Management Letters
Cuadernos de Gestión

Volume 25 / Number 2 (2025) • ISSN: 1131-6837 / e-ISSN: 1988-2157
https://ojs.ehu.eus/index.php/CG

Universidad del País Vasco
Euskal Herriko Unibertsitatea

Enpresa Institutua, UPV/EHU

Conocimiento en Gestión/Management Knowledge

Management Letters / Cuadernos de Gestión

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Indexed in / Indizada en:

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Metrics in / Métricas en:

Journal Impact Factor (JIF) and Journal Citation Indicator (JCI), Journal of Citation Reports
CiteScore, Scopus

SJR. SCImago Journal & Country Rank, Scopus Sources

Published by / Editada por:

Enpresa institutua / Instituto de Economía Aplicada a la Empresa
(Universidad del País Vasco/Euskal Herriko Unibertsitatea)
Avda. Lehendakari Aguirre, 83 48015 Bilbao (España)
https://www.ehu.eus/es/web/ieae

Supporting entity: Fundación Emilio Soldevilla para la Investigación y Desarrollo de la Economía de la Empresa

ISSN: 1131-6837 / e-ISSN: 1988-2157
Depósito legal: BI - 1.172-01

Photo Credit: Vitor Pinto

Email: revista.cuadernosdegestion@ehu.eus

Management Letters / Cuadernos de Gestión

journal homepage: https://ojs.ehu.eus/index.php/CG

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Fundación Emilio Soldevilla para la Investigación y Desarrollo de la Economía de la Empresa

enpresa institutua
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Management Letters / Cuadernos de Gestión

journal homepage: https://ojs.ehu.eus/index.php/CG
ISSN: 1131-6837 / e-ISSN: 1988-2157

Circular Economy agriculture and supply chain: a literature review

La Economía Circular agrícola y la cadena de suministro. Una revisión de la literatura

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ARTICLE INFO

Received 30 May 2024,
Accepted 21 February 2025

Available online 3 April 2025

DOI: 10.5295/cdg.242224lo

JEL: Q56, M11

ABSTRACT

This study analyzes scientific production on the circular economy (CE) in the agri-food supply chain (AFSC), visualizing its future perspectives. A search was conducted in the Web of Science (WoS) and Scopus databases following the PRISMA methodology, resulting in 182 documents after applying inclusion and exclusion criteria. Scientific mapping was performed through citation analysis and annual production by journals and authors, also applying Tree of Science (ToS) methodology to study temporal contributions and cluster analysis in subareas. The results show a notable increase in scientific production, highlighting Italy, India, and China as the most productive countries, with the journals *Journal of Cleaner Production* and *Sustainability* leading in publications. Two relevant studies were identified: one introduces a new indicator to measure resource efficiency in the supply chain (SC), while the other proposes a model that integrates blockchain technology. Both studies are recognized for their high citation counts and impact in the field. There is also a call for more precise assessment tools, the exploration of innovative technologies, and the promotion of collaboration between academia and industry. Finally, we highlight the importance of investigating specific SCs, such as olive oil and meat, to generate effective strategies for the CE, underlining that this study provides a robust methodology for future analyses and public policy decisions.

Keywords: Circular economy, Supply chain, Scientometrics, Tree of Science.

RESUMEN

El presente estudio analiza la contribución científica a la economía circular (CE) en la cadena de suministro agroalimentaria (AFSC), visualizando sus perspectivas futuras. Se realizó una búsqueda en las bases de datos Web of Science (WoS) y Scopus siguiendo la metodología PRISMA, lo que resultó en 182 documentos tras aplicar criterios de inclusión y exclusión. Se llevó a cabo un mapeo científico mediante análisis de citas y producción anual por revistas y autores, utilizando también la metodología Tree of Science (ToS) para estudiar las contribuciones temporales y un análisis de clústeres en subáreas. Los resultados muestran un notable aumento en la producción científica, destacando a Italia, India y China como los países más productivos, en revistas Journal of Cleaner Production y Sustainability lidera las publicaciones. Se identificaron dos estudios relevantes: uno introduce un nuevo indicador para medir la eficiencia de recursos en la cadena de suministro (SC), y el otro propone un modelo que integra la tecnología blockchain. Ambos estudios son reconocidos por su alto conteo de citas y su impacto en el campo. Además, se resalta la necesidad de herramientas de evaluación más precisas, la exploración de tecnologías innovadoras, y fomentar la colaboración entre académicos y la industria. Finalmente, se subraya la importancia de investigar cadenas de suministro específicas, como el aceite de oliva y la carne, para generar estrategias efectivas hacia la CE, resaltando que este estudio proporciona una metodología robusta para futuros análisis y decisiones en políticas públicas.

Palabras clave: Economía circular, Cadena de suministro, Cienciometría, Tree of Science.

1. INTRODUCTION

The circular economy (CE) in the agri-food supply chain (AFSC) is becoming essential as the global population grows, from 1.6 billion in 1900 to nearly 8 billion in 2020, creating an unsustainable demand for food coverage (Yadav *et al.*, 2022). This supply chain (SC) encompasses all stages from agricultural production to consumption, involving various stakeholders such as farmers and food processors, thus constituting a complex system (Viswanadham & Kameshwaran, 2013). The sector generates 1.2 billion tons of waste annually, a figure that could nearly double by 2025, leading to economic losses of approximately USD 400 billion (Sinha & Tripathi, 2021). Looking ahead, it is crucial to address waste and post-harvest losses to ensure a sustainable agri-food supply chain (SAFSC) (Hertel, 2015). Additionally, current linear production and consumption models generate significant amounts of waste, highlighting the need to adopt circular approaches. Although there are limitations in global measurements, a study financed by the European Union (EU) estimated that households in the North produce between 1 and 2 tons of solid waste annually (Tisserant *et al.*, 2017). In 2007, global waste reached 3.2 gigatons, with only 1 gigaton being recycled or reused, indicating low resource efficiency. While attention to plastics is notable, construction and other materials constitute the largest sources of waste (Pacini & Golbeck, 2020). It is estimated that only 37% of materials are circular, and the factual figure for solid waste recycling could be as low as 15% (Pietzsch *et al.*, 2017).

