2021	Yu, 2021
Ding, 2021	Denicolai et al., 2021	Haftor et al., 2021	Broo & Schooling, 2023	Canhoto, 2021	
Kazancoglu et al., 2021	Dubey et al., 2021	Denicolai et al., 2021	Sjodin et al., 2018	Butticè et al., 2019	
Lachman & López, 2019	Chiarini, 2021	Ogbeibu et al., 2022	Jain et al., 2022		
Froehlich, 2017	Kazancoglu et al., 2021	Dominique-Ferreira et al., 2021	Polemis & Spais, 2020		
Stehel et al., 2019	Hill & Böse, 2016	Braganza et al., 2021	Hill & Böse, 2016		
Flores & Villalobos, 2020	Li et al., 2022	Prem, 2019	Sly & María, 2021		
Nam, 2020	Hamida et al., 2021	Krieger et al., 2021	Rahman et al., 2022		
Pan et al., 2022		González-Cancelas et al., 2019	Pandey & Basu, 2020		
Grønsund & Aanestad, 2020	Brown & Vergragt, 2008	Chiarini, 2021	Zhou et al., 2021		
Adnan et al., 2019	Benzidia et al., 2021	Penagos-Londoño et al., 2021	Stehel et al., 2019		
	Brown & Vergragt, 2008	Grønsund & Aanestad, 2020	Bhattacharyya & Shah, 2022		
	Flores & Villalobos, 2020	Klumpp & Zijm, 2019	Ding, 2021		
		Vinichenko et al., 2020			
		Hidalgo et al., 2020	Hamida et al., 2021		
		Sousa & Wilks, 2018	Pan et al., 2022		
		de Kervenoael et al., 2020	Chatterjee et al., 2021		
		Silva & Bonetti, 2021	Bag et al., 2022		
		Nguyen et al., 2022	Allal-Chérif et al., 2021		
		Lachman & López, 2019	Lee & Kim, 2020		
		Kim & Chung, 2019			

under the influence of new technologies (Grønsund & Aanestad, 2020; Vinichenko et al., 2020).

5.1.1 | AI and hunger eradication

This subsection covers topics related to SDG2, "zero hunger," including sustainable industry development, institutional barriers in agriculture, global population growth, and related societal challenges. Articles addressing food production, quantity and quality, and global food safety are also included. Researchers approach hunger eradication from different angles, such as policymaking (Stehel et al., 2019), overcoming institutional and industrial barriers (Lachman & López, 2019), and addressing population growth and food insecurity (Flores & Villalobos, 2020). Kazancoglu et al. (2021) investigate food safety and quality improvements through new technologies.

5.1.2 | Employee roles and organizational structure

This subsection addresses gender equality (SDG5) and good health and well-being (SDG3), with a focus on sustainable human development. Froehlich (2017) explores the aging population and the integration of older workers in knowledge-intensive organizations using AI. Nam et al. (2020) investigate perceptions of job insecurity related to technology usage, while Grønsund and Aanestad (2020) examine human-algorithm interaction in the maritime industry. Adnan et al. (2019) study the influence of religiosity on the adoption and effective use of new technologies.

5.1.3 | Mature industries and new technologies

Mature industries, such as education and automotive, require significant resources and innovations for sustainable development from a

human perspective (SDG3, SDG4, and SDG5). Vinichenko et al. (2020) analyze the education industry's sustainable development, highlighting the role of AI in enhancing competitiveness, collaboration, and university performance. Ding (2021) investigates the intersection of education and hospitality industries, focusing on how machine learning technologies can improve staff training and optimize working hours in the restaurant business.

5.1.4 | Summary

The People theme explores AI's role in enhancing well-being and equality. It emphasizes efforts to eradicate poverty and hunger, promote health and education, and achieve gender equality. These findings reflect a comprehensive approach to leveraging AI for human-centric sustainable development.

5.2 | Planet

The Planet theme primarily targets two areas: 1. Changes in supply chain management with respect to planetary resources (Dubey et al., 2021; Hill & Böse, 2016); 2. Industry-specific aspects related to consumption (Chiarini, 2021; Hamida et al., 2021). Some papers address both topics concurrently.

5.2.1 | Supply chain management and planetary resources

This subsection highlights responsible consumption and production (SDG12) as the key theme. The role of AI in sustainable supply chain management is explored from different perspectives, such as the impact of the COVID-19 pandemic on supply chain transformation (Dubey et al., 2021), AI's influence on resource consumption in the manufacturing industry (Chiarini, 2021), and the growth of export potential in small and medium-sized enterprises through environmental AI strategies (Denicolai et al., 2021). Hill and Böse (2016) investigate AI-assisted resource optimization for reducing air pollution. Goralski and Tan (2020) examine the benefits and limitations of AI in addressing sustainability challenges at the organizational and process levels.

