Sustainability Meets Innovation: Leveraging Artificial Intelligence to Promote Responsible Consumption in Product Development Strategies

Loredana Maria Popescu[1], Ovidiu Andrei Cristian Buzoianu[2], Radu Florin Chiotan[3] and Otilia Ganea[4]

[1) 2)]Bucharest University of Economic Studies, Bucharest, Romania.
[3)]"Valahia" University of Târgoviște, Romania.
[4)]Romanian Academy, Research Institute for Quality of Life – ICCV, Romania.
E-mail: maria.popescu@mk.ase.ro; E-mail: ovidiu.buzoiuanu@man.ase.ro;
E-mail: raduchiotan99@gmail.com; E-mail: otilia.ganea@gmail.com

Please cite this paper as:
Popescu, L.M., Buzoianu, O.A.C., Chiotan, R.F. and Ganea, A.,2024. Sustainability Meets Innovation: Leveraging Artificial Intelligence to Promote Responsible Consumption in Product Development Strategies. In: R. Pamfilie, V. Dinu, C. Vasiliu, D. Pleșea, L. Tăchiciu eds. 2024. *10th BASIQ International Conference on New Trends in Sustainable Business and Consumption.* Almeria, Spain, 6-8 June 2024. Bucharest: Editura ASE, pp.32-39
DOI: 10.24818/BASIQ/2024/10/016

Abstract

In the current landscape, marked by an increasing demand for sustainable practices and responsible consumption, companies across various sectors are challenged to reconsider their approaches to product development. This paper investigates how artificial intelligence (AI) can be employed as a powerful tool for integrating sustainability into the product development process, enabling organizations to meet consumer demands for more environmentally friendly and socially responsible options.

The main purpose of this research is to determine the relationship between the degree of effectiveness and fascination of users towards artificial intelligence, the influence of the social circle and the pressure to use various forms of artificial intelligence and the danger of losing one's identity and human abilities through the use of artificial intelligence and robots.

The presence of artificial intelligence devices in the daily lives of individuals and consumers has a number of advantages and disadvantages. In this paper we will analyze the relationship between the advantages brought by artificial intelligence through increased efficiency and the fascination created by it and the main fears related to the human abilities of consumers. The role of the social circle in multiplying the benefits created by artificial intelligence will also be analyzed.

This tendency to use robots or artificial intelligence systems is increasingly present in the daily life of consumers and in the relationship they have with various organizations. To better understand this interaction it is important to know the advantages and disadvantages that the development of artificial intelligence has in contemporary society. The paper also addresses ethical dilemmas and privacy concerns associated with using AI for sustainability in product development, proposing balanced approaches that respect both companies' innovation needs and consumers' values and expectations. It explores ways in which AI technology can support the transition to circular production models, waste reduction, and the encouragement of recycling and reuse.

The findings of the study underscore that the intelligent implementation of AI-based solutions in the product development process can play a key role in promoting sustainable business practices and creating a long-term competitive advantage. This approach not only responds to the growing demand for sustainable products but also contributes to global sustainable development goals while strengthening the relationship between brands and their consumers.

In conclusion, the paper demonstrates that technological innovation, especially the application of AI, is crucial for redefining product development in a manner that prioritizes sustainability. Hence, the research offers valuable insights for business leaders and product developers interested in integrating environmental considerations and social responsibility at the core of their innovation strategies.

Keywords

artificial Intelligence, consumption, development, sustainability

DOI: 10.24818/BASIQ/2024/10/016

Introduction

In an era defined by rapid transformations and pressing ecological imperatives, the topic of sustainability is becoming a cornerstone in corporate strategies, shaping new paradigms in product development. Faced with rising environmental awareness and increasingly stringent legislative requirements, companies are being urged to redefine their traditional approaches and incorporate principles of sustainability and social responsibility. In this complex context, artificial intelligence (AI) emerges not only as a vector of innovation, but also as a catalyst for integrating sustainability into the core of product development processes.

Several authors emphasize the importance of initial trust in these new technologies, but also how to integrate them into the daily activity of individuals. Previous research has shown that consumer acceptance of AI and robots depends on the specific situation in which they are used. For example, banking robots are much more easily accepted by the consumer compared to smart cooking devices or smart legal advice.

There are several factors that affect the general acceptance or rejection of bots. Increased performance, social pressure to use smart devices, the entertainment and fascination created by the device, as well as its ease of use are just some of the factors that positively affect the willingness to use smart devices. especially to the relationship between the individual and technology and less to the influence of the social circle on the perception related to artificial intelligence. Although the influence of the social circle was included in models related to the use of AI, this was more correlated with the evaluation of the mode of use and less with the reduction of fears related to the use of AI.