The relationship between the CE and agriculture is fundamental for the agri-food system to evolve from a linear "extract-manufacture-dispose" model to a circular bioeconomy (CB) that prioritizes waste reduction and recycling, alongside the transition from fossil fuels to bio-based alternatives. This transformation is essential for sustainably meeting the increasing food and energy needs of a growing population. However, it is vital to adopt an approach that not only focuses on technology, but also considers economic value and distributive effects through a new social cost-benefit framework to guide the trajectory towards circularity. Additionally, the reuse of agricultural waste is being explored, such as in the olive oil industry, where research is being conducted on the production of lactic acid from olive leaves, despite challenges in fermentation. This approach not only validates the utilization of waste, but also promotes a greener economy by converting waste into valuable products (Gugel *et al.*, 2024; Khanna *et al.*, 2024).

To better understand the current state of research and identify gaps in this field, a comprehensive literature review was conducted. This review provides a foundation for analyzing the advancements and challenges in applying CE principles to the agriculture supply chain (ASC).

Of the 182 articles selected, we identified 17 related to the literature review. The originality of this analysis lies in its focus on research related to the CE applied to the ASC, specifically its first link, a critical sector due to its high waste generation and resource inefficiency. This differentiates it from previous studies that address the CE in sectors such as the biomass (Longo *et al.*, 2024) or meat SCs (Caccialanza *et al.*, 2023). Although many of the 17 references analyzed discuss the broader applications of CE, this study offers a more specialized approach, highlighting the role of blockchain technology and Industry 4.0 (I4.0) (A. Kumar *et al.*, 2024) in advancing the CE in the ASC. It identifies gaps in its adoption, especially in developing economies, an aspect not notably addressed in the existing literature. Additionally, it emphasizes the need for further research in specific SCs, such as olive oil (Stempfle *et al.*, 2021) and meat (Caccialanza *et al.*, 2023), to develop tailored CE strategies, providing a more structured call for future research compared to previous studies. Furthermore, it underscores the importance of more precise indicators and evaluation tools (Silvestri *et al.*, 2022) to measure the impact of CE initiatives, particularly in resource efficiency and waste reduction, offering a unique methodological approach.

While the reviewed references offer valuable insights into various aspects of CE, such as the biomass SC (BSC) (Longo *et al.*, 2024), meat SC (Caccialanza *et al.*, 2023), and blockchain applications (Sendros *et al.*, 2022), they often focus on specific sectors or technologies without the methodological rigor and holistic perspective of this review. For example, the review of the BSC by Longo *et al.* (2024) focuses on life cycle thinking (LCT) and CE principles but lacks the temporal and scientometric analysis provided herein; Caccialanza *et al.* (2023) review sustainability practices in the meat SC without integrating emerging technologies or offering comprehensive mapping of the field; and the scoping review by Sendros *et al.* (2022) explores the potential of blockchain applications in agriculture without situating it within the broader context of CE and the ASC as effectively as this study.

Another point that highlights the originality of this research lies in the combination of two methodologies: the Tree of Science (ToS) (Valencia-Hernandez *et al.*, 2020), which helps identify and organize the most influential articles on the CE and SC; and the PRISMA method (Moher *et al.*, 2009), which ensures a rigorous and transparent process in the selection and evaluation of scientific articles. By combining different methodologies, this approach effectively identifies relevant studies, particularly notable in their application to CE within the agricultural sector, facilitating the determination of research gaps and opportunities for improvement. Publications in this field were examined using Scopus and Web of Science (WoS), focusing on key contributions through scientometric techniques. Scientific mapping was conducted, including citation analysis and a description of the annual production of journals and researchers. After applying ToS methodology to review contributions to CE over time, cluster analysis was performed to study articles in different subfields. This work not only helps to highlight significant advances in CE and effective strategies for analyzing the literature and unstructured information but also introduces efficient methods for systematic literature reviews. The structure of the article is as follows: introduction, theoretical framework, definition of CE and its principles, methodology, results and discussion, conclusions, and implications.

2. THEORETICAL FRAMEWORK

The growing concern for sustainability in the ASC drives the adoption of the CE, although its implementation faces challenges (Schipfer *et al.*, 2024). The CE offers a framework to optimize resource use and reduce waste, particularly in food waste management, where losses are significant at all stages, from production to consumption (Kounani *et al.*, 2023). Traditional linear models have generated economic losses and food security issues, in addition to environmental impacts (Padthar *et al.*, 2024). The CE proposes

solutions such as waste prevention, recycling, and biorefinery, transforming waste into valuable products (Medhekar, 2024). However, sustainability in the ASC requires a holistic approach, considering population growth, climate change, and resource depletion (Bigliardi *et al.*, 2024). Collaboration among multiple stakeholders, the implementation of green technologies, and sustainability assessment are crucial (Yaqot *et al.*, 2023). The CE presents opportunities through sustainable development goals (SDGs), value creation, efficient food distribution, and technological advancements (Sadh *et al.*, 2023).

3. DEFINITION OF THE CIRCULAR ECONOMY AND ITS PRINCIPLES

The concept of CE has recently emerged in the literature, gaining recognition through promotion by EU institutions as a key approach to mitigate the consumption of limited natural resources (Nikolaou *et al.*, 2021). After analyzing 221 definitions, a comprehensive definition was proposed that encompasses the principles, strategies, and drivers of CE, highlighting its contribution to environmental, economic, and social sustainability: "The circular economy is an economic system that entails a shift from a linear production model to a circular one, which involves eliminating the extraction of virgin resources through reduction, alternative reuse, recycling, and recovery of materials along the supply chain, aimed at promoting the maintenance of value and sustainable development (SD), creating environmental quality, economic development, and social equity, to benefit present and future generations. This is made possible through a coalition of stakeholders (industry, consumers, policymakers, and academia) and their innovations and technological capabilities" (Kirchherr *et al.*, 2023). The principles of CE are related to the so-called Rs, which range from the well-known 3 Rs to broader approaches that indicate up to 10 Rs: reject, rethink, reduce, reuse, repair, restore, remanufacture, repurpose, recycle, and recover (Korhonen *et al.*, 2018).

