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The Intersection of AI and Sustainability in Business Management: An Overview

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Abstract: *Artificial Intelligence (AI) has emerged as a cutting-edge technology that has the potential to revolutionize industries and societies on a global scale. AI offers a distinctive opportunity to confront the managerial obstacles associated with sustainability in the context of Sustainable Development (SD). In the management context, this study investigates the relationship between AI and SD, emphasizing the potential of AI to contribute to SD through a variety of applications. The research provides a bibliometric literature review of scientific publications on AI and SD, identifying critical areas in which AI can make a substantial contribution to the attainment of sustainability in business management.. Some of these areas are sustainable agriculture, computer sciences, economy and business management, and decision-making processes. The ethical considerations and challenges associated with the use of AI in business management literature in the context of SD were also addressed. Furthermore, the paper discusses the potential impact of AI on management practices and decision-making, with a particular emphasis on the implementation of AI strategies and the implementation of AI-based solutions to enhance environmental performance. This article has proposed and discussed the potential of AI to be integrated into management practices to facilitate SD and assist organizations in achieving their strategic objectives. Additionally, the research contributes to the ongoing discussion regarding the function of AI and SD in management. The study concludes by advocating for additional research and collaboration among a variety of stakeholders to optimize the potential of AI in SD.*

Keywords: Artificial Intelligence, Sustainable Development, Business Management

I. INTRODUCTION

AI is an engineering field that aims to construct computers with human intellect and behavior [1,2]. Current management research focuses on creating work models that use AI solutions instead of human labor [3,4], making them simpler and less stressful [5,6]. AI is any software technology that can perceive (audio, visual, textual, and tactile (face recognition) [7,8], decide (especially in medical diagnosis systems) [9,10], predict (weather forecast) [11,12], automatically extract and recognize patterns from data (discovery of fake news circles in social media), interact (social robots or chatbots), and reason logically. This approach includes several subfields, including machine learning [13,14]. Recent business management research on AI and SD is connected to environmental risk management and human resource management [15,16]. This approach covers broad organizational management procedures.

AI may help generate advantages or solve managing challenges at many levels of management [17]. AI has the ability to revolutionize businesses and society [18]. Rapid advances in AI have led to sophisticated algorithms and intelligent systems that can learn and adapt to complicated data sets [19], making AI an appealing alternative for many companies looking to enhance operations and bottom lines [19,20]. Business difficulties are becoming more complicated [21,22]. They accelerate data growth, driving firms to respond quicker and optimize decision routes. Digitization and AI are needed as management uses more digital technologies [23]. Management applies AI in modern technical tools to automate, optimize, and expand solution capabilities. AI optimises tasks and replaces repetitious human activities with more efficient technology in a globalising society [24]. This approach optimizes tasks, improving work quality, performance, resource management, customer analysis, and personalization [18,25]. Now, generative AI algorithms and cost efficiency are the most important aspects of AI. AI-embedded technologies in management assist simplified

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procedures and operations as well as complex analytics and large data. AI may be used for R&D, tool and process creation, or buying ready-to-use solutions.

This study examines AI and SD in management and emphasize AI's potential to help to sustainable development via diverse applications. The study addresses two RQs:

RQ1: How is AI in management research heading to enhance SD?

RQ2: Which sectors do AI support management SD goals?

AI is anticipated to bring new chances to help SD-focused management in this essay. This research examines scholarly literature-described SD methodologies and circumstances for AI-management integration. AI's ability to improve speed, efficiency, productivity, and creativity across industries offers a unique opportunity to accelerate SD advancement [26,27]. Given firms' low SD achievements, AI may be a new technology that will greatly aid SD. Thus, AI's huge potential creates new managerial views and significant problems [28]. New AI-based solutions using competitive algorithms are needed for sustained development [14,19]. AI is a new technology that is already influencing company rivalry, and it may provide SD implementation opportunities [22].