5.2.2 | Industry-specific aspects of consumption

This subsection focuses on the application of AI in specific industries for responsible consumption and production. Hamida et al. (2021) demonstrate how the construction industry can reduce emissions and energy use to minimize environmental impact. Li et al. (2022) explore long-term trends in the tourism industry at the organizational and technical levels. Prem (2019) investigates the possibilities of AI for regional development, emphasizing the need for policymaker involvement and the formation of necessary rules for successful technology implementation. Benzidia et al. (2021) examine the application of AI in the supply chain integration process and its impact on environmental performance within French hospitals.

Several studies intersect multiple themes, such as deep learning by individuals, groups, professional communities, and other institutions (Brown & Vergragt, 2008), or the development and testing of green solutions for the needs of humanity, industry, and the planet (Flores & Villalobos, 2020). Ogbeibu et al. (2022) explore the benefits of new technologies, including AI, in addressing global warming challenges and fostering environmental sustainability.

5.2.3 | Summary

In the Planet subchapter, AI's impact on ecological sustainability is examined. The findings highlight AI's potential in optimizing resource consumption, reducing pollution, and fostering responsible production. This theme underscores the importance of AI in maintaining a sustainable ecological balance.

5.3 | Prosperity

The Prosperity subsection encompasses an extensive range of studies, revealing the fragmented nature of the research. Nevertheless, the primary focus lies in AI innovations within specific industries (e.g., Araujo & Kollat, 2018; Krieger et al., 2021) and the outcomes for businesses and society stemming from the sustainable implementation of these technologies (e.g., Dominique-Ferreira et al., 2021; Sjodin et al., 2018). Organizational factors prove crucial in achieving sustainable development, with various articles at the intersection of organizational-technological, organizational-technological-environmental, and other factors.

5.3.1 | Industry-specific AI innovations and applications

The development of AI-driven innovation in particular sectors (SDG8) is a recurring subject. The food, auditing, transportation, and other industries are represented in the majority of the reviewed papers. Businesses in the food industry engage customers in responsible brand development (Araujo & Kollat, 2018). Machine learning methods facilitate dialog, content dissemination, and evaluating the effectiveness of social media strategies.

Krieger et al. (2021) explore AI usage for audit practices, emphasizing the impact of technological, organizational, and environmental contextual factors on the adoption process. AI techniques contribute to a better understanding of client and audit risks. Additionally, AI social robots in hospitality services, AI and virtual reality in the fashion industry, and AI-driven digital twins in infrastructure industries are transforming these sectors (Broo & Schooling, 2023; de Kervenoael et al., 2020; Silva & Bonetti, 2021).

5.3.2 | Sustainable changes through business adaptation

The second significant aspect of the Prosperity theme is the research focus on the sustainable changes brought about by AI through business adaptation, such as shifts in employee roles, the inclusion of all population groups in value creation, and regional development. These investigations also concentrate mainly on SDG8 (decent work and economic growth).

Haftor et al. (2021) present a conceptual framework for applying machine learning to generate industrial value, forming a virtuous cycle of learning and value creation. Case studies by Klumpp and Zijm (2019) help classify employee roles in the innovation process and discuss measures at various company levels. Sousa and Wilks (2018) identify essential skills for sustainable business development in the technological future, including problem-solving, critical thinking, creativity, and emotional intelligence, among others.

Several studies explore the integration of older individuals into active societal roles (Hidalgo et al., 2020), the transformation of logistics processes influenced by AI (Allal-Chérif et al., 2021), and the positive effects of AI on the environmental, social, and financial aspects of a company's strategy (Bag et al., 2022).

5.3.3 | Summary

The Prosperity theme delves into AI's contribution to economic growth and innovation. It emphasizes AI's role in enhancing industry performance, reducing inequalities, and promoting sustainable communities. These insights underscore AI's potential to drive sustainable economic prosperity.

5.4 | Peace

The Peace theme, while not featuring as many articles as other sections, can be tentatively divided into two subgroups: Promoting Institutions and Industry-Specific Contributions to Global Sustainable Development.

5.4.1 | Promoting institutions

This subgroup discusses how technological advancements can foster the development of peace, justice, and strong institutions. The focus is on the transfer of technology from more developed regions to developing ones, helping to establish fair and robust institutions. For example, Sly and María (2021) showcases the role Chinese policymakers play in shaping and developing regions based on technological progress, providing opportunities to export new approaches that spread influence and support sustainability.