4. METHODOLOGY

4.1. Search strategy

We conducted a systematic literature review to identify relevant publications on CE in ASC, selecting the WoS and Scopus databases for their comprehensive coverage of high-impact research globally (Marín-Velásquez & Arrojas-Tocuyo, 2021; Moral-Muñoz *et al.*, 2020). The search was limited to the period 2010-2024 for two main reasons: first, the emerging research in CE, as CE only became a distinct area of study in 2010. By restricting the timeframe, the focus is guaranteed to be on current and relevant literature aligned with temporary interpretations of CE. Second, the quality and availability of data in Scopus and WoS are generally higher for recent publications, minimizing the risk of including limited or incomplete information when considering research prior to 2010. To optimize the collection of significant publications, various document types were included, such as articles, reviews, book chapters, and conference proceedings, acknowledging the diversity of approaches and contributions in the field of CE. The search strategy combined keywords and Boolean operators, employing terms such as CE, agriculture, and SC using the AND operator, as well as incorporating synonyms and related terms to broaden the search without sacrificing specificity. Table 1 presents a detailed list of terms and search parameters used in WoS and Scopus, with the results refined through a screening process following PRISMA guidelines.

Table 1
Parameters used in circular economy agriculture and supply chain

Databases	Web of Science	Scopus
Range	2010-2024	
Date	January 25, 2024	
Document type	Papers, books, chapters, and conference proceedings.	
Search fields	Title, abstract, and keywords	
Words	"circular" AND "economy" AND "agriculture" AND "supply" AND "chain"	
Results	190	140
Total (WoS + Scopus)	182	

Source: own elaboration.

Figure 1 illustrates the general procedure for identifying the most pertinent academic literature on the CE and ASC. The PRISMA method was employed to appraise only the most relevant literature (Moher *et al.*, 2009). The examination process was comprised of two main stages. Initially, the ToS metaphor was used to portray the progression of various contributions associated with the CE, resembling a tree structure. The ToS employs the SAP algorithm to select papers from a citation network (Valencia-Hernández *et al.*, 2020). Papers positioned in the roots signify seminal publications; those in the trunk support current literature and are substantiated by the roots; while those in the branches represent primary subtopics. ToS has been widely used to depict trends in diverse fields such as agriculture, business, and health. Subsequently, the second stage entails traditional scientometric analysis, amalgamating data from popular databases like Scopus and WoS.

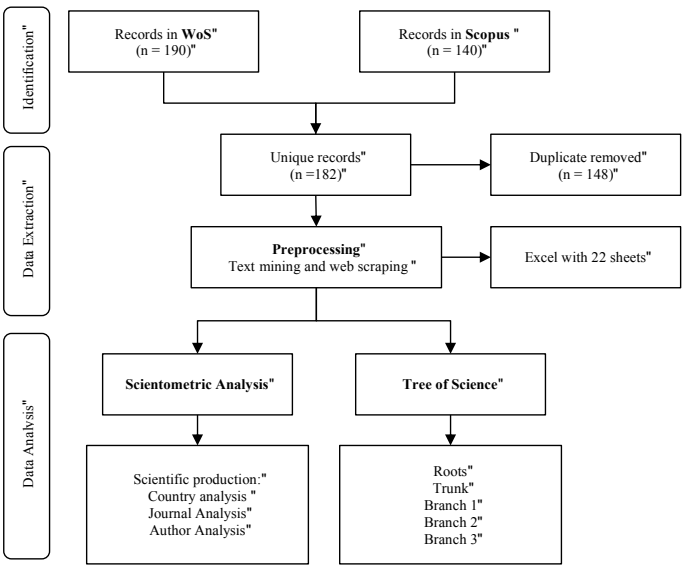

Figure 1
PRISMA diagram for preprocessing data
Source: own elaboration.

4.2. Scientific mapping

Belmonte and colleagues (Belmonte *et al.*, 2020) characterized scientific mapping as a method in scientometrics enabling the examination of academic literature by using bibliometric metrics related to authors and publications. For instance, scientometric analysis is commonly used for identifying groundbreaking innovations (Leydesdorff *et al.*, 2021) and evaluating the performance of universities (Al-Jamimi *et al.*, 2022). This research centers on four dimensions: scientific output, geographical origin, journal sources, and authorship examination. This approach offers readers a comprehensive view of a research topic, beginning with a broad summary and concluding with an in-depth exploration of collaborative networks. To leverage citation analysis, this study adopted the technique advocated by Hurtado-Marín *et al.* (2021). This innovative approach establishes a collaboration based on references, resulting in improved accuracy in discerning the network structures with scientometric data. These methods were developed using the statistical software Rstudio (version 2023.12.1+402), along with its supplementary package Bibliometrix (Aria & Cuccurullo, 2017). Visualizations were generated using the ggraph R package (version 2.0.6) (Si *et al.*, 2022) and Gephi (version 0.10.1) (Bastian *et al.*, 2009).

5. RESULTS AND DISCUSSION

This section provides a descriptive examination of CE in agriculture within SC using bibliometric methodologies. Four dimensions were examined: scholarly output, national contributions, journal output, and authorship patterns.

5.1. Scientometric analysis

5.1.1. Scientific production

Figure 2 illustrates the progression of article production in relation to this topic. The graph demonstrates a marked expansion of research activity in this area over the past 6 years, particularly evident in the substantial increase in articles indexed within the Scopus database. Notably, between 2019 and 2023, the annual growth rate in the number of publications in WoS amounted to 66%, while in Scopus, it reached 56%.

During the pandemic and post-pandemic period, scientific writing has undergone significant growth. During crises like the pandemic, the scientific community tends to intensify its research and publication efforts to address emerging challenges. This increase in scientific output has also been driven by the need to rapidly share relevant information to develop effective solutions. Furthermore, the digitization and accessibility of online platforms have facilitated collaboration among researchers and the rapid dissemination of new findings.

In the post-pandemic era, this momentum in scientific writing has persisted, as challenges related to CE, preparedness for future pandemics, and recovery from social and economic impacts remain. Additionally, awareness about the importance of scientific research and international collaboration has increased during the pandemic, which could continue to foster the production and dissemination of scientific knowledge in the future.