This paper deeply explores the potential of AI to harmonize innovation with the imperative of sustainability, highlighting the ways in which emerging technologies can facilitate the transition to responsible consumption practices. Our academic inquiry navigates the complexity of this landscape, investigating how AI systems can decode and interpret vast data sets on consumer preferences and the environmental impact of products to promote a production ethic that balances efficiency with environmental responsibility.

In a world where resource limitations and the urgency of climate action are becoming increasingly palpable, AI's role in promoting sustainability extends beyond simply making existing processes more efficient. We investigate in depth how AI-based innovations can support the concept of a circular economy, helping to reduce waste, encourage recycling and reuse, and ultimately build production and consumption systems that respect planetary boundaries.

At the same time, the paper addresses the complexity of ethical dilemmas and privacy challenges that accompany the adoption of AI in sustainable product development. By proposing balanced thinking frameworks, the study seeks to harmonize companies' need for innovation with consumer values and expectations, suggesting that prudent and ethical implementation of AI-based solutions can build a bridge between sustainability aspirations and economic realities.

1. Literature review

The review of existing literature highlights the significant intersection between sustainability and innovation, providing a theoretical and practical basis for exploring how artificial intelligence (AI) can contribute to promoting responsible consumption in product development strategies. Previous work in this area has illustrated various perspectives on how organizations can embrace sustainability and innovation, highlighting the need for an integrated approach to meet contemporary challenges.

Lazaretti et al. (2019) emphasized the importance of building sustainability and innovation in organizations, arguing that business practices must evolve to incorporate sustainability principles that support innovation. In a similar manner, Maier et al. (2020) explored the relationship between innovation and sustainability, conducting a bibliometric literature review that highlights the growing trend of research focused on these topics. Bos-Brouwers (2010) provided concrete evidence of how SMEs integrate sustainability and innovation into their practices, highlighting the importance of these

dimensions for long-term competitiveness. In the same context, Adams et al. (2016) conducted a systematic literature review on sustainability-oriented innovation, concluding that innovative approaches that focus on sustainability can generate significant advantages for organizations.

Recent contributions, such as the work of Rădulescu et al. (2023), highlighted the importance of sustainable development in public administration, showing how research, practice and education in this field can contribute to the promotion of effective sustainability strategies. Schilirò (2019) also examined the link between sustainability, innovation and efficiency, providing valuable insights into how they can complement each other to support sustainable development.

Regarding the specific application of artificial intelligence in the context of sustainability, Ghoreishi et al. (2023) discussed the impact of AI on circular value creation for sustainable development goals, highlighting the potential of AI to facilitate innovations that promote sustainability.

Burlacu et al. (2022) explore the challenges and perspectives of sustainable development in digital public administration in Romania, highlighting how digitalization can facilitate administrative processes and contribute to sustainable development goals. This perspective is crucial to understanding how technological innovations, including AI, can improve efficiency and sustainability in the public sector. In a similar context, Ladaru, et al., (2022) discuss the management of human resources in the face of the labor force crisis, in the light of the economic reforms in the Republic of Moldova. Their study emphasizes the need for innovation and competitiveness for economic progress, highlighting how effective human resource management is vital for organizational sustainability and resilience.

In addition, Bălu et al. (2019) address innovation governance at European level, highlighting how coordination and cooperation between Member States can support innovation and sustainability. This perspective is relevant to understanding the broader context in which innovation and sustainability intersect at the supranational level. Hermann (2022) provided an ethical perspective on the use of AI in marketing for social good, emphasizing the need for an ethical approach in exploiting the technology for sustainability.

On the other hand, Govindan (2022) provides a multi-theoretical perspective on how artificial intelligence drives sustainable frugal innovation. This study highlights the potential of AI to generate innovative solutions that address sustainability needs in a cost-effective way, laying the groundwork for a deeper understanding of how emerging technologies can be used to address sustainability challenges.

Therefore, the review of existing literature indicates a growing recognition of the critical role that innovation and emerging technologies, such as artificial intelligence, play in promoting sustainability. These findings underline the importance of a holistic approach to product development that combines performance with social and environmental responsibility, thus responding to current consumer demands and contributing to global sustainable development goals.

