The Impact of Artificial Intelligence on Environmental Challenges Embedded in Macromarketing Strategies

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Abstract

Artificial intelligence brings numerous benefits if implemented effectively in macro-marketing strategies, innovatively addressing contemporary environmental challenges. The role of artificial intelligence in global campaigns is complex, manifesting its importance from optimizing resources, predicting consumer behavior to supporting informed decisions. Technological advancements and artificial intelligence are driving major changes to the way businesses operate. In the context of globalization, both marketing and markets are taking on a new shape, directly influencing competition and the way business strategies are developed, including those related to sustainability. Optimization, predictive analytics, modeling and simulation are artificial intelligence techniques that are extremely important in the conduct of macromarketing. Environmental challenges are among the most pressing issues facing modern society, so rapid and innovative solutions are needed.

Keywords: *macromarketing, environmental challenges, artificial intelligence (AI)*

JEL classification: M30, M31

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1. Introduction

Artificial Intelligence (AI) is considered to be a factor of great importance in the evolution of modern technologies, with a significant impact in various economic and social domains. However, with the technological expansion the problems related to sustainability and environmental challenges need an optimal solution. Thus, the integration of artificial intelligence into macromarketing strategies should provide opportunities to manage these challenges more effectively.

Sustainability is a pressing issue that is the subject of considerable reflection within the field of macromarketing. Macromarketing has consistently

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addressed marketing and environmental issues for nearly four decades, from Fisk's (1974) work on marketing and the environment and considerations of socially responsible consumption (Antil 1984; Leigh, Murphy & Enis 1988), to the issue of environmentalism as a macro-priority for market organization and market actors (Dobscha and Ozanne 2001; Kilbourne, McDonagh & Prothero 1997; Kilbourne & Mittelstaedt 2012; Prothero et al. 2011; Shultz and Holbrook 1999) and the role of sustainability in marketing functions (Arvidsson, 2008; Kilbourne, 2004; McDonagh, Dobscha & Prothero 2012; Prothero, McDonagh & Dobscha 2010). Sustainability is currently a highly debated topic, and it needs to be integrated into the strategy of any organization that wishes to remain competitive in a changing market.

Thus, environmental challenges such as climate change, pollution and depletion of natural resources need to be properly integrated into companies' marketing and production processes. Moreover, customers have become increasingly informed and awareness of the environmental impact of business activities is driving consumers to adjust their preferences according to their sustainability values. The fundamental challenges of sustainability are consumption problems (Stern, 2000), in other words they are largely caused by unsustainable consumption practices. Bearing in mind that macromarketing analyzes the interplay between economic systems, societies and the environment there is a need for an innovative approach to marketing strategies that propose solutions to stimulate sustainable consumption (Minculete et al, 2014).

Macromarketing is about process and consequences, macromarketing is about market matching or equalizing supply and demand through sustainable market transactions. In the context of macromarketing, the organization of current supply and demand equalization issues is embedded mainly in the studies of macromarketing historians, researchers concerned with competition and markets, and those interested in marketing and development (Fisk, 2006). Moreover, globalization has contributed to the expansion of international trade, increased global production and consumption, and increased environmental impacts. One of the unintended effects of globalization is massive pollution as supply chains have become longer and more complex.

Under these circumstances, if artificial intelligence and innovative technologies are properly integrated into macromarketing strategies, companies can optimize global supply chains to reduce environmental impact, which is essential in the context of globalization (Sisu, J. A., et al, 2024). Kotler (2002) suggested that globalization and the electronic revolution are two major challenges facing business today. Beck (2001) argued that globalization is not a choice that firms make and that it is an imperative of incipient cosmopolitan capital.

Pieterse (1995) has argued that we should consider globalization in the plural because the process unfolds simultaneously in multiple dimensions. Thus, we may miss the essential character of the process if our selection of 'facts' is too narrow (Veseth, 1998). Beck (2000) presented three different forms of the word global. He distinguishes between globality (a world state or condition), globalism

(a political characterization), and globalization (a process that is taking place). Globalization as used here refers to the process by which nation states become more economically, financially, and culturally integrated through the economic actions of transnational actors (Dicken 1998; Jones 2000).

Macromarketing analyzes economic interactions on a global scale, so strategies need to take into account various socio-economic, cultural and environmental factors that vary from region to region. In this context the integration of artificial intelligence tools helps companies to navigate this complex environment, providing solutions to understand and manage supply and demand in international markets. Environmental challenges need to be analyzed on a global scale, from climate change and pollution to resource depletion. Artificial intelligence has an important role to play in creating global technological solutions, and is often used to monitor and optimize resource consumption globally, thus promoting more effective collaboration on sustainability.

Investigating the impact of artificial intelligence on environmental challenges embedded in macromarketing strategies is necessary to gain an overview of the existing literature, highlighting the points of interest of researchers over time, as well as areas in need of expansion. Keeping in mind that technology is constantly evolving, environmental challenges are increasing, so it is essential to understand how AI can be used in a way that simultaneously supports economic efficiency and environmental sustainability, providing innovative solutions to global challenges. This study provides a unique integration of three domains: artificial intelligence, environmental challenges (sustainability) and macromarketing. Currently, there are numerous studies on sustainability and artificial intelligence, but macromarketing is under-researched.