The annual scientific output within a particular subject serves as a barometer for tracking shifts in a research domain, while paper citations gauge its relative significance within the academic community. Moreover, comparing production figures between the Scopus and WoS databases is pivotal as it sheds light on the advantages and constraints associated with each database selection. Consequently, this study examined publications on CE in agriculture for SC spanning from 2010 to 2023, alongside the yearly citation counts to gauge the impact of the topic (see Fig. 2). Furthermore, the combined unique production from both datasets was assessed to discern the parallels and distinctions in CE in agriculture for SC production between Scopus and WoS. Finally, the evolution in production was categorized into three phases: initial growth, rapid expansion, and stability. These delineated stages help to better understand the various temporal dynamics within CE in agriculture for SC (Sun *et al.*, 2020).

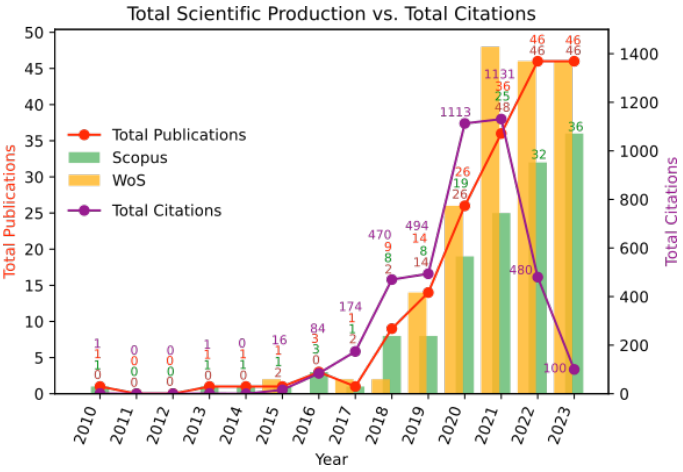

Figure 2
Total Scientific Production vs. Total Citations
Source: own elaboration.

Early growth phase (2010-2017): Within this timeframe, there were a total of 8 publications, constituting 4% of the overall output. WoS contributed 1 publication, while Scopus accounted for 7. This variability arises from WoS initiating publications on CE in agriculture for SC in 2014, whereas Scopus began in 2010. Citations garnered during this phase amount to 7% (276) of the total citations, reflecting the delayed impact of publications. Throughout this period, a consistent annual increase was observed in citation metrics. The most referenced study was by Di Maio *et al.* (Kulakovskaya *et al.*, 2023), which introduced a novel value-based indicator for evaluating the SC actor's performance concerning resource efficiency and CE principles.

Expeditious advancement phase (2018-2020): There was a marked annual surge in both total publications and citations during this period. This phase accounts for 25% (45) of all publications and 51% (2077) of citations. The increase in articles on CE is driven by various factors related to the European Green Deal, particularly the push for sustainability that began in 2019. This initiative has promoted research in CE as a strategy to combat climate change and biodiversity loss. Despite its goal to re-

duce pressure on EU ecosystems, there is a risk of transferring environmental damage to other countries through biomass imports, emphasizing the need for sustainable supply chains (SSC) at a global level (Henke *et al.*, 2024). The high consumption footprint of the EU, especially in resource-intensive products, and the dependence of the food industry on imports such as meat and palm oil, underline the urgency of exploring circular alternatives. Moreover, global competition in staple foods highlights the importance of sustainable sourcing policies that address environmental justice and food security. Thus, research in CE becomes essential for formulating policies that limit negative environmental and social impacts (Wei & Kallbekken, 2024). In conclusion, the growth in this field responds to the need for sustainability, impact mitigation, and the search for solutions for social justice and food security within the framework of the SDGs.

Stability phase (2021-2023): This phase has been condensed to 3 years as production levels remained consistent throughout. With a total of 124 publications, representing 68%, there was a growth rate of 12%. However, the total number of citations received declined due to the delayed impact of this factor.

5.1.2. Country analysis

The use of country analysis as a scientometric method to pinpoint the most prolific regions globally within a specific subject is increasingly prevalent (Chen, 2023). The productivity of a country reflects the government's investments in science aimed at fostering industrial innovation (Zanardello, 2023). A total of 53 countries are engaged in research on the CE for SC, with the top 10 outlined in Table 2.

The citation data column indicates the cumulative citations from both WoS and Scopus per country. Analogous to the production results, the top 10 countries accounted for 40.79% of the total citations. Notably, Malaysia, the Netherlands, and Pakistan, while absent from the list due to their relatively low production figures, demonstrate notable citation indices of 362, 260, and 141, respectively. Conversely, while China excels in scientific output, its impact is comparatively less pronounced.

Table 2
Top 10 most productive countries

Country	Production		Citation		Q1	Q2	Q3	Q4
Italy	31	14.69%	573	8.62%	10	1	3	0
India	18	8.53%	389	5.85%	5	1	0	1
China	16	7.58%	134	2.01%	1	4	2	1
United Kingdom	11	5.21%	583	8.77%	3	2	0	0
Germany	9	4.27%	269	4.04%	3	1	0	0
France	7	3.32%	433	6.51%	7	0	0	0
Greece	7	3.32%	106	1.59%	1	1	1	0
Turkey	6	2.84%	65	0.98%	3	1	0	0
USA	6	2.84%	84	1.26%	1	0	0	0
Australia	5	2.37%	77	1.16%	1	0	0	0

Source: own elaboration.