A bibliometric literature study of AI and SD research papers focuses on AI's ability to help business management attain SD. AI may improve resource allocation in sustainable agriculture, economics and management, computer science, and production and environmental decision-making, according to the assessment. Thus, this report identifies literature patterns and trends, research gaps, and novel research fields. The report also tackles SD AI difficulties and ethics. The study also discusses how AI strategy and AI-based solutions affect management practices. Finally, this research adds to the SD conversation by emphasizing AI's potential to help management achieve SD. The report indicates that stakeholders must collaborate and investigate AI in SD to realize its potential.

The purpose and two research questions above guide the article's construction. Article organization follows. This study's introduction states its purpose and research questions. Justification exists for the research issue. This study's techniques are described in the second part. The final component presents bibliometric literature review findings as maps and descriptions. Discussion of findings and selection of future study topics follows.

Method

This study relies on bibliometric literature review [11,29]. Query syntax is used to examine the Scopus scientific database [30] and find keywords-specified areas of AI and SD in business management [31]. This work uses the bibliometric review approach to identify knowledge gaps [30] and research directions based on bibliographic database data [25,29,32]. This article scanned the whole Scopus database but limited it to 1995–2022, as shown in Figure 1, and topic area (Table 1). This analysis examines Scopus metadata of scientific publications [11,33]. This database was chosen for its scholarly reputation and greater content collection. Bibliometric visualization tool program examined Scopus database bibliometric records. This approach produces bibliometric maps using VOSviewer (version 1.6.18). This study uses bibliometric analysis to visualize query terms as a network [34]. Table 1 lists two queries from this approach. The searches have a syntax that matches the database and provide variable quantities of results [35] based on circumstances (Table 1). The Scopus website's “analyze search results” function was used to evaluate Q1 online [35].

Table 1. Syntaxes used in Queries after calibration for the Scopus scientific database exploration of AI and SD concepts.

Symbol	Query syntax	No. Results
Q1	TITLE-ABS-KEY ("artificial intelligence" AND "sustainable development")	3301
Q2	TITLE-ABS-KEY ("artificial intelligence" AND "sustainable development") AND (EXCLUDE (PUBYEAR , 2023)) AND (LIMIT-TO (SUBJAREA , "BUSI")	391

Source: Authors’ elaboration.

Because Scopus was not filtered by publication type, years, or category, presented searches do not vary [11]. Each time, query results were downloaded as.csv files and all publishing fields were marked during export. Further analyses were performed in VOSviewer and bibliometric maps were created [36]. The queries were proposed to answer two RQs from the Introduction, indicate the current direction of research on applying AI in management to improve SD, and define fields where AI supports organization managers' sustainability goals.

The study is limited by the quantity of co-occurrences, which affects its graphical presentation and bibliometric map clarity [4]. The bibliometric map required 10 keyword co-occurrences per figure. In this research, VOSviewer indicated scientific development directions for AI and SD connections.

Results

This research investigated 3301 Q1 and 391 Q2 papers and publications from 1995 to 2022. Because Q2 data could be evaluated more thoroughly, only complete bibliometric analysis of 391 results was done. The study excluded 2023 owing of current publications. Scopus provided the above searches' articles and publications.