The synergy between these three areas is currently insufficiently explored. The present research is based on VOSviewer data processing, making a valuable contribution to understanding the evolution of the literature on the topic of integrating artificial intelligence into macromarketing strategies. Moreover, the bibliometric map highlights key concepts (AI, sustainability, macromarketing) and how these concepts are addressed in the literature. In addition, the bibliometric map in this study highlights emerging research directions, demonstrating new connections between AI, marketing and sustainability that have not been previously explored.

2. Literature review

Humankind faces a myriad of existential environmental challenges, including: resource depletion, deterioration of ecosystem services, pollution, biodiversity loss and climate change (Martin, Maris and Simberloff, 2016). Environmental problems are the result of complex, often non-linear, interactions between humans and the environment, and our understanding of them is usually incomplete and marked by uncertainties (Underdal, 2010). These problems cannot be managed solely in terms of cause-effect relationships, as they involve multiple

actors and vary in time and space, often with very large time lags between human action and environmental effects (Voulvoulis, 2012).

Because of their complexity, these problems are often not well communicated and are frequently misunderstood by the public, the press and politicians (Renn, 2005). AI is a rapidly developing technology, aiming to make life easier for individuals, increase their standard of living, and open new horizons for humanity (Șen, 2018). Technological advances frequently lead to structural changes in business paradigms, as is the case with AI in marketing (Kumar, Rajan, Venkatesan & Lecinski, 2019).

Thus, artificial intelligence is having a profound impact on the way businesses operate, leading to a reconfiguration of marketing paradigms and strategies used by companies. By redefining the structure of organizations, AI provides automated and predictive solutions that enable companies to be more efficient and competitive in an increasingly complex and dynamic global environment. Moreover, AI is transforming the structure of global markets, generating new ways to connect supply and demand and address environmental challenges.

Advances in AI are enabling companies to remain competitive in increasingly data-driven marketing landscapes (Nunan & Di Domenico, 2013), so many companies have invested in innovative technologies to facilitate various marketing-related tasks such as chatbots, customer experience optimization, customer research and content creation, customer relationship management, image recognition, search engine optimization, personalization, profiling, and strategic planning (Haenlein & Kaplan, 2019).

Given that artificial intelligence has a constitutive relationship with big data (Brynjolfsson & McAfee, 2017), data-driven, self-learning algorithms open up new possibilities for harvesting, classifying, organizing, storing, and retrieving big data generated in organizations, including data that was previously considered cumbersome and difficult to analyze (Paschen, Wilson & Ferreira, 2020). Automating processes with AI provides additional opportunities for performance and productivity improvement (Huang & Rust, 2018). Thus, the integration of artificial intelligence into macromarketing strategies is supported by the numerous opportunities it offers.

Hunt (1977) suggested that macromarketing refers to the study of (a) marketing systems, (b) the impact and consequences of marketing systems on society, and (c) the impact and consequences of society on marketing systems. Hunt (1981) took up this view and noted that it (1) allows for different levels of aggregation, (2) includes work on social responsibility and economic development, and (3) considers the impact of different legal, political and social value systems. As sustainability becomes a megatrend for business, just as quality and information technology have become megatrends for business, macromarketing thinking may become more prevalent.

Soleimani (2018) points out that AI techniques can be implemented through (1) optimization, (2) prediction, (3) modeling and simulation, and (4)

decision support. At the macromarketing level, the optimization provided by AI aims at streamlining economic and logistical processes on a large scale, leading to the reduction of excessive consumption of resources and the reduction of waste. Prediction integrated into macromarketing strategies makes it possible to anticipate consumption trends and fluctuations in global markets. Predictive analytics based on big data can be used to predict demand in different regions, identifying consumption trends that are likely to occur in certain economic or climatic contexts.

In terms of sustainability, AI predictions allow companies to adjust their production to avoid over-consumption of natural resources, thus reducing pressures on the environment. Through modeling and simulation in the context of artificial intelligence, different economic and marketing scenarios can be tested before formulating appropriate strategies and implementing optimal solutions. Using AI, the integration of green strategy, aiming to transition to renewable energy or reduce the carbon footprint in different industries can be simulated. With the decision support provided by AI, managers can make informed decisions based on real-time data analysis, contributing to better resource management and efficient budget allocation. Recommendations for environmental decisions can be integrated to reduce pollution or adopt greener production practices.

Meade and Nason (1991) argue that macromarketing is developed as a study of the complex coordination and control processes underlying the growth, evolution and design of exchange systems. In an analysis of market development, Klein and Nason (2000) identified the structural and functional elements of a marketing system as including (1) distribution methods, (2) channel structure, (3) available products and services, (4) advertising and various marketing information, and (5) pricing methods and policies. Wilkie and Moore (1999) discussed the aggregate marketing system of a society, noting that marketing is highly adaptable to cultural and political contexts, but by traveling around the world one can find societies with very different marketing systems.