5.4.2 | Industry-specific contributions to global sustainable development

This subgroup highlights industry-specific research that addresses peace, justice, and strong institutions (SDG16). It encompasses a variety of industries, with each study offering unique insights. Canhoto (2021) discusses the importance of detecting and preventing money laundering using new technological capabilities. The author suggests a new approach to training AI for this industry, given the lack of available data. Butticè et al. (2019) examine the country-specific effects of green campaigns, demonstrating that such campaigns are more widespread in countries with limited environmental sustainability orientation. Lee and Kim (2020) argue that companies can consider sustainability as a new growth engine by developing new businesses that differentiate the customer experience, create effective organizational structures, generate business impact, and leverage the latest ICT technologies, including AI.

5.4.3 | Summary

Focusing on peace and justice, this theme explores AI's potential in supporting legal systems and governance. The findings reveal the importance of AI-driven solutions in conflict resolution and fostering strong institutions. This section emphasizes the role of AI in building a peaceful and just society.

5.5 | Partnership

The Partnership theme emphasizes the importance of sustainable collaboration among various institutional stakeholders for joint development, with new technologies serving as a key factor for success. In our literature review of Partnership for the Goals (SDG17), only one article is featured. Yu (2021) explore the timely subject of government-industry-university relations in the age of AI. They highlight the ways in which AI capabilities influence business, knowledge, and regulatory subsystems as the foundation for sustainable development at the national level. The shift of primary development resources to the digital realm drives a change in established paradigms and alters the rules of engagement within the partnerships among stakeholders.

6 | DISCUSSION

Our analysis of the role of AI in sustainability reveals a diverse approach to the development of SDGs, with most research concentrated in the Prosperity section, focusing on organizational and industrial changes due to AI implementation. We propose to group our studies according to the degree of sustainable AI impact on: (1) organizational or company level; (2) industrial or regional level; (3) technical articles aimed at developing and testing algorithms on specific examples.

6.1 | Organizational aspect

This section highlights researchers' contributions to the prosperity pillar, with most articles related to SDG9 (Industry, Innovation, and Infrastructure). These studies discuss industrial changes resulting from AI implementation in companies (Braganza et al., 2021; Jain et al., 2022; Klumpp & Zijm, 2019), industrial barriers hindering effective technology application (Kazancoglu et al., 2021;Lachman & López, 2019; Stehel et al., 2019), and relationships between companies, partners, and customers (Silva & Bonetti, 2021; Vinichenko et al., 2020). Authors note the competitive advantage of applying AI-based programs in practice, often related to environmental, financial, and social factors (Bag et al., 2022).

An essential aspect in this subsection is a company's transition to a more stable position and how this process forms additional competitive advantages compared to other industry players. Companies consider UN SDGs as targets for efficiency, cost reduction, quality improvement, and more (Kazancoglu et al., 2021; Sjodin et al., 2018). Manufacturing is the most prominent industry in this context (Chiarini, 2021; Dubey et al., 2021; Pan et al., 2022), followed by agriculture (Lachman & López, 2019; Stehel et al., 2019) and food production (Flores & Villalobos, 2020; Kazancoglu et al., 2021), focusing on innovation, testing new solutions, and addressing hunger (SDG2) or health and well-being (SDG 3) goals. These articles may also relate to the people pillar. Researchers target policymakers as one of the AI application beneficiaries (Li et al., 2022; Stehel et al., 2019), emphasizing more accurate supply and demand forecasting methods for a stable industry and society position.

AI implementation in a company requires infrastructure preparation and a change in business approach. Employees should focus more on problem-solving, critical thinking, creativity, and people management (Jain et al., 2022; Sousa & Wilks, 2018). Consequently, changes in the company's business model entail significant shifts in personnel training. The staff becomes crucial in integrating solutions at planning, implementation, and operation stages (Ding, 2021; Hill & Böse, 2016). Productive employment and decent work (SDG8) are also often discussed in this section, with AI-based innovations allowing for rethinking employee roles in the company, changing work process perceptions (Jain et al., 2022).

Regional development is considered in combination with new growth and development mechanisms (Sly & María, 2021, Prem, 2019). AI algorithms enable drawing non-obvious conclusions from complex tasks for industry development, such as defining participant relationships, identifying key development points, and long-term planning amid uncertainty (González-Cancelas et al., 2019).

Population growth studies under climate change are relevant for many researchers and practitioners (Flores & Villalobos, 2020; Hamida et al., 2021; Polemis & Spais, 2020). Forming a more optimistic vision for the industry and predicting results can help attract investors and other participants. Simultaneously, the industry's sustainable development concerning reducing emissions and resource use is supported by AI-based application implementation.