2. Methodology

The methodology adopted in this research had the main objective of investigating how artificial intelligence (AI) can be used to promote responsible consumption within product development strategies, with a particular emphasis on the integration of sustainability aspects. In achieving this objective, the methodological approach focused on reviewing the literature and analyzing the data extracted from it. Next, the methodological steps followed are described, respecting the structure and rigors of the academic style.

The literature review process began with the identification and selection of relevant sources in the fields of artificial intelligence, sustainability, and product development. A systematic search strategy was used in recognized academic databases such as Web of Science, Scopus and Google Scholar, using relevant keywords and phrases such as "artificial intelligence and sustainability", "AI in product development" and "responsible consumption". Inclusion criteria were clearly defined to ensure the relevance and quality of the selected sources, with priority given to studies that directly addressed the intersection of AI and sustainable practices in the context of product development.

For this purpose, several objectives were formulated on the basis of which a mediation model was designed, with the related hypotheses. The first objective relates to the influence of the perceived advantages of using artificial intelligence, which will increase the number of people using such devices in their daily lives. As more people use AI devices, there will be social pressure to expand their use. Thus the first hypothesis is formulated: Hypothesis 1 (I1): An increased degree of efficiency and fascination with artificial intelligence increases the social pressure to use forms of artificial intelligence and robots.

The second objective relates to the impact that the spread of artificial intelligence has on consumer fears, namely that of reducing human abilities due to the use of artificial intelligence. The more the use of artificial intelligence becomes a common phenomenon, the more it will become a habit and enter the daily routine of consumers and individuals in general. For this, the second hypothesis was formulated: Hypothesis 2 (I2): The impact of the social circle reduces the perception of loss of one's identity due to the use of artificial intelligence. The third objective concerns the direct influence that the advantages brought by artificial intelligence have on the reduction of human abilities.

After the identification of the relevant works, the data extraction process followed, through which the essential information related to the objectives of the study, the applied methodologies, the obtained results and the authors' conclusions were systematized.

This step also included a critical evaluation of the sources, looking at the methodological robustness, relevance and applicability of the findings in the context of our research. The extracted information was organized into summary tables, facilitating comparison and contrast of results from different studies.

Following the data analysis, the collected information was synthesized and interpreted, with the aim of identifying common themes, trends and gaps in the specialized literature. This phase allowed not only to consolidate an in-depth understanding of the current state of research in the field, but also to formulate hypotheses related to the potential of AI to support sustainability objectives in product development. In addition, emphasis was placed on identifying future research directions and developing practical recommendations for companies and policy makers.

3. Findings

The systematic literature review revealed several significant findings regarding the role of artificial intelligence (AI) in promoting sustainability and responsible consumption in product development strategies. These findings highlight not only the potential of AI to facilitate sustainable innovation, but also the challenges and limitations associated with its implementation in organizational practice. Table 1 summarizes the main findings, their limitations and future research directions on the role of artificial intelligence (AI) in promoting sustainability and responsible consumption in product development strategies:

Tabel 1: AI and Sustainability: Key Findings and Future Directions

Aspect	Description	Limitations	Future Directions
Process Efficiency	AI can significantly improve production processes, reducing resource consumption and carbon emissions without compromising product performance or quality.	May require significant initial investment; depends on the availability of accurate and comprehensive data.	Exploring cost-effective AI solutions and models that require less data while maintaining efficiency.
Understanding Consumer Preferences	AI technologies facilitate the analysis of consumer data, allowing companies to understand preferences for sustainable products and develop corresponding solutions.	Relies heavily on the quality and quantity of consumer data collected; potential biases in data may influence outcomes.	Enhancing data collection methods to be more inclusive and unbiased; developing algorithms that can adapt to diverse consumer needs.
Product Design Innovation	AI supports innovation in product design by identifying sustainable materials and modeling production processes with minimal environmental impact.	Innovative uses of AI in design may face resistance due to traditional processes and lack of expertise.	Promoting education and training in AI and sustainable design practices to overcome resistance to change.
Complexity and Cost of Technology	The complexity and costs associated with implementing AI solutions can limit technology	High implementation costs and complexity may deter smaller companies from adopting AI	Seeking partnerships and funding opportunities to lower the barrier to AI

	adoption, especially for SMEs.	technologies.	adoption for SMEs.
Ethical and Privacy Considerations	The use of AI raises ethical and privacy concerns related to data collection and analysis, requiring careful approaches that respect consumer rights.	Managing the balance between innovative use and ethical concerns can be challenging; requires stringent data protection measures.	Developing clear guidelines and policies for ethical AI use, focusing on consumer privacy and data security.
Lack of Specific Regulatory Framework	There is a need for clarification of the regulatory framework governing the use of AI in sustainable product development, to reduce uncertainties and facilitate innovation.	Current regulatory frameworks may not fully address the unique challenges and opportunities presented by AI in sustainable development.	Advocating for updates to regulatory frameworks to better support the integration of AI in sustainable product development.