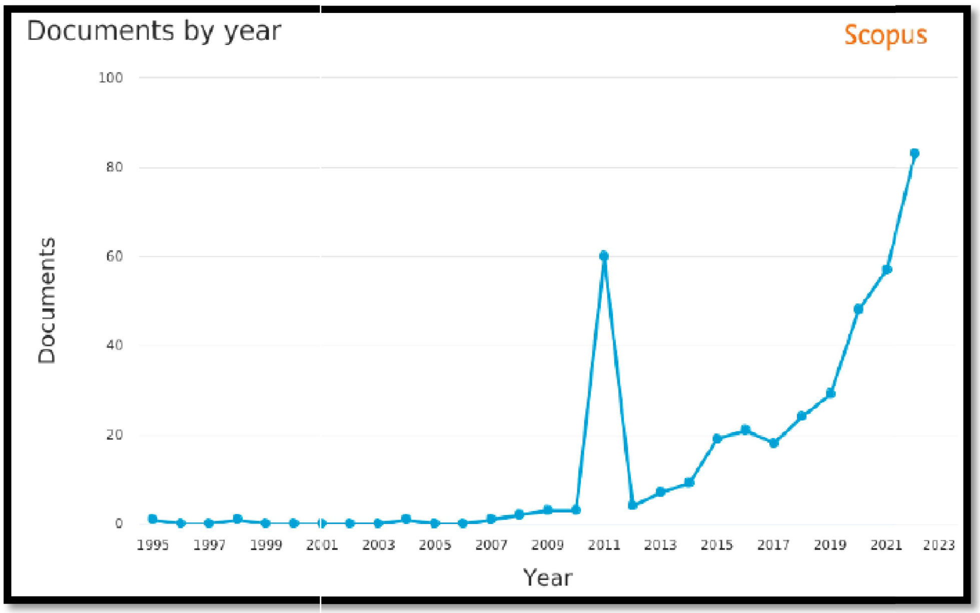

Fig. 1. Publication graph from Query Q2 showing number of publications in given years. Source Authors elaboration in Scopus.

Figure 1 displays SD and AI-correlated papers each year. The publishing dates have risen since 2011. SD and AI publications peaked then. The 2011 launch of the Sustainable Development Goals (SDGs) to replace the Millennial Development Goals may have contributed to the publishing surge. The quantity of AI-SD conferences in 2011 caused the peak, and the materials of the single conference caused the graph shift (Figure 1). After the epidemic [37], publications increased considerably. For automation, the globe looked to AI to fulfill the SDGs [38].

VOSviewer software was used to trace the network of relationships between “artificial intelligence” and “sustainable development” using Scopus keywords and indexed phrases [36]. A factor of 10 frequent connections was used to Q2 data to examine 45 keywords. VOSviewer automatically colored and clustered the findings into 5 groups. Figure 2 shows the most common terms in “artificial intelligence” and “sustainable development” scholarly articles.

Figure 2 shows five connected bibliometric map networks showing AI and SD relationships and co-occurrence. Lines connecting keywords indicate links and publications connected to their co-occurrence [36]. Lines with more co-occurrences are larger. Most linkages include "artificial intelligence", "sustainable development", "sustainability", "decision support systems" and "decision making". Figure 2's center has clusters of the greatest co-occurring sets.