We anticipated a more significant response to combating the COVID-19 pandemic; however, such works are relatively rare. These papers generally address issues common to all sectors, such as supply chain management (Dubey et al., 2021).

Researchers also compare the application of various new technologies to achieve sustainability. In the literature we studied, in addition to AI, authors refer to technologies like virtual and augmented realities, blockchain, and 5G. Consequently, the proposed conclusions are often general regarding new IT solutions' advantages. However, when ranking capabilities and potential, AI often holds an edge (Brown & Vergragt, 2008; Silva & Bonetti, 2021).

In the case of the planet pillar, authors identify key areas where AI could provide advantages, such as reducing emissions, conserving natural resources, and decreasing energy costs (Benzidia et al., 2021; Denicolai et al., 2021; Goralski & Tan, 2020). However, some papers in this section express doubts about using AI to achieve sustainability, indicating an existing discrepancy in understanding the results and requiring additional attention from researchers and practitioners.

Having explored the organizational considerations for integrating AI into sustainable development, we now turn our attention to the technical aspects. This shift is essential as the technical foundation plays a crucial role in enabling the organizational strategies and must be carefully aligned with the broader sustainability objectives.

6.2 | Technical aspect

The planet pillar in this section explores algorithms that address global challenges like healthcare, knowledge, and humanity (Benzidia et al., 2021; Brown & Vergragt, 2008). Forecasting and targeting humanity's global problems have been accomplished with the help of AI-based programs (Canhoto, 2021; Flores & Villalobos, 2020). Addressing such challenges contributes to society's stability and growth (Hidalgo et al., 2020; Penagos-Londoño et al., 2021).

6.3 | Processing aspect

The processing section presents works focused on a company's internal transformation, including its business model, strategy, resource reallocation, and changes in business processes. The proposed conclusions in such articles highlight improvements at the company level in relation to AI implementation or usage. Most of the papers in this subchapter also belong to the organizational section and have been discussed previously. The findings in these papers offer recommendations at the company and industry level. However, unlike those in the organizational chapter, the remaining research does not provide conclusions concerning changes at the industry or regional level.

Discussions about the role of AI software continue at the company level. Despite the complexity and uncertainty, authors tend to lean towards an optimistic outlook for such integrations (Ogbeibu et al., 2022). However, the workforce will require new skills; significant changes in functionality are possible depending on the industry and specialization within the company (Adnan et al., 2019; Grønsund & Aanestad, 2020). Moreover, authors suggest not expecting rapid changes within the company. New technologies involve high costs and changes that unprepared organizations may not overcome (Adnan et al., 2019).

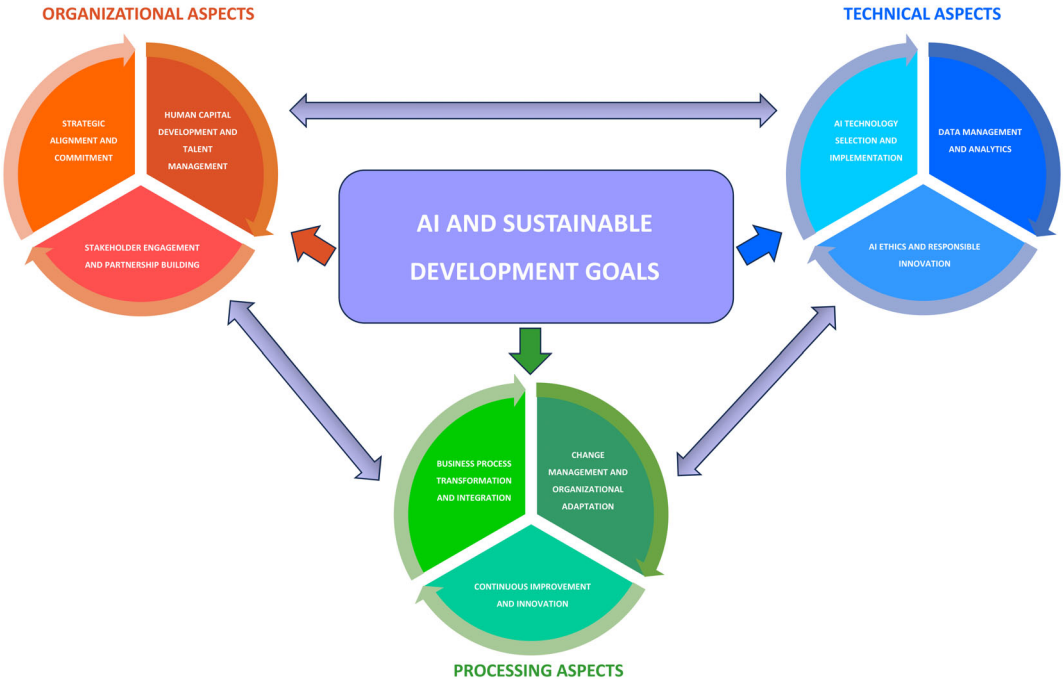

FIGURE 2 Conceptual model diagram.