According to SCIMAGO, the countries listed in Table 2 are constantly researching current topics, making them the countries that generate the most articles. The increase in publications on CE in countries such as Italy, China, India, and the United Kingdom reflects the implementation of government policies that promote resource efficiency, resource scarcity in some cases (such as in Italy), strong industrial foundations (China), economic growth (India), and robust research infrastructure (United Kingdom). Government support, research funding, and regulatory frameworks, along with the need to optimize resources and manage waste, drive innovation and research in more efficient production processes. The presence of top-ranking universities and research institutions, as well as international collaboration and industry participation, significantly contributes to scientific output. While environmental awareness plays a role, the relative importance of each factor varies among countries, requiring specific contextual analyses for comprehensive understanding. Future studies should unravel the complex interplay of these factors for each nation (Banerjee *et al.*, 2024)

These findings illustrate the challenges in determining the ideal number of clusters within CE for SCs through an experiment employing newspaper data. Figure 3 displays six subgroups of countries. The inset figure illustrating clustering by size (top left) indicates comparable sizes among the five largest clusters, while the inset figure depicting nodes and links over time (bottom left) reveals the evolving interaction among new countries and relationships. Based on this representation, it is evident that new relationships have been steadily growing since 2016, leading to the establishment of a robust scientific community focused on CE for SC collaboration.

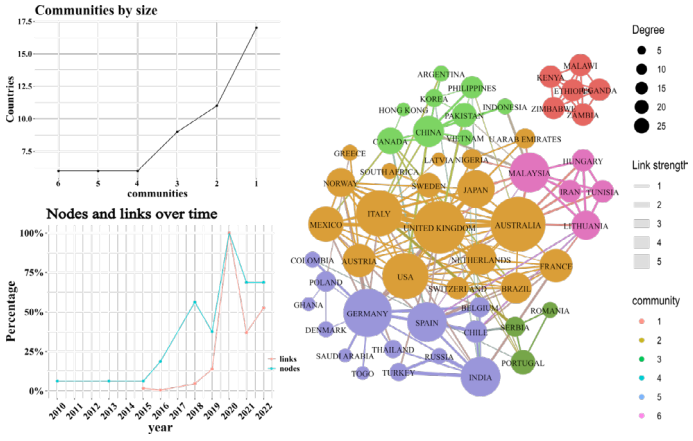

Figure 3
Country collaboration network
Source: own elaboration.

5.1.3. Journal analysis

The *Journal of Cleaner Production* boasts the largest volume of publications. *Sustainability* is also highlighted as a notable journal focusing on the environmental, cultural, economic, and social sustainability of humanity. Table 3 presents this data, revealing that the most influential journals in terms of impact factor include *Resources, Conservation and Recycling* (2.68), *Journal of Cleaner Production* (1.98), and *Science of the Total Environment* (1.95). Figure 3 illustrates the citation analysis using references retrieved from searches on Scopus and WoS. The citation network delineates various themes within a set of papers, with

each node representing a journal and the links indicating references between the journals.

Table 3
Top 10 most productive journals

Journal	WoS	Scopus	Impact Factor	H-Index	Quartile
Journal of Cleaner Production	18	10	1.98	268	Q1
Sustainability (Switzerland)	0	10	0.66	136	Q1
Science of The Total Environment	8	9	1.95	317	Q1
Energies	10	2	0.63	136	Q1
Environmental Science and Pollution Research	8	3	0.94	154	Q1
Nongye Gongcheng Xuebao/Transactions of The Chinese Society of Agricultural Engineering	0	5	0.45	60	Q2
Sustainability	24	0	0.66	136	Q1
Circular Economy and Sustainability	0	3	—	—	—
Resources, Conservation and Recycling	0	3	2.68	170	Q1
Smart Innovation, Systems and Technologies	0	3	0.17	31	Q4

Source: own elaboration.

Figure 4 shows the citation network among journals, where three main groups are observed. In the first group, two studies published in *Science of the Total Environment* stand out. One paper discusses the challenges and barriers faced in on-farm composting and the application of compost derivatives, such as European regulations, variability in compost quality, and greenhouse gas emissions. It also presents recommendations, innovations, and future research directions to address these issues and promote a CE system in agricultural waste recycling (De Corato, 2020). The other discusses the potential for harvesting vegetation in wetland buffer zones to minimize phosphorus and promote CE value chains by using plant biomass for various purposes such as building materials, paper production, and bioenergy. This approach could provide compensation to landowners for restored land that is no longer suitable for conventional farming practices (Walton *et al.*, 2020). In the second group, the *Journal of Cleaner Production* is highlighted, with one particular study standing out that focuses on identifying the barriers to adopting I4.0 and CE in the ASC in India (S. Kumar *et al.*, 2021). Of note in the third group is the journal *Plos One* with a study that examines the knowledge, use, disposal, and local consequences of single-use plastics in remote island communities in southern Sulawesi, Indonesia, and identifies a complex set of factors contributing to extensive plastic leakage into the marine environment (Phelan *et al.*, 2020). The figure showing nodes and links over time reveals that the proportion of links compared to nodes (journals) has been higher in recent years. This means that CE for the SC has positioned itself as a topic of interest for research in the international context.

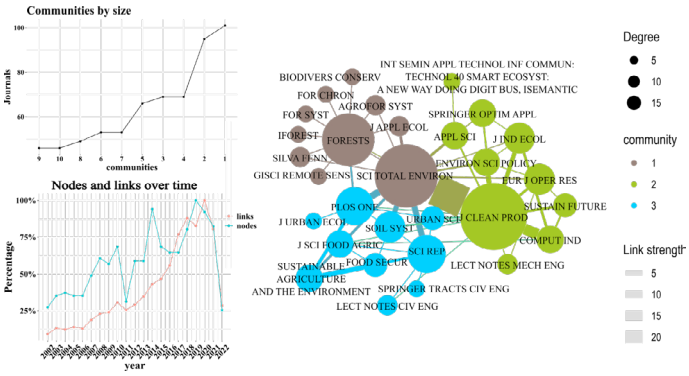

Figure 4
Journal collaboration network
Source: own elaboration.

5.1.4. Author Collaboration Network

Table 4 shows the ten most productive researchers on CE in agriculture for the SC. Professor D. Bochtis is among those who have authored the most articles on CE, with an h-index of 41. He recently published research that explores the practical implementation potential of carbon farming technologies in the agricultural sector, aligning them with EU policy frameworks (Kyriakarakos *et al.*, 2024). The researcher with the highest h-index is Professor S. Mangla. His latest study explores how digital traceability practices can improve sustainability performance in food firms, with sustainability-oriented innovation (SOI) mediating the relationship and supply chain learning (SCL) moderating the link between digital traceability and innovation (Zhou *et al.*, 2024). In this sense, there is a relationship between the quantity of publications and the quality of the scientific community regarding CE for the ASC.