Source: own processing

These findings highlight both the significant potential of AI in supporting sustainability in product development and the challenges and limitations that must be addressed to maximize this potential. Future research directions suggest avenues for overcoming these barriers, including exploring cost-effective AI solutions, enhancing data collection methods, promoting education and training, seeking partnerships and funding, developing ethical guidelines, and advocating for regulatory updates.

The analyzed studies demonstrate that artificial intelligence (AI) has a significant contribution to the efficiency of production processes, thus contributing to the reduction of resource consumption and carbon emissions. By optimizing processes, AI enables organizations to achieve their sustainability goals without compromising performance or product quality. At the same time, AI plays a crucial role in analyzing consumer data, facilitating a deep understanding of their preferences for sustainable products. This capability enables companies to develop products that meet the demand for greener and more socially responsible options.

The research highlights how AI can support innovation in product design, enabling the development of solutions that combine performance with sustainability principles. AI technologies can identify sustainable alternative materials and design manufacturing processes that minimize environmental impact. However, implementing AI-based solutions can be hit by technology complexity and cost. Especially for small and medium-sized enterprises (SMEs), these barriers can make it difficult to adopt AI as a tool for promoting sustainability.

The use of AI also raises ethical and privacy concerns, including the collection and analysis of consumer data. It is essential that organizations approach these issues with caution, ensuring that the use of AI respects the rights and expectations of consumers.

The lack of a clear and specific regulatory framework to guide the use of AI in the development of sustainable products is another challenge. This uncertainty can inhibit innovation and reduce the effectiveness of technology implementation in product development strategies.

In the rapidly evolving landscape of technology and environmental sustainability, the integration of Artificial Intelligence (AI) stands out as a beacon of hope and innovation. Table 2 delves into the intricate relationship between AI applications and their potential to foster sustainability across various sectors. It outlines the pivotal areas where AI contributes significantly to sustainable practices, including streamlining processes, understanding consumer preferences, and pioneering innovation in product design. Moreover, it addresses the inherent challenges that accompany these advancements, such as technology complexity, ethical concerns, and regulatory frameworks, while proposing strategic solutions to navigate these obstacles. This comprehensive overview serves as a roadmap for stakeholders aiming to harness AI's power to make substantial and meaningful progress towards a sustainable future.

Table 2. AI for Sustainability: Pathways and Challenges

Aspect	Description	Examples	Potential Impacts	Challenges	Strategies to Overcome Challenges
AI in Promoting Sustainability	Central idea of using AI to enhance sustainability efforts across various sectors.	- Smart energy grids - Precision agriculture	- Reduced environmental footprint - Enhanced resource efficiency	Lack of specific regulatory framework inhibits innovation and effectiveness.	- Develop international standards - Promote collaborative governance models
Streamlining Processes	AI applications optimize operations to reduce resource consumption, waste, and carbon emissions, contributing to environmental sustainability.	- Automated logistics - Energy-efficient manufacturing systems	- Significant reduction in emissions and waste - Cost savings through optimized resource use	Technology complexity and costs are barriers to adoption.	- Subsidies and financial incentives for green technology adoption - Training programs to build AI expertise in sustainability sectors
Understanding Consumer Preferences	AI tools analyze consumer data to help businesses develop products and services that align with sustainability values, driving market demand for green products.	- AI-powered market research tools - Consumer behavior analysis platforms	- Increased adoption of sustainable products - Shift in consumer behavior towards more sustainable practices	Requires careful data management to address ethical and privacy considerations.	- Implement strict data privacy measures - Transparent consumer data usage policies
Innovation in Product Design	Leveraging AI to explore new materials, designs, and processes that are both innovative and sustainable, reducing the environmental impact of products.	- AI in material science for sustainable materials discovery - AI-driven design for energy efficiency	- Development of groundbreaking sustainable products - Reduction in the use of harmful materials and energy consumption	Technology complexity and costs are barriers to adoption.	- Foster public-private partnerships for R&D in sustainable technologies - Encourage interdisciplinary research combining AI, design, and sustainability