Additionally, integration efficiency and sustainable development can be influenced by human factors that are difficult to account for in advance. In our review, one such factor is religiosity, which cannot be unequivocally attributed to either the positive or negative side. Therefore, researchers should pay extra attention to non-obvious human factors that can potentially impact a company and industry's sustainable development when working with AI.

Supply chain transformations continue at the processing level (Allal-Chérif et al., 2021; Bag et al., 2022). Such research is more concentrated around purchasing departments and/or logistics, with a focus on determining optimal procurement proposals and delivery optimization. On one hand, such functionality is easier to automate, freeing up more working time for staff. On the other hand, researchers emphasize the importance of working with talent and developing leadership competencies in new or renewed employees.

Researchers explore compelling cases of using AI to change established companies. However, they note that drawing unambiguous conclusions about changes based on isolated successful IT solution integration cases is not possible. More research and comparative analysis of successful cases in similar circumstances are needed.

7 | CONCEPTUAL MODEL FOR INTEGRATING AI INTO SUSTAINABLE DEVELOPMENT

The increasing role of AI in driving sustainable development has generated significant interest among researchers, practitioners, and policymakers. Based on our literature review, we propose a conceptual model that highlights the key organizational, technical, and processing aspects for integrating AI into sustainable development efforts. This model aims to provide a comprehensive framework for organizations and industries to navigate the challenges and opportunities presented by AI and contribute positively to the achievement of SDGs, see Figure 2. This figure provides a clear visual guide to the relationships and flow between different aspects of integrating AI into sustainable development.

7.1 | Organizational aspects of the conceptual model

7.1.1 | Strategic alignment and commitment

To successfully integrate AI into sustainable development initiatives, organizations must align their strategies, goals, and objectives with the principles of sustainability and the broader SDGs. This requires strong commitment and support from top management, as well as effective communication and collaboration among various organizational stakeholders. Organizations should also develop clear performance metrics and targets related to sustainability and AI, monitor progress regularly, and adjust their strategies as needed to ensure continuous improvement.

7.1.2 | Human capital development and talent management

The effective implementation of AI technologies for sustainable development depends heavily on the availability and quality of human capital. Organizations must invest in the development of their workforce to ensure they possess the necessary skills, knowledge, and expertise

to work with AI systems effectively. This includes providing training and development opportunities in areas such as data science, machine learning, and ethical AI, as well as fostering a culture of innovation, adaptability, and continuous learning. Furthermore, organizations should adopt talent management strategies that attract, retain, and develop employees with the right combination of technical and non-technical skills to support their AI-driven sustainability initiatives.

7.1.3 | Stakeholder engagement and partnership building

Collaboration and partnerships play a critical role in driving sustainable development through AI. Organizations should actively engage with various stakeholders, including customers, suppliers, regulators, academia, and non-governmental organizations, to identify opportunities for collaboration, share knowledge and best practices, and co-create innovative solutions. Building strong partnerships across sectors and industries can help organizations access valuable resources, expertise, and networks, as well as accelerate the development and adoption of AI technologies for sustainable development.

7.2 | Technical aspects of the conceptual model

7.2.1 | AI technology selection and implementation

AI technology selection and implementation is a nuanced process that requires careful consideration of both the potential benefits and associated risks. For example, machine learning algorithms can significantly enhance predictive accuracy in areas such as energy consumption forecasting, leading to more efficient resource utilization. However, these algorithms may also inadvertently introduce biases or errors if not properly validated, posing ethical and operational challenges.

Recent developments in the field of AI ethics have led to the creation of frameworks and guidelines that emphasize transparency, fairness, and accountability. Organizations must be mindful of these principles when implementing AI technologies to ensure responsible innovation. Practical examples of potential social impacts include the creation of new job opportunities in AI-driven industries but also the risk of job displacement in traditional sectors. Environmental impacts may encompass the use of AI in optimizing energy consumption, reducing waste, and supporting sustainable agriculture practices. Economic impacts could involve leveraging AI to drive innovation, increase productivity, and contribute to equitable economic growth, while also considering potential market disruptions and inequalities.

7.2.2 | Data management and analytics

Data is a critical enabler of AI-driven sustainability initiatives. Organizations must establish robust data management practices to ensure the quality, accuracy, and availability of data for AI systems. This includes developing data governance policies and procedures, as well as implementing data storage, processing, and analytics infrastructure that supports the needs of AI applications. Moreover, organizations should prioritize the responsible and ethical use of data, addressing issues such as data privacy, security, and bias.