Dixon (2002), in a detailed historical analysis of the origins of macromarketing, stated that society is structured by social institutions, and the nature of the market and the role it plays are interconnected with other institutions. Macromarketing is the study of these interactions. The initial impetus in the development of macromarketing was the expansion of the research agenda beyond the narrow managerial orientation of traditional micromarketing. This orientation is reflected in Fisk's (1981) call for research examining the consequences of marketing for the wider systems of which marketing is a part. Fisk was particularly concerned with the social and environmental consequences of marketing activities. Further development can be traced back to Nason and White (1981), who examined Slater's (1968) macromarketing perspective, which articulates how marketing processes can be modified to achieve different social effects. A review of the literature on globalization and development in macromarketing shows that Slater's perspective has been substantially adopted. In the last twenty years, there has been a large body of work on the relationship between market processes and societal development.

One of the positive effects of societal development is the emergence of innovative technologies and artificial intelligence. AI has the ability to optimize

processes and improve customer interaction. Moreover, it is redefining the way companies approach the complex challenges of the global market. All these transformations integrated into a broad concept, macromarketing, address the long-term effects of marketing activities on society and the environment. The integration of artificial intelligence into macromarketing strategies is not just an opportunity, but becomes an essential step towards sustainability. There is a synergy between artificial intelligence and macromarketing, providing an innovative paradigm for business (Năstase, M., 2010) that has the dual role of optimizing financial results and helping to create a sustainable future.

3. Methodology and stages of research

In an ever-changing economy it is very important to explore and adopt those technological solutions that can address society's environmental needs and promote the well-being of communities. Through this research we aim to analyze the impact of artificial intelligence on environmental challenges integrated into macromarketing strategies. An analysis in this area can provide valuable insights for strategic decision-making. Artificial intelligence has the ability to analyze large amounts of data, providing valuable insights into the environmental impacts of different marketing strategies. By using artificial intelligence, companies can make more informed decisions that are based on detailed and predictive analytics, as well as simulations that highlight effective ways to address environmental challenges. By analyzing the literature we aim to provide a clear framework for understanding how artificial intelligence can influence environmental challenges in macromarketing strategies. At the same time, this research can provide a solid basis for the development of innovative and responsible marketing strategies that contribute to a sustainable future. In this context, the central research question is: What are the implications of artificial intelligence on environmental challenges embedded in macromarketing strategies?

To carry out this research we utilized the Web of Science platform, thus, we collected scientific articles in a database, which we subsequently processed with the VOSviewer software. The keywords used to design the bibliometric map are: macromarketing, environmental challenges, artificial intelligence (AI). We obtained 2372 articles referring to the keywords and the connections between them and other relevant topics (Figure 1).

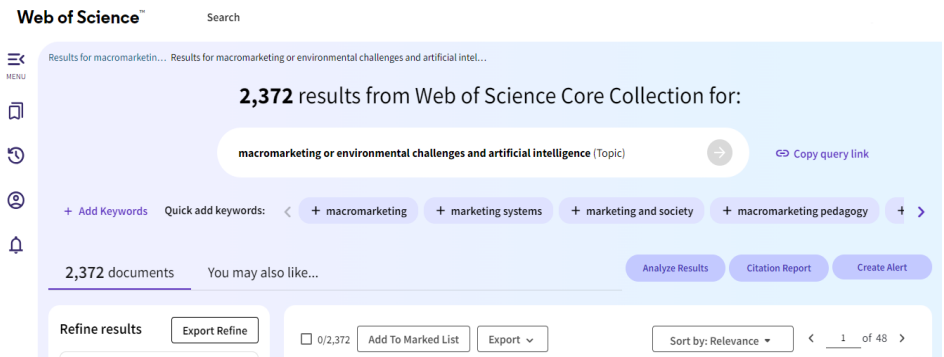

Figure 1. Web of Science scientific publications database filtering results

Source: print screen Web of Science

In the table below we have presented the evolution of the number of specialized articles, thus we observe that since 2022 the interest of specialists in studying the role of artificial intelligence has greatly increased. Rapid developments in the field of AI, including machine learning, big data analytics, and natural language processing, have created new opportunities for the application of these technologies in macromarketing strategies. The rapid growth in the number of AI-related academic publications is justified by the important role attributed to artificial intelligence worldwide. The table below shows the number of publications by year of publication.