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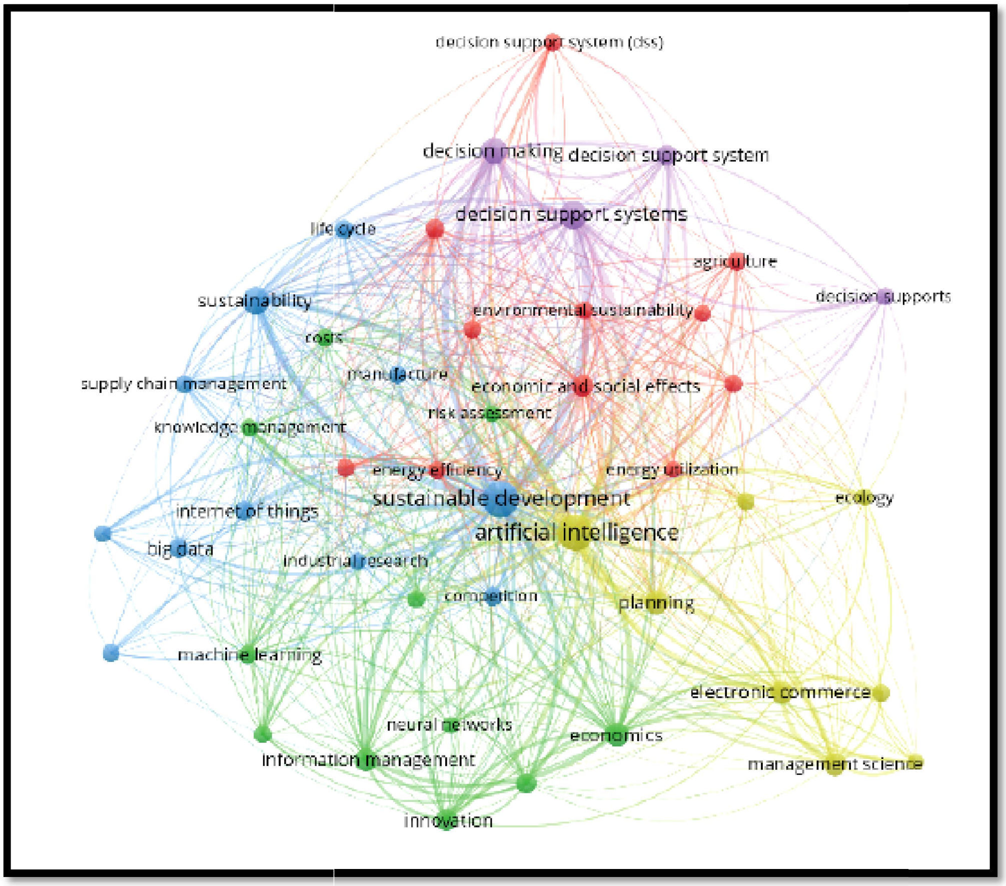

Fig. 2. Indexed keyword co-occurrences in the full counting method of Q2 results. Source: Authors' elaboration.

Linking out to keywords shows weaker connections. Common discipline keywords were automatically clustered into five. Electromobility [39], a recent development, is not explicitly mentioned in the keywords [40,41]. Instead, broad phrases like "innovation", "ecology", and "sustainability" prevail, which may be applied to numerous market elements. Three clusters dominate: red, green, and blue. Each keyword includes 11 components. The red cluster has environmental and social components. green means management and innovation. Modern technology and progress are blue. Yellow is AI applications. The last purple one emphasizes choice. The fourth, blue cluster has eight elements while the fifth, purple cluster has five (Table 2). The research uses keywords as network nodes. Edges connect keywords [30]. Edges "are co-occurrence links between terms" [36]. Each map has one sort of link.

Table 2. Clusters automatically presented by the VOSviewer and presented in Figure 2.

Cluster	Color	Keywords
1.	red	agricultural robots (10), agriculture (16), climate change (15), decision support system (dss) (14), developing countries (12), economic and social effects (32), energy efficiency (15), energy utilization (11), environmental sustainability (15), environmental technology (15), supply chains (20)
2.	green	costs (13), economics (50), forecasting (13), information management (37), innovation (30), knowledge management (14), learning systems (14), machine learning (18), neural networks (10), regional planning (23), risk assessment (10)
3.	blue	big data (20), competition (17), industrial research (10), industry 4.0 (13), internet of things (22), life cycle (17), manufacture (12), supply chain management (16), sustainability (81), sustainable development (286), sustainable development goals (12)

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4.	yellow	artificial intelligence (300), ecology (13), electronic commerce (43), environmental management (12), industry (15), management science (36), planning (51), research and development management (10)
5.	purple	decision making (65), decision support system (23), decision support systems (100), decision supports (13)

Source: Authors' elaboration.

VOSviewer calculates the aforementioned collections automatically. The collections are organized by element count. Keywords are alphabetized. The number of keyword occurrences is in brackets.