7.2.3 | AI ethics and responsible innovation

The development of AI technologies for sustainable development must be guided by ethical considerations and principles of responsible innovation. Organizations should develop and adhere to AI ethics guidelines and frameworks that address issues such as transparency, fairness, accountability, and human rights. Furthermore, organizations should consider the potential social, environmental, and economic impacts of their AI-driven sustainability initiatives, and strive to minimize any negative consequences while maximizing positive outcomes.

7.3 | Processing aspects of the conceptual model

7.3.1 | Business process transformation and integration

AI-driven sustainability initiatives often require significant changes to existing business processes and operations. Organizations should conduct a thorough assessment of their current processes to identify areas where AI can be effectively integrated to enhance efficiency, reduce costs, and improve sustainability outcomes. This may involve redesigning workflows, automating repetitive tasks, and streamlining decision-making processes to leverage the full potential of AI technologies. Organizations must also ensure that AI systems are seamlessly integrated with existing systems and infrastructure to facilitate smooth and efficient operations.

7.3.2 | Change management and organizational adaptation

The successful implementation of AI technologies for sustainable development requires organizations to adapt to new ways of working and thinking. Change management plays a critical role in facilitating this transition, helping organizations manage the complexities and uncertainties associated with AI-driven transformation. Organizations should develop a comprehensive change management strategy that addresses key aspects such as communication, employee engagement, and cultural adaptation. This strategy should also include measures to mitigate potential resistance to change and ensure that employees feel supported and empowered throughout the transformation process.

In the context of AI integration for sustainable development, the application of specific change management models or strategies can provide a structured approach to guide organizations through the

transformation process. For example, Kotter's 8-Step Change Model (Kotter, 2012) can be particularly relevant:

- Creating a Sense of Urgency: Highlighting the importance of AI in achieving sustainability goals and creating a compelling vision for change.
- Building a Guiding Coalition: Assembling a cross-functional team with the influence and expertise to lead the AI integration effort.
- Forming a Strategic Vision and Initiatives: Developing a clear vision and strategy for how AI will contribute to sustainable development within the organization.
- Enlisting a Volunteer Army: Engaging employees at all levels to support and participate in the AI-driven transformation.
- Enabling Action by Removing Barriers: Identifying and addressing organizational barriers that may hinder the successful implementation of AI technologies.
- Generating Short-Term Wins: Creating early successes in AI integration to build momentum and demonstrate tangible progress.
- Sustaining Acceleration: Continuously driving the change effort, adapting to challenges, and seizing new opportunities for AI-driven sustainability.
- Instituting Change: Embedding AI-driven sustainability practices into the organizational culture, ensuring long-term commitment and success.

By applying such a model, organizations can systematically navigate the complexities of AI integration, aligning technological advancements with sustainability objectives, engaging stakeholders, and fostering a culture of continuous innovation and adaptation.

7.3.3 | Continuous improvement and innovation

Sustainable development is an ongoing journey, and organizations must continually innovate and evolve to meet the changing needs of their stakeholders and the environment. AI-driven sustainability initiatives should be designed with flexibility and adaptability in mind, allowing organizations to respond effectively to emerging challenges and opportunities. This requires a commitment to continuous improvement and a culture of experimentation, learning, and innovation. Organizations should regularly evaluate the performance and impact of their AI-driven sustainability initiatives, incorporating feedback and lessons learned to refine their strategies and enhance their outcomes over time.

In the pursuit of continuous improvement and innovation for AI-driven sustainability initiatives, organizations can benefit from adopting specific methodologies that promote adaptability, efficiency, and iterative progress. Two such methodologies are Agile and Lean:

- Agile Methodology: Agile emphasizes flexibility, collaboration, and iterative development. In the context of AI-driven sustainability, Agile can enable organizations to rapidly adapt to changing requirements, foster cross-functional collaboration, and deliver incremental improvements. Regular review and adaptation cycles ensure that AI solutions are aligned with sustainability goals and can be quickly adjusted to respond to new challenges or opportunities.
- Lean Methodology: Lean focuses on maximizing value while minimizing waste. By applying Lean principles to AI-driven sustainability initiatives, organizations can streamline processes, eliminate inefficiencies, and focus on activities that directly contribute to sustainable development outcomes. Techniques such as Value Stream Mapping can be used to identify and eliminate bottlenecks, ensuring that AI technologies are implemented in the most effective and resource-efficient manner.