Filtering results of the Web of Science scientific publications database, distribution over the period 1980-2024

Table 1

Publication Years	Count	Publication Years	Count
2024	573	**2007**	5
2023	487	**2006**	4
2022	322	**2005**	12
2021	226	**2004**	1
2020	189	**2003**	2
2019	114	**2002**	5
2018	50	**2000**	1
2017	53	**1999**	2
2016	55	**1998**	2
2015	49	**1997**	1
2014	47	**1996**	3
2013	33	**1995**	2
2012	37	**1994**	1
2011	25	**1992**	9
2010	16	**1989**	2
2009	21	**1985**	1
2008	21	**1980**	1

Source: own processing based on data from Web of Science

For the present research we loaded the database of publications selected by the above keywords into VOSviewer, version 1.6.19 in RIS format. We created a bibliometric map in which keywords are grouped into distinctly colored clusters. This map highlights the links between important concepts such as: macromarketing, environmental challenges and artificial intelligence (AI). The size of the words and nodes on the map indicate the relevance of the identified key concepts. More prominent words appear more often in the authors' research, and the smaller distance between them signifies a stronger connection. The curved line joining two words indicates that they appear together in an article, thus representing the link between the two key concepts. The thick lines connecting the

keywords indicate strong connections and significant relationships between the concepts discussed in the analyzed publications. Keywords located further away from each other have a weaker connection, while closer words indicate a stronger connection. Both line thickness and color intensity signal how frequently two keywords appear together in a publication.

4. Bibliometric research results

We entered the data into the VOSviewer software and generated the Network Visualization map. This graphically illustrates the links between the keywords found in the analyzed publications. The Network Visualization map provides an overview of the keywords in the selected database, facilitating an objective analysis of the scientific data. Three clusters were identified in this research. Clusters represent groups of words clustered around common topics or themes (Figure 2).

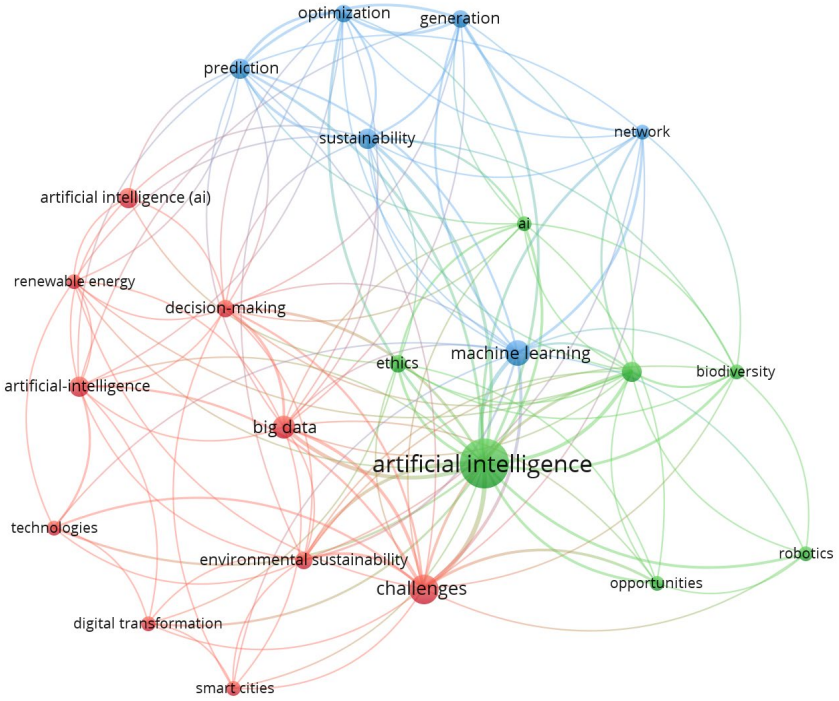

Figure 2. Network visualization
Source: output soft VOSviewer version 1.6.19

In the above figure we observe three different clusters, the first cluster is red, the second green and the third blue. In the first cluster the largest nodes are represented by the keywords: *big data, challenges, decision-making, environmental sustainability.* In the second cluster we notice: *artificial intelligence, biodiversity,*

ethics, management. In the third cluster we observe the following words with a higher frequency of occurrence: *generation, machine learning, optimization, prediction.*

The following figure shows the overlapping of the publication network. The colors blue, green and yellow explain the frequency of occurrence of the keywords in the articles of the formed publication base. The color blue signifies a lower score, thus a low number of keyword occurrences in the articles, green indicates an average occurrence, and yellow is used for high frequency occurrences. This is also confirmed in Table 1, which shows that from 2022 the number of publications in the research area started to increase.