Figures 3 and 4 are suggested from Figure 2 and Q2 query results. See Figure 3 for a keyword overlay from 2012 to 2018, which is restricted by the 2011 high. The visualisation's bottom right colour bar shows how scores are transferred to hues [42,43]. Overlay and network visualizations are equivalent [36] (Figure 2). This was achieved using VOSviewer and the complete count approach for indexed terms with 10 co-occurrences [11]. In this overlay study, darker colors represent the oldest terms connected to the progress of connecting artificial intelligence and sustainable development, while lighter colors represent newer keywords. Changes in subsidiary studies relative to the core skeleton of the two primary keywords are visible. Figure 4 shows scored objects whose colors depend on their scores [36], which vary from blue (lowest score) to green and yellow (highest score) [4]. Yellow keywords are in the overlay map borders (Figure 3). This suggests low correlations across the time examined, suggesting new research avenues or trends. Yellow keywords include "learning systems", "knowledge management", "life cycle", "industry 4.0", "manufacturing" and "industrial research". Darker colors are central. They highlight the study topics from the start of the era and show a shift over time and new sectors. Artificial intelligence and sustainable development are strongly linked. VOSviewer visualises point properties (Figure 3). Network and density visualisations (Figures 2 and 4) exclude point properties.

Figure 4 shows a density visualization to test Figure 2's keywords. The three most commonly used terms (100 or more in Table 1) are yellow in Figure 4. A core triangle of artificial intelligence (300), sustainable development (286), and decision support systems (100). There are more keywords with many occurrences, however they are tightly tied to the three clusters and leading keywords. Thus, keyword weight shows significance. Figure 4's map representation emphasizes terms with larger weights [4]. Figure 3 shows the automatically created legend for 2012-2018, highlighting the older (darker) and newer co-occurring terms in the literature.

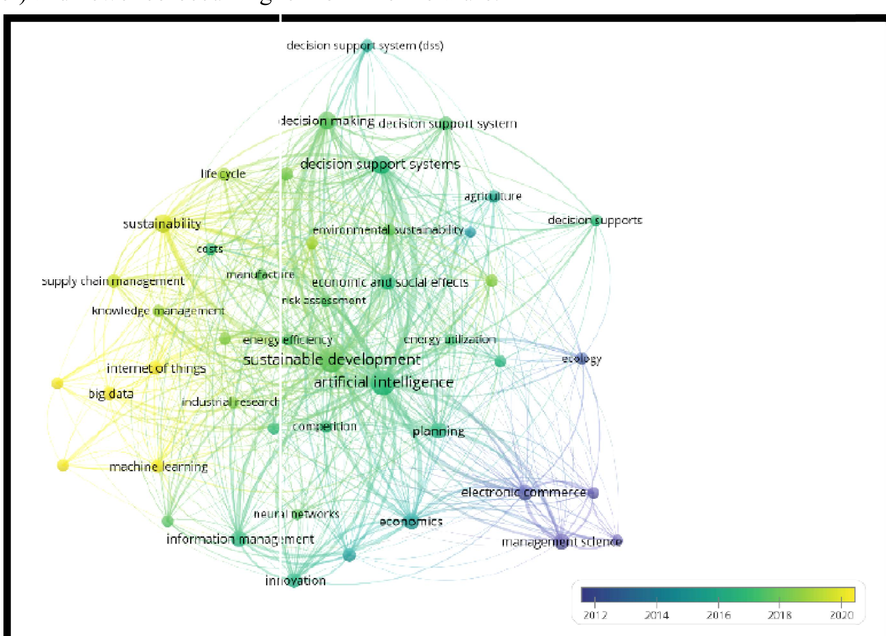

Fig. 3. Overlay map of the indexed keyword co-occurrences. Source: Authors' elaboration

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Density visualization may be positional or clusteral. Figure 4 shows item density-position density visualization [30]. The right radio button in VOSviewer's settings panel created the keyword density visualization. Like the network visualization, the item density visualization (Figure 4) labels keywords. Each point in Figure 4 has a color whose saturation indicates keyword density. The default colors are blue, green, and yellow [25]. Greater the number of components around a point, the greater their weights [30]. As the point approaches yellow, neighboring keywords gain weight [36]. Figure 4 shows a dense term cluster in the center.