Table 4
Production by Author

No.	Researcher	Total Articles	Scopus h-Index	Affiliation
1	Bochtis D	3	41	Centre For Research And Technology-Hellas, Thessaloniki, Greece
2	Kumar S	3	10	Indian Institute Of Management, Mumbai, India
3	Mangla S	3	62	O.P. Jindal Global University, Sonipat, India
4	Ram M	3	23	Graphic Era Deemed to be University, Dehradun, India
5	Zhang H	3	4	Ottawa Research and Development Centre, Ottawa, Canada
6	Achillas C	2	24	International Hellenic University, Thessaloniki, Greece
7	Agnusdei G	2	12	Universidad del Salento, Lecce, Italy

No.	Researcher	Total Articles	Scopus h-Index	Affiliation
8	Al-Ansari T	2	42	Hamad Bin Khalifa University, Doha, Qatar
9	Ashekuzzaman S	2	12	Munster Technological University (MTU), Bishopstown, Ireland
10	Bucea-Manea-Tonis R	2	9	National University of Physical Education and Sports, Bucharest, Romania

Source: own elaboration.

Figure 5 shows the scientific collaboration network among the authors in Table 4. This network is constructed based on their personal networks. The collaboration network shows two prominent groups, the first being a highly cohesive group where the main researchers appear. For example, researchers Achillas and Bochtis authored a study that aims to bridge the gap between theory and practice in supply chain management (SCM) for bioenergy and bioresources, suggesting innovative approaches and solutions to enhance efficiency in this field (Achillas & Bochtis, 2021). In the second group, researcher Dr. S. Ashekuzzaman appears with other authors of a paper that examines the nutrient and metal content of dairy processing sludge, which are bio-based fertilizers (Shi *et al.*, 2022).

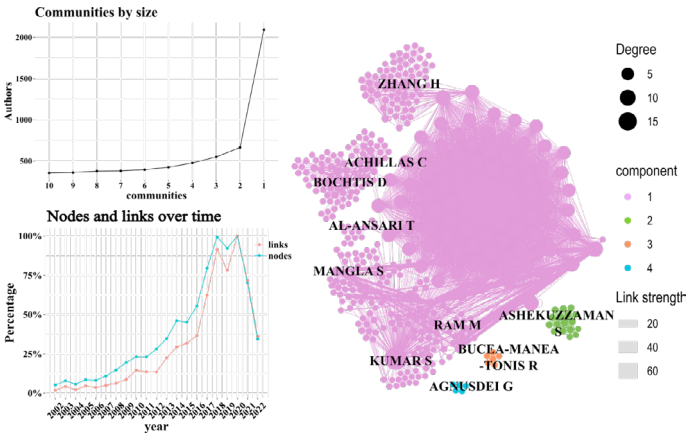

Figure 5
Author collaboration network
Source: own elaboration.

5.2. *Tree of Science*

The network analysis enabled us to identify the most significant documents (Figure 6). Records with the highest metrics were chosen for examination and arranged using the analogy of the ToS: foundational (roots), fundamental (trunk), and contemporary (leaves) categories (Valencia-Hernández *et al.*, 2020). To delineate subareas or shared research domains, we employed the clustering algorithm suggested by Blondel *et al.* (2008), resulting in the identification of the four primary groups visible in the leaf category.

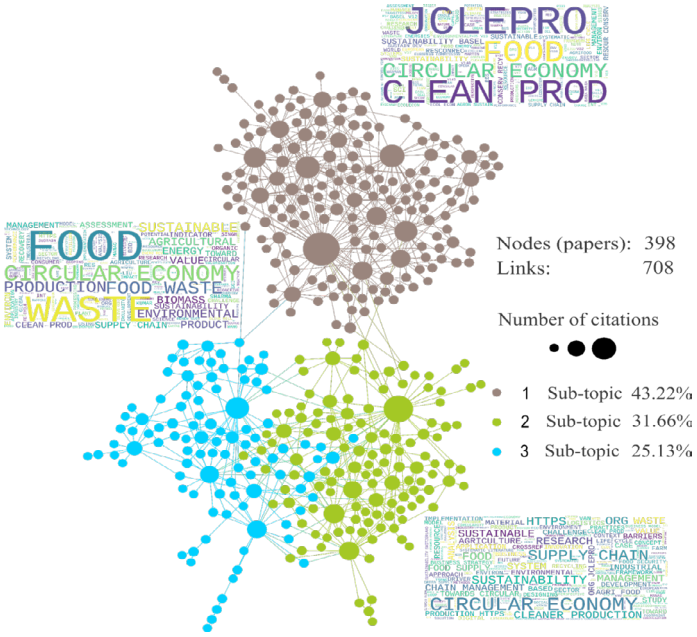

Figure 6
Internetwork with the three biggest clusters
Source: own elaboration.

5.2.1. Root

The foundational articles on CE for the ASC encompass various perspectives. The first delineates the CE goal of enhancing resource efficiency and achieving a harmonious balance between the economy, environment, and society. Despite its nascent stage, CE primarily emphasizes recycling over reuse (Ghisellini *et al.*, 2018). Another article seeks to disentangle the concepts of "CE" and "Sustainability," outlining eight distinct relationships between them based on a thorough literature review. It underscores the commonalities and disparities between CE and sustainability (Geissdoerfer *et al.*, 2017). Meanwhile, a third study aims to clarify the CE concept by examining 114 definitions, revealing a predominant focus on reduce, reuse, and recycle activities rather than systemic shifts and links to SD (Kirchherr *et al.*, 2017). The fourth paper delves into the origins and conceptualizations of CE, emphasizing process redesign and material cycling to foster sustainable business models. It calls for a revised definition of CE centered on maximizing ecosystem functioning and human well-being (Murray *et al.*, 2017). Additionally, a fifth article defines CE in the context of SD and explores its environmental sustainability, identifying six key challenges for achieving global net sustainability (Korhonen *et al.*, 2018). Finally, the need to transition to a CE in the agro-food sector is discussed in the sixth study, prompted by the unsustainability of current economic models, resource scarcity, and food loss and waste generation throughout the SC (Esposito *et al.*, 2020).