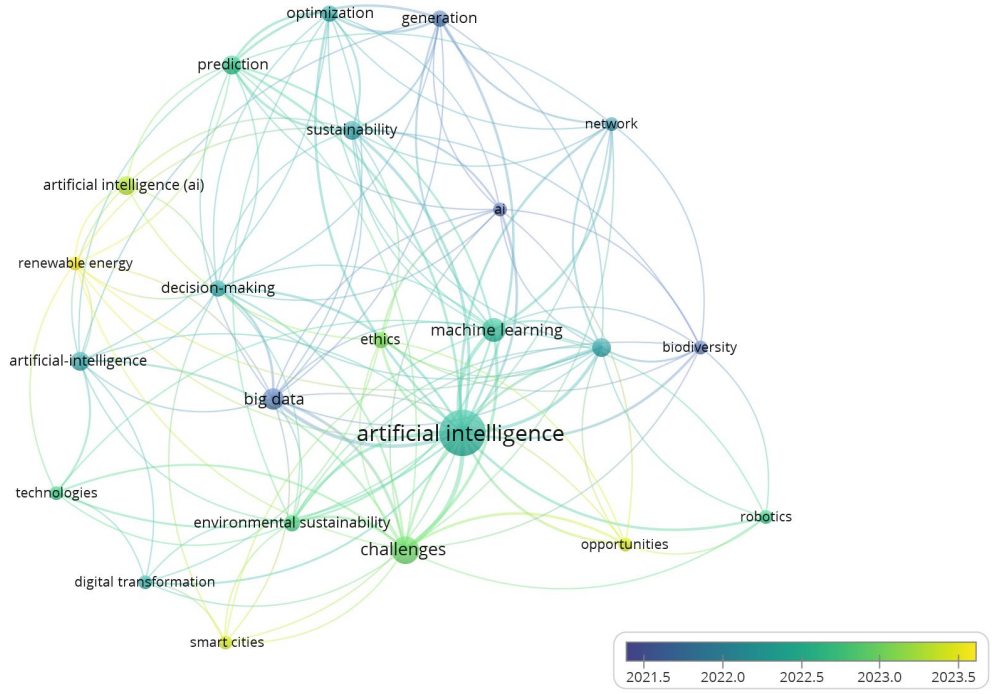

Figure 3. Overlay visualization
Source: VOSviewer software output version 1.6.19

We evaluated the density of publications both by visualizing the item density and by visualizing the cluster density. This density is indicated by three colors: blue, green and yellow. The color blue reflects low density, green indicates medium density and yellow represents high density. If the keyword is represented by a yellow node then the density of articles around that concept is higher. Article density indicates the authors' interest in a particular research topic. If the keyword is represented by a blue node then the density of articles around that topic is lower. In the figure below, it can be seen that the highest densities are around the terms: *artificial intelligence, challenges, big data ethics, management, machine learning, sustainability.*

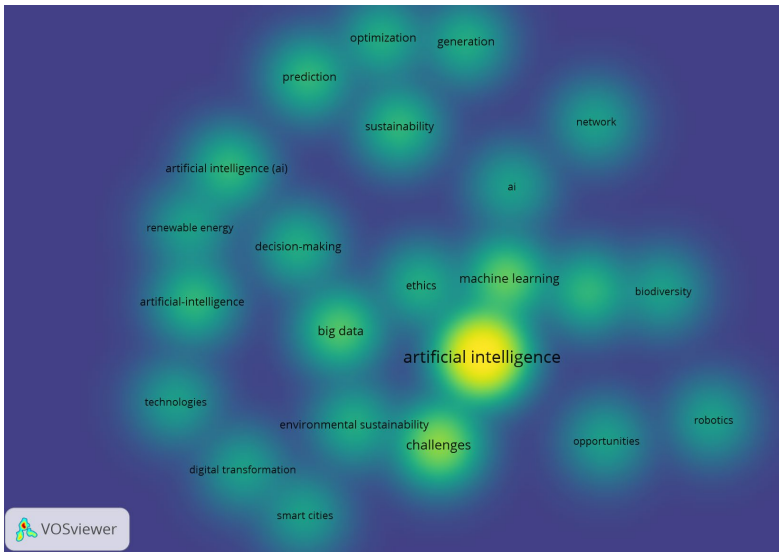

Figure 4. Item density visualization
Source: VOSviewer software output version 1.6.19

All keywords have been organized in clusters, allowing visualization of the density of each cluster. The individual representation of each cluster highlights the frequency of occurrence and their links between different publications. The figure below shows that each cluster contains a keyword with a high weight: *challenges* (cluster 1 - red), *artificial intelligence* (cluster 2 - green), *machine learning* (cluster 3 - blue).

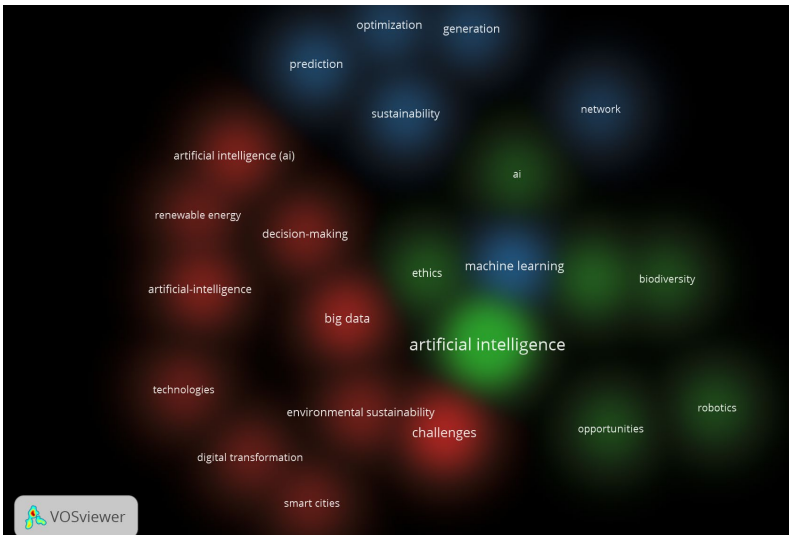

Figure 5. Density visualization cluster
Source: output soft VOSviewer version 1.6.19