Source: own processing

Table 2 illustrates how artificial intelligence (AI) can be mobilized to support sustainability in various sectors, presenting key areas of application, concrete examples, potential impacts, challenges encountered and proposed strategies to overcome these obstacles. It highlights innovative approaches through which AI can optimize processes, understand consumer preferences and innovate product design to reduce environmental footprint and promote responsible consumption. Despite challenges such as technological complexity, associated costs, ethical considerations and the lack of a specific regulatory framework, the table proposes strategies such as developing international standards, providing subsidies and financial incentives, implementing strict data protection measures and promoting public-private partnerships for research and development (R&D). These strategies are essential for overcoming existing barriers and fully exploiting the potential of AI in promoting sustainability.

Conclusions

In conclusion, the research carried out highlights the crucial role of technological innovation, especially artificial intelligence (AI), in redefining product development with a clear priority for sustainability. Thus, the research provides valuable insights for business leaders and product developers interested in integrating environmental and social responsibility considerations into the core of their innovation strategies. The intelligent implementation of AI-based solutions in the product development process can play a key role in promoting sustainable business practices and creating a long-term competitive advantage. This approach not only responds to the increased demand for sustainable products, but also contributes to global sustainable development goals, while strengthening the relationship between brands and their consumers.

The results obtained demonstrate that technological innovation, especially the application of AI, is essential for redefining product development in a way that prioritizes sustainability. The research therefore provides valuable insights for business leaders and product developers interested in integrating environmental and social responsibility considerations into their innovation strategies. Thus, in a context marked by rapid transformations and pressing ecological imperatives, this study emphasizes the importance of continuous adaptation and innovation to embrace the principles of sustainability and social responsibility in product development, providing a valuable contribution to the literature and practical guidelines for the industrial sector and policy makers.

References

Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., and Overy, P., 2016. Sustainability-oriented innovation: A systematic review. *International Journal of Management Reviews*, *18*(2), 180-205.

Bălu, F.O., Bălu, P.E., Burlacu, S., Diaconu, A., Badea, C.G., and Buzoianu, O.A.C., 2019. Governance of Innovation at European Level. *Proceedings of the 33rd IBIMA Conference, 10-11 April 2019, Granada, Spain.*

Bos-Brouwers, H.E.J., 2010. Corporate sustainability and innovation in SMEs: Evidence of themes and activities in practice. *Business strategy and the environment*, 19(7), 417-435.

Burlacu, S., Pargaru, I., Iacob, O.C., and Gombos, S.P., 2022. Digital Public Administration and the Perspectives of Sustainable Development in Romania. *European Journal of Sustainable Development*, 11(4), 230-230.

Ghoreishi, M., Treves, L., Teplov, R., and Pynnönen, M., 2023. The Impact of Artificial Intelligence on Circular Value Creation for Sustainable Development Goals. In *The Ethics of Artificial Intelligence for the Sustainable Development Goals*, pp. 347-363. Cham: Springer International Publishing.

Govindan, K., 2022. How artificial intelligence drives sustainable frugal innovation: A multitheoretical perspective. *IEEE Transactions on Engineering Management*.

Hermann, E., 2022. Leveraging artificial intelligence in marketing for social good — An ethical perspective. *Journal of Business Ethics*, 179(1), 43-61.

Ladaru, R.G., Burlacu, S., Guțu, C. and Platagea Gombos, S., 2022. Human resources management - labor crisis. In: *30 Years of Economic Reforms in the Republic of Moldova: Economic Progress via Innovation and Competitiveness, Vol II*. [online] Academy of Economic Studies of Moldova. pp.187–194. https://doi.org/10.53486/9789975155649.29.

Lazaretti, K., Giotto, O.T., Sehnem, S., and Bencke, F.F., 2019. Building sustainability and innovation in organizations. *Benchmarking: An International Journal*, 27(7), 2166-2188.

Maier, D., Maier, A., Aşchilean, I., Anastasiu, L., and Gavriş, O., 2020. The relationship between innovation and sustainability: A bibliometric review of the literature. *Sustainability*, 12(10), 4083.

Rădulescu, C.V., Mănescu, C.O., Popescu, M.L., and Burlacu, S., 2023. Sustainable Development in Public Administration: Research, Practice, and Education. *European Journal of Sustainable Development*, 12(4), 27-27.

Schilirò, D., 2019. Sustainability, innovation, and efficiency: A key relationship. *Financing Sustainable Development: Key Challenges and Prospects*, 83-102.