Both Agile and Lean methodologies promote a culture of continuous learning, experimentation, and improvement. By integrating these methodologies into AI-driven sustainability initiatives, organizations can create a dynamic and responsive approach that continually evolves to meet the changing needs of stakeholders and the environment, thereby enhancing the effectiveness and impact of their efforts.

In conclusion, our conceptual model highlights the key organizational, technical, and processing aspects that organizations should consider when integrating AI into their sustainable development efforts. By addressing these critical aspects, organizations can harness the power of AI technologies to drive positive social, environmental, and economic outcomes and contribute to the achievement of the UN SDGs. While the model provides a comprehensive framework for organizations, it is essential to recognize that each organization's context and needs will be unique. Therefore, the model should be adapted and customized to reflect the specific challenges and opportunities faced by individual organizations and industries.

8 | FUTURE RESEARCH AREAS

8.1 | Human factors and AI adoption

The findings chapter highlighted various organizational, technical, and processing aspects of AI implementation for sustainable development. However, non-obvious human factors, such as religiosity, culture, and cognitive biases, have been underexplored in the literature. These factors can significantly influence the successful adoption and integration of AI in organizations and industries, as they shape employee attitudes, decision-making processes, and overall organizational culture.

Future research in this area could examine how these human factors interact with AI adoption and their implications for sustainability. For instance, researchers could explore how cultural differences influence AI implementation strategies and outcomes across different countries and industries. This could involve investigating the role of national culture in shaping organizational receptiveness to AI-driven sustainability initiatives, as well as the ways in which cultural dimensions, such as power distance or uncertainty avoidance, affect AI adoption processes and outcomes.

Additionally, research could delve into the impact of cognitive biases on AI integration and decision-making related to sustainability. This might involve studying how biases, such as confirmation bias or

the sunk cost fallacy, influence decision-makers' perceptions of AI's potential for sustainable development and their subsequent actions.

Understanding these human factors and their impact on AI adoption for sustainability will provide valuable insights for organizations, policymakers, and practitioners, helping them develop more effective strategies for overcoming potential barriers and fostering successful AI integration.

8.2 | AI in combating global challenges

While the findings chapter discussed various applications of AI in promoting sustainable development, the potential of AI in addressing global challenges like climate change, pandemics, and inequality remains underexplored. Given the urgency of these issues and their interdependence with the SDGs, future research should focus on developing new algorithms, tools, or strategies that leverage AI capabilities to tackle these challenges across different industries and sectors.

For example, research could investigate how AI can be used to enhance climate change modeling and prediction, support the development of clean energy technologies, or optimize resource allocation for disaster response and mitigation. Similarly, studies could explore the application of AI in public health to improve disease surveillance, vaccine development, and health system management during pandemics, or analyze how AI-driven solutions can help reduce inequality by promoting inclusive economic growth and access to essential services.

In our review of AI in combating global challenges, we recognize that our findings are shaped by the specific search strategy and criteria we employed. While we have identified certain trends and gaps within the scope of our review, we acknowledge that there are indeed studies that have adopted AI in addressing critical global issues such as climate change and public health. For example, Morgan et al. (2023) have used an ensemble machine learning model to delineate groundwater potential zones in desert fringes, contributing to our understanding of climate change impacts in specific regions. Similarly, Nguyen et al. (2022) have adopted AI in vaccine development, specifically in designing a multi-epitope candidate vaccine to control African swine fever spread. Given these examples, we emphasize that our suggestions for future research are based on the specific scope and limitations of our review. We encourage researchers to consider the broader landscape of AI applications in global challenges and to build upon both the findings of our review and the existing body of work in these critical areas.

By examining these topics, future research can contribute to a better understanding of AI's potential in addressing global challenges, fostering innovative solutions, and promoting sustainable development across various domains.

8.3 | Case analyses and comparative studies

The findings chapter emphasized the need for more case analyses and comparative studies to better understand the impact of AI on sustainable development in different industries, countries, and contexts. Conducting such research will provide valuable insights into best practices, common challenges, and the factors that contribute to successful AI implementation.

Future research could involve in-depth case studies of organizations that have successfully integrated AI technologies for sustainable development, examining the strategies employed, the challenges encountered, and the outcomes achieved. These case studies could span a range of industries and countries, allowing for cross-case comparisons and the identification of common patterns and themes.

Moreover, researchers could conduct comparative studies that examine AI implementation across multiple organizations or industries, focusing on factors such as organizational structure, culture, and industry dynamics. Such research could reveal insights into the conditions that facilitate or hinder AI adoption for sustainability, as well as the potential benefits and risks associated with various implementation strategies.

By conducting case analyses and comparative studies, future research can help organizations, policymakers, and practitioners develop more effective approaches to AI-driven sustainable development, tailored to specific industries, contexts, and challenges.