After entering selected items from the Web of Science database into VOSviewer, the key items were organized into distinct clusters. Key concepts within a cluster are conceptually similar. Thus, keywords are interconnected by common research topics, domain-specific terminology and semantic associations. By grouping them into the same cluster, it is possible to identify characteristics or links that make them relevant in a specific research context. Below we have presented each cluster and its characteristic keywords. Table 2 shows **cluster 1,** we observe a very strong link between *challenges, big data, decision-making and environmental sustainability.*

Cluster 1 (red)

Table 2

Keyword	Cluster	Links	Total link strength	Occurrences
artificial intelligence (ai)	1	6	6	5
artificial-intelligence		12	14	5
big data		15	25	7
challenges		18	41	11
decision-making		15	20	4
digital transformation		7	8	3
environmental sustainability		13	19	4
renewable energy		10	10	3
smart cities		7	7	3
technologies		7	10	3

Source: own processing based on data from VOSviewer software version 1.6.19

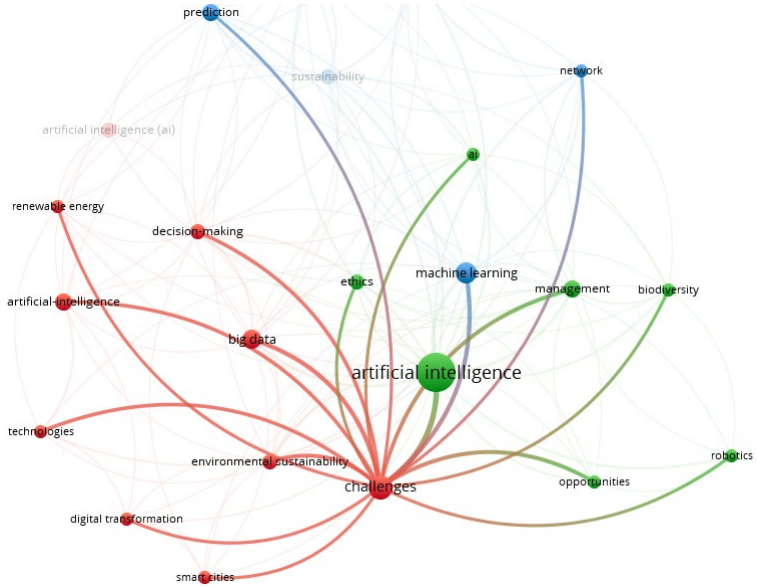

Figure 6. Cluster 1 (red)

Source: output soft VOSviewer version 1.6.19

The first cluster indicates the interconnectedness between artificial intelligence, big data, challenges, decision making, digital transformation, digital transformation, environmental sustainability, renewable energy, smart cities and technologies. All these concepts point to the importance of advanced technologies in addressing environmental and social issues, providing a solid basis for developing sustainable and innovative strategies. Moreover, by integrating artificial intelligence globally, more informed and effective decisions can be made, contributing to a greener and more sustainable future.

Taking into account social and environmental challenges, the use of artificial intelligence, big data and digital technologies, marketing strategies can be optimized, helping to build a more sustainable and responsible society. Artificial intelligence plays an important role in macromarketing as it provides effective tools for analyzing and anticipating consumer behavior. By using big data marketers can better understand consumer preferences and behaviors, facilitating the process of setting marketing strategies across the board.

Macromarketing strategies need to focus on social and environmental challenges, but addressing these challenges requires a proactive approach. Macromarketing strategies address environmental challenges in order to develop a more sustainable and equitable society. Furthermore, macromarketing includes the promotion of environmental sustainability as part of corporate social responsibility.

The promotion of renewable energy is also an essential component of macromarketing, given the current challenges of climate change. The concept of smart cities aligns with macromarketing principles as it involves the integration of advanced technologies to create more sustainable urban environments. **In Cluster 2** presented in Table 3 we observe that *artificial intelligence* is at the center of the analyzed publications

Cluster 2 (green)

Table 3

Keyword	Cluster	Links	Total link strength	Occurrences
ai	2	12	16	3
artificial intelligence		21	72	30
biodiversity		10	13	3
ethics		9	12	4
management		15	24	5
opportunities		7	11	3
robotics		6	8	3