5.2.2. Trunk

The trunk hosts a series of noteworthy studies. One delves into leveraging big data to enhance sustainability management

in the agricultural waste valorization SC. This study amalgamates concepts from I4.0, sustainability, and the agri-food sector to evaluate the environmental impacts of various pretreatment processes and technologies (Belaud *et al.*, 2019). Another study explores the sustainability dimensions of short supply chains (SCs) within the context of CE principles. It elucidates the interconnectedness of SCs with circularity and sustainability, considering factors like environmental impact, health, food quality, consumer behavior, producer-consumer relationships, and local economies (Joshi *et al.*, 2020). The CE paradigm finds application in agro-industrial systems to curtail losses and waste in food SCs, with precision agriculture and artificial intelligence assuming pivotal roles (Kiss *et al.*, 2019). The use of multifunctional computer models is advocated to facilitate monitoring, simulation, forecasting, and optimization in precision agriculture, with due consideration to the social and cultural aspects of human behavior. A separate endeavor aims to delineate key CE dimensions within the agri-tourism sector and evaluate their efficacy using the combined analytical hierarchy process (AHP)-TOPSIS method. This study underscores the significance of destination attractiveness, community contributions, and sustainable livelihoods in shaping CE decisions within agri-tourism clusters, with Pithoragarh emerging as a prominent cluster in Uttarakhand, India (S. Kumar *et al.*, 2021; Lal *et al.*, 2020). Furthermore, strategies targeting soil enhancement in local food production systems are outlined to bolster resilience and foster a CE ethos, focusing on soil restoration via carbon sequestration and on-farm cycling of nutrients. The integration of smart web-based geospatial decision support systems for sustainable land use planning and management is advocated, alongside the potential use of forensic soil science in cold case investigations (Mehmood *et al.*, 2021; Silvestri *et al.*, 2022). In a comprehensive review, the literature on CE in the ASC is examined, pinpointing the drivers and barriers to the adoption of CE practices in the ASC. Environmental, policy, and economic benefits are identified as prime motivators, while institutional, financial, and technological hurdles impede CE implementation. The study calls for globally accepted standards and frameworks, as well as government intervention to foster CE initiatives within the agriculture sector (Tseng *et al.*, 2019).

5.2.3. Branch 1

The texts reviewed encompass various aspects of CE and its application within different sectors, emphasizing the significance of LCT and assessment tools in enhancing sustainability. One paper focuses on the BSC, stressing the need for comprehensive tools to improve circularity and sustainability in bioenergy (Caccialanza *et al.*, 2023). Another study examines the interdependencies among the water, energy, and food sectors, encouraging CE approaches, especially in food waste management (Del Borghi *et al.*, 2020). Additionally, a proposed framework of environmental and energy performance indicators aims to evaluate the EU's Common Agricultural Policy in line with CE strategies (Feng & Lam, 2021). Other research explores sustainability within the meat SC and food waste management in India, emphasizing waste reduction and effective management practices (Ghisellini *et al.*, 2023). The importance of CE in mitigating environmental impacts, particularly in resource-intensive agricultural systems, is highlighted, along with the potential of the bioeconomy to facilitate circularity through renewable biological resources (Kharola *et al.*, 2022; Longo *et al.*, 2024). Moreover, an overview of the adoption of a CE in China underscores the need for comprehensive approaches to promote CE across various levels (Morales *et al.*, 2021). Finally, a study analyzes the relationship between sustainability and CE, emphasizing their integration into policy formulation and strategies to address SDGs, particularly in sectors like agriculture and innovation. Overall, these studies underscore the importance of CE principles and strategies in fostering sustainability across different sectors (Rodias *et al.*, 2020).

5.2.4. Branch 2

One study explores CE-based integrated farming systems for indigenous chicken, employing the triple bottom line (TBL) approach and sustainable agriculture to enhance food security efforts (Abbasi *et al.*, 2024). Through in-depth analysis and qualitative data gathering, valuable insights into the complexities of the indigenous chicken sector are obtained. Simulation and modeling reveal interactions within subsystems, leading to the development of a transformative indigenous chicken-based integrated farming system value chain framework (Deekonda, 2023). Additionally, the study emphasizes the importance of CE principles and integration of forward and reverse linkage to achieve sustainability across the value chain (Khan & Mahajan, 2023). Another study explores CE principles in the agri-food sector, highlighting the need for value optimization and collaboration to address inefficiencies and excessive waste. It presents empirical evidence on the adoption of CE practices within Indian agribusiness, identifying influencing factors and firm-level strategies (Matkerimova *et al.*, 2022). Finally, an analysis aims to evaluate the sustainability of circular agriculture, considering its impact on food security, circularity, environmental efficiency, and energy efficiency, aligning with SDGs and emphasizing the benefits of corporate social and ecological responsibility in promoting sustainable agricultural development (Poponi *et al.*, 2023).

5.2.5. Branch 3

Several papers examine the challenges and opportunities of transitioning the agricultural sector to a CE, emphasizing the importance of conversion technology, SSC, stakeholder involvement, and the use of analytical tools. Anaerobic digestion (AD) stands out as a critical organic waste conversion technology, its success reliant on feedstock properties and operational parameters (Ncube *et al.*, 2022). Additionally, agricultural waste biomass, including starch, cellulose, and protein, presents significant potential for the development of value-added products and bioenergy through biological and physiochemical processes (Haque *et al.*, 2023). The assessment of circularity within the agroindustry, particularly in sectors like the olive oil industry, underscores the need to monitor progress and enhance sustainability through the development of appropriate indicators (Kounani *et al.*, 2023). Furthermore, applying CE principles to the olive oil SC in Italy reveals opportunities for environmental improvement, particularly through waste valorization and the adoption of renewable

energy sources, as evidenced by life cycle assessments and environmental impact evaluations (Sadh *et al.*, 2023).