8.4 | AI's role in transforming mature companies

The findings chapter highlighted the potential of AI in transforming mature companies but also noted the need for further research to better understand the challenges and opportunities associated with implementing AI technologies in such organizations. Mature companies often face unique barriers, such as entrenched organizational structures, legacy systems, and resistant corporate cultures, which can hinder the adoption and integration of AI-driven sustainable initiatives.

Future research in this area could focus on examining the specific challenges mature companies face when implementing AI for sustainability, as well as the strategies and interventions that can help overcome these barriers. This might involve studying how mature companies can effectively navigate the process of digital transformation, restructure their operations, and develop new business models that leverage AI capabilities for sustainable growth.

Additionally, research could explore the role of leadership and change management in driving AI adoption within mature companies, including the development of training programs, communication strategies, and incentives that foster a culture of innovation and agility. Researchers could also investigate the factors that contribute to the successful integration of AI technologies in mature organizations, such as the alignment of AI-driven initiatives with corporate sustainability goals, the availability of necessary resources, and the presence of supportive internal and external stakeholders.

By delving into these topics, future research can provide valuable insights and guidance for mature companies seeking to harness AI for sustainable development, as well as contribute to a deeper

understanding of the factors that enable successful AI implementation in various organizational contexts.

8.5 | Balancing AI's sustainability benefits and risks

In our exploration of AI's role in sustainable development, we have focused on the opportunities and applications that contribute to the achievement of the SDGs. While we recognize that there may be potential risks and unintended consequences associated with AI technologies, our review did not specifically delve into these aspects. Future research may wish to explore these dimensions in greater detail to provide a more comprehensive understanding of the balance between AI's sustainability benefits and potential risks.

For example, research could investigate the development of AI solutions that minimize energy and resource consumption, as well as the design of policy frameworks and industry standards that promote the responsible and sustainable use of AI technologies. Studies could also delve into the ethical dimensions of AI implementation, examining issues such as fairness, accountability, and transparency in AI-driven decision-making, as well as the implications of AI for privacy, data security, and human rights.

Furthermore, researchers could explore strategies for addressing the potential labor market impacts of AI adoption, such as reskilling and upskilling programs, social safety nets, and policies that promote inclusive and equitable access to AI-driven opportunities. By focusing on these topics, future research can help ensure that AI's contributions to sustainable development are maximized while its potential risks are carefully managed and mitigated.

9 | CONCLUSION

The integration of AI into sustainable development initiatives represents a transformative opportunity for organizations, industries, and policymakers. This study has provided a comprehensive exploration of the organizational, technical, and processing aspects that underpin the successful incorporation of AI into sustainability efforts. Through a systematic literature review, we have identified key themes and insights that form the basis of a conceptual model, offering a holistic framework for navigating the complex landscape of AI-driven sustainable development.

Organizational Aspects: Strategic alignment, human capital development, and stakeholder engagement emerged as vital components for aligning AI initiatives with sustainability goals. The importance of top management commitment, workforce training, and cross-sector collaboration was underscored as essential for success.

Technical Aspects: The selection and implementation of AI technologies, data management, and ethical considerations were highlighted as critical factors. The study emphasized the need for careful evaluation of AI techniques, robust data governance, and adherence to ethical principles to ensure responsible innovation.

Processing Aspects: Business process transformation, change management, and continuous improvement were identified as key elements in leveraging AI for sustainability. The application of specific methodologies, such as Agile or Lean, and the integration of change management models like Kotter's 8-Step Change Model, were suggested to enhance efficiency and adaptability.

Our research also pointed to areas for future exploration, including the investigation of non-obvious human factors, the role of AI in combating global challenges, and the need for more case analyses and comparative studies. The potential risks and unintended consequences associated with AI technologies were acknowledged, with recommendations for future research to strike a balance between AI's sustainability benefits and potential risks.

The limitations of this study, such as the focus on specific databases and the exclusion of non-technical articles detailing AI techniques, should be considered when interpreting the findings. However, the insights and framework provided in this research contribute valuable knowledge to the field and offer practical guidance for organizations seeking to harness AI for sustainable development.

In conclusion, this study underscores the transformative potential of AI in driving sustainable development and provides a roadmap for organizations, practitioners, and researchers to navigate the challenges and opportunities in this rapidly evolving field. By addressing the critical aspects outlined in our conceptual model, we can harness the power of AI to drive positive social, environmental, and economic outcomes, contributing to the achievement of SDGs. The journey towards AI-driven sustainability is complex and ongoing, and this research serves as a foundational step towards a more sustainable and innovative future.

10 | DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the authors used ChatGPT to assist with language verification and polishing. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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