Source: own processing based on data from VOSviewer software version 1.6.19

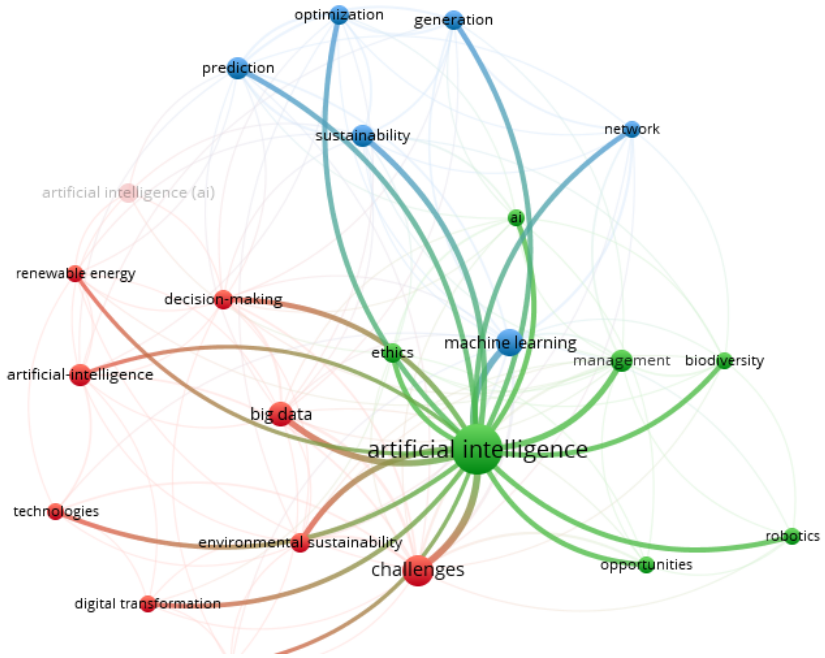

Figure 7. Cluster 2 (green)
Source: output soft VOSviewer version 1.6.19

The strong link between artificial intelligence and biodiversity, ethics, management, opportunities and robotics, indicates the strong interest of researchers in studying how emerging technologies can contribute to solving critical global challenges such as pollution and environmental degradation. Innovative technologies offer significant opportunities as they promote sustainable and ethical solutions that respond effectively to consumer and societal demands. Artificial intelligence and robotics can be used responsibly by large companies to promote environmental conservation and create a more sustainable future. On a global scale artificial intelligence is seen as a very powerful tool that can be used to monitor and protect biodiversity. In the context of macromarketing, artificial intelligence can contribute to biodiversity conservation and to building a responsible and sustainable brand image. Companies need to be transparent about their use of artificial intelligence, adhere to high ethical standards to maintain their credibility and respond promptly to consumer demands for social responsibility. The integration of robotics into macromarketing strategies can significantly change the way natural resource and ecosystem management is conducted. Both artificial intelligence and robotics offer major opportunities in various sectors, including biodiversity conservation and the creation of new sustainable business models.

Moreover, artificial intelligence can be integrated into more effective monitoring of ecological processes, sustainable resource management, so that decisions become more informed. Integrated digital technologies in the context of macromarketing are extremely important as companies can improve their

reputation and respond to environmental demands, thus gaining significant competitive advantages. Innovation opportunities in macromarketing relate to the development of technological solutions to help protect biodiversity, thereby promoting sustainable products and services. **Cluster 3,** presented in Table 4, focuses on the key term: *machine learning.* It is closely related to generation, networking, optimization, prediction and sustainability. We observe the interconnectivity between innovative technologies and sustainability in the context of macromarketing.

Cluster 3 (blue)

Table 4

Keyword	Cluster	Links	Total link strength	Occurrences
generation	3	11	20	4
machine learning		15	30	8
network		10	16	3
optimization		11	18	4
prediction		13	22	5
sustainability		14	22	5

Source: own processing based on data from VOSviewer software version 1.6.19

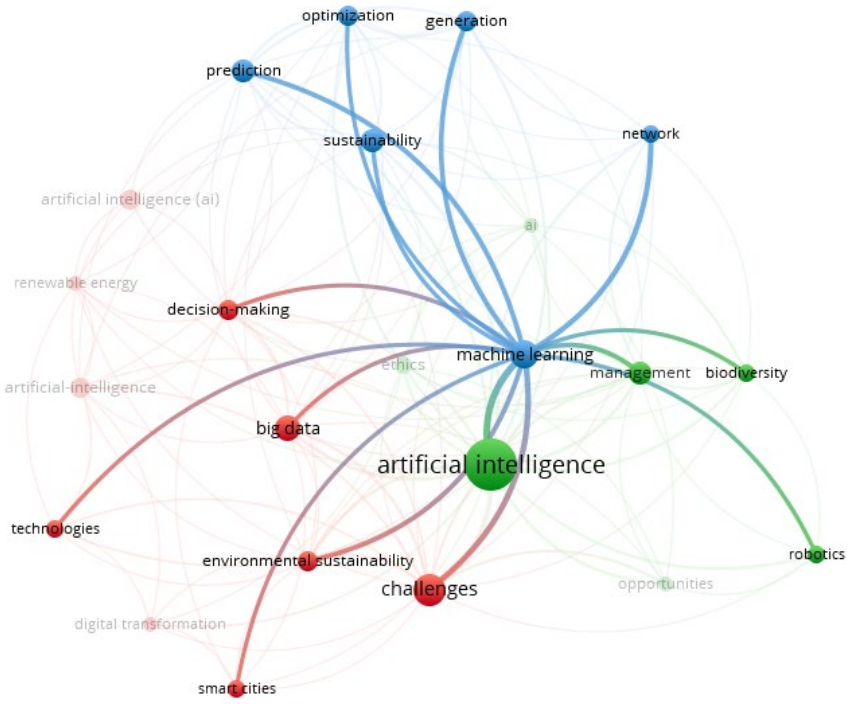

Figure 8. Cluster 3 (blue)