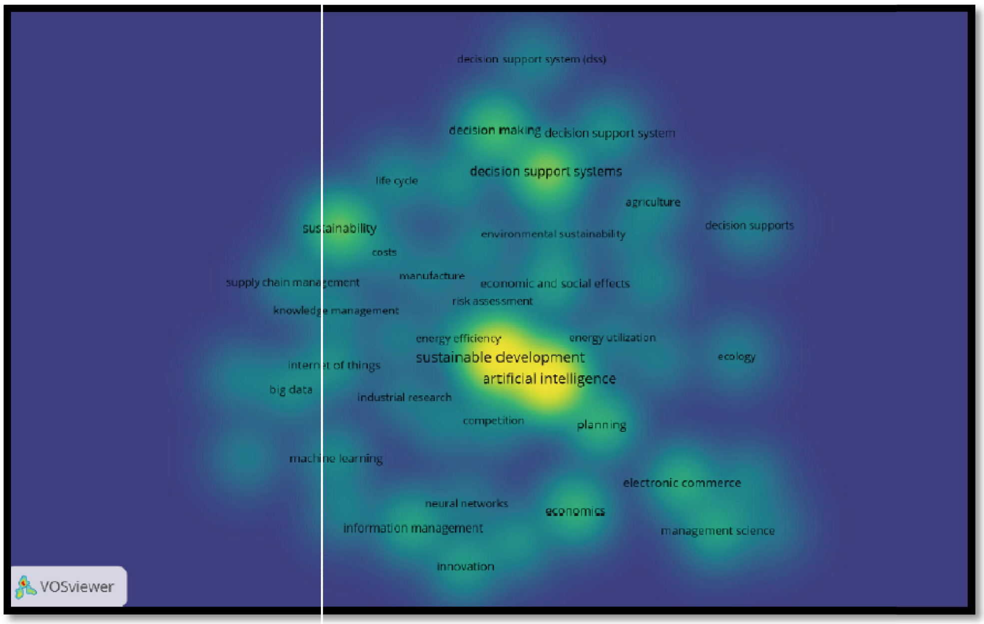

Fig. 4. Item density visualization. Source: Authors' elaboration

According to the analysis, the most important keywords may not belong to the most clusters. Figure 2 shows a greater density of decision support systems and decision-making. On the other hand, "sustainability" is not dense.

II. DISCUSSION AND CONCLUSIONS

This article sought to discover keyword-specific regions of literature on AI and SD in business management. Two RQs were mentioned in the introduction and connected to the directly inquiries in the techniques section to answer this research topic. Scopus was used to identify 3301 (Q1 in Table 1) and 391 (Q2 in Table 1) peer-reviewed AI and SD academic papers. The studies are not exhaustive, but they provide the most prominent AI and SD terms in Scopus-indexed business management literature. The findings indicate the context of words used in bibliometric maps. The findings showed that AI supports management's SD objectives in sustainable agriculture, computer sciences, economics and business management, and decision-making.

New notions make detailed analysis difficult. The investigation focuses on frequent synonyms. Language research and semantic analysis are absent from the study. While it may be an intriguing new study avenue, it may reveal academics' varied views on AI and SD as interwoven notions. Researchers must carefully assess article material at the selection stage using applications like VOSviewer due to the varying nomenclature. Pay attention to non-sustainability terms, researchers. This requires researchers to do a thorough qualitative examination of surveyed papers before employing VOSviewer. VOSviewer software may only be used after a qualitative examination that excludes items not relevant to AI and SD. Thus, the researchers stressed the necessity to apply SD and AI to economics. SDGs are gaining scientific and practical attention for this reason.

This research is limited by the absence of thorough dynamic analysis in VOSviewer to assess keyword relationships. This dynamic analysis can only be done using VOSviewer, and its graphical depiction is unfeasible owing to the enormous number of discovered connections. Future further investigations may examine this analysis. Stakeholder cooperation may benefit future AI investigations in SD, notably in self-employment and green job development.

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