Source: output soft VOSviewer version 1.6.19

By integrating machine learning, companies can benefit from innovative tools to optimize processes and predict consumer behavior. Machine learning also enables companies to generate innovative solutions that directly contribute to promoting sustainability. By integrating innovative technologies, large companies and beyond have the opportunity to improve their marketing performance, while contributing to protecting the environment and creating a more environmentally responsible society. Machine learning is an important branch of artificial intelligence that ensures that performance is enhanced based on experience. At the macromarketing level, machine learning enables the identification and anticipation of consumer trends, the optimization of marketing processes and the development of sustainable products and services.

Through machine learning, companies can more easily identify consumers' consumption behaviors and use the information obtained to develop effective marketing strategies tailored to market needs. Another key aspect of machine learning is content or idea generation. Personalized recommendations can be generated for consumers, creating automated content. All these aspects can contribute to innovation in creating sustainable products. In the context of macromarketing, innovative digital technologies enable companies to create scalable and personalized marketing campaigns tailored to the perferences of the target audience, promoting green products and sustainable solutions. Using advanced networks marketers can build predictive models to help better understand market dynamics and the impact of marketing actions on the environment. Moreover, optimization in the context of macromarketing is extremely important as it contributes to sustainability by reducing excessive consumption of resources and waste generated in production and distribution processes. In modern marketing sustainability has become a central concern and machine learning can provide solutions to make marketing practices more sustainable. In the context of macromarketing, artificial intelligence helps to promote sustainable products by providing consumers with clear information about the environmental impact of their choices and educating them about the benefits of sustainable products.

5. Conclusions

Artificial intelligence has become a very effective tool to address environmental challenges in the digital age. Machine learning and robotics are advanced technologies that enable companies to optimize their processes to contribute to environmental sustainability and the development of smart cities. Moreover, the integration of artificial intelligence within organizations can improve decision-making in the context of environmental challenges, generating opportunities for sustainability.

Artificial Intelligence (AI) is one of the fastest growing fields in recent years. Environmental challenges, ranging from climate change, natural resource depletion to biodiversity loss, require an innovative and proactive approach. Under

these conditions, macromarketing has an important role to play in influencing consumer behavior and companies' management decisions.

Artificial intelligence can be used to manage renewable energy grids more efficiently, facilitating the integration of sustainable energy sources into smart cities. Integrating innovative technologies also facilitates the monitoring and protection of biodiversity.

Companies must therefore take all these aspects into account and integrate artificial intelligence to optimize processes. Marketing must become more efficient and greener. Integrating artificial intelligence into macromarketing strategies is an innovative way to respond to global environmental challenges. Artificial intelligence tools if used effectively contribute to building a more sustainable economy as they facilitate process optimization, big data analytics, improve energy efficiency and promote more responsible consumption. However, the integration of artificial intelligence needs to be guided by ethical principles, striking a balance between innovation and environmental protection. Artificial intelligence must transform the future of marketing considering both its efficiency and its ability to support a greener and more responsible future.

Through this research the bibliometric map has highlighted a number of keywords: artificial intelligence, big data, challenges, decision making, digital transformation, digital transformation, environmental sustainability, renewable energy, smart cities, technologies, biodiversity, ethics, management, opportunities, robotics, machine learning, networking, optimization, prediction and sustainability. This bibliometric map highlights that research themes have not been sufficiently explored. However, we have identified that there is a link between artificial intelligence, environmental challenges and sustainability in the literature, which are part of macromarketing strategies. In the present research, the bibliometric map allows us to assess the degree of documentation in the researched areas, highlighting the links between different topics, themes and approaches. This research is interdisciplinary in that it addresses topics such as marketing, AI and environmental challenges, bringing an original perspective on the connections between the domains. The novelty of the study is that it addresses the link between advanced technologies and macromarketing strategies, providing a holistic approach to environmental sustainability. Another novel element is the exploration of how these new technologies are fundamentally changing the way companies construct their marketing strategies.

The research results indicate the keywords that appear most frequently in the literature, providing an overview of the field of artificial intelligence and macromarketing strategies. The resulting clusters indicate the strong link between artificial intelligence, sustainability, environmental challenges and optimization, all of which need to be integrated into macromarketing strategies. Moreover, the bibliometric map shows the evolution of research over time, providing insights into how interest in sustainable technologies and artificial intelligence has grown in recent years. This highlights that the topics discussed are topical and relevant to global environmental issues.

The results of this research can be a practical guide for managers and practitioners alike to understand which technologies are having the greatest impact in their field or research directions. Moreover, managers could gain a better understanding of current trends in the use of artificial intelligence for green and sustainable marketing solutions. The clusters in this research point to strong links between key concepts such as digital transformation, renewable energy, ethics and strategic macromarketing decisions. All of these apects contribute to the development of a clear theoretical framework for understanding how AI influences macromarketing strategies in the context of environmental challenges.

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