CE is emerging as an effective solution to enhance sustainability in the ASC by addressing the interplay between economic, environmental, and social dimensions. While CE has emphasized the importance of recycling, a broader perspective that incorporates resource reduction and reuse is required to facilitate significant changes in the agricultural sector. Furthermore, technologies such as big data and artificial intelligence are crucial for managing agricultural waste and optimizing precision agriculture, helping to reduce waste and improve efficiency. However, there are institutional, financial, and technological barriers that hinder implementation, making it necessary to promote collaboration among stakeholders and government support. Case studies highlight the need for strategies tailored to local contexts, as evidenced in the poultry sector, which demonstrates how CE can enhance food security. The integration of sustainability indicators into policy formulation is key to advancing and aligning agricultural practices with the SDGs. In summary, adopting a CE model in agriculture can yield multiple benefits, with a collaborative approach being fundamental to enhancing its role in global sustainability.

6. CONCLUSIONS AND POLICY IMPLICATIONS

The present research has provided a panoramic view of scientific contributions in the field of CE applied to the ASC. The ToS analysis has allowed us to identify seminal, fundamental, and contemporary studies, highlighting the main lines of research and trends in this area. Additionally, scientific mapping has revealed valuable information about scientific production in terms of the most prolific countries and journals, as well as collaboration networks among authors.

6.1. Findings

This review evaluates the relevance of academic works through methodologies such as citation counts and thematic clustering, highlighting two influential studies. The first, by Di Maio *et al.* (2017), introduced a new value-based indicator to measure performance in the SC, focusing on the CE, which boasts a high citation count, demonstrating its impact in the field. The second, by Casado-Vara *et al.* (2018) proposed an SC model using blockchain technology, also with numerous citations and essential for the adoption of innovations in the CE. While other studies are relevant, these two are notable for their significant influence and innovative approaches at various stages of research.

6.2. Research gaps

The relationship between I4.0 and the CE in SAFSC presents significant research gaps. Currently, few studies integrate these concepts, and there is a notable lack of research addressing the challenges of adopting I4.0 technologies that facilitate the CE, especially in developing economies (A. Kumar *et al.*, 2024). This review addressed the research gap regarding the CE for ASC, providing a comprehensive and updated overview of scientific contributions (Gallego-Schmid *et al.*, 2024).

6.3. Future research directions

This literature review on the CE in ASC highlights several key areas that are crucial for future research and development. First, there is a need to develop more precise indicators and assessment tools to measure the impact of CE initiatives, including more refined metrics for resource efficiency, waste reduction, and environmental sustainability. Additionally, the exploration of innovative technologies is emphasized, highlighting the importance of technological advancements such as AD for the valorization of agricultural waste and the generation of value-added products. There is also a need to foster closer collaboration among academics, policymakers, industries, and farmers, directing efforts toward creating effective partnerships that connect research with practice. The study identifies specific challenges in different sectors and regions, suggesting that future research should focus on tailored solutions to overcome barriers such as the lack of fiscal incentives and the implementation of environmental standards. Finally, there is a need for more specific research on certain SCs within the agricultural sector, such as olive oil and meat, to generate effective strategies for transitions toward the CE.

6.4. Limitations

This study, while providing valuable insights into the CE in ASC, faces several limitations: the analysis is based on data from Scopus and WoS, which although extensive databases, may not capture all relevant research, including gray literature and publications in lesser-known journals, potentially resulting in an incomplete representation of the research landscape. Furthermore, the citation analysis may be subject to biases, such as publication and prestige bias, which influence the ranking and interpretation of key groups and contributors.

Moreover, it is important to consider that the concept of the SC originates from the business sector and is primarily used in that context (Ketchen & Hult, 2007). This implies lower academic interest in publishing research on this topic compared to other more theoretical areas. As a result, the available scientific literature may be limited in certain aspects, potentially influencing the depth of the analysis conducted.

Another limitation to consider is citation bias (Flammer, 2021). By focusing on highly cited studies, there is a risk of overvaluing well-established works at the expense of emerging research that has not yet had sufficient time to accumulate a significant number of citations. This could affect the identification of recent trends or disruptive innovations in agri-food SCM.

Despite these limitations, the study makes a significant contribution and presents a methodological framework that can be replicated and adapted for future research, promoting the comprehensibility and reproducibility of findings in this important area.

6.5. Practical implications

This study provides a valuable contribution to research in the agricultural CE by offering a rigorous and replicable methodology for future research and identifies priority areas for study (waste conversion, integrated circular production systems, and specific applications) in agricultural sub-sectors. For example,

Longo *et al.* (2024) propose that, in olive oil production, the abundant agricultural olive residue generated can be upcycled for lactic acid production, which has wide industrial applications in the food, pharmaceutical, and cosmetic industries. Another group has suggested implementing reverse logistics practices for indigenous chickens through the recycling and reuse of poultry litter generated as a natural and enriching fertilizer in crops like bananas, enhancing soil fertility (Abbasi *et al.*, 2024)

Furthermore, this manuscript reveals strategic information for policy and business decision-making (highlighting leading countries and journals, as well as key contributions), analyzes barriers to the adoption of the CE, offers a multidimensional perspective of the field (including collaboration analysis), and emphasizes the importance of the CE for sustainability.

Its practical approach and solid methodology make it an essential tool for the scientific community and the formulation of public policies.

6.6. Theoretical Contributions

The methodological innovation of this study lies in the integration of two complementary methodological approaches: the ToS and PRISMA methodology. This combination enables the identification of emerging studies in our area of interest and provides a structured framework for detecting research gaps and future trends. Additionally, the article highlights the need to develop more precise evaluation tools and foster interdisciplinary collaboration, both of which are fundamental elements for advancing knowledge in the sustainable management of SC within the CE paradigm.

Additionally, this methodological combination ensures that, while other literature reviews are often fragmented or focus on individual papers, the methodology used in this study is rigorous and replicable. This research contributes to the literature by identifying priority areas within agricultural CE and SC. It provides a structured theoretical foundation for future studies and guides the development of more effective strategies for implementing CE principles in agriculture.

The context-specific nature of some research may limit the generalizability of the findings to other products, regions, or farming practices. Nevertheless, CE in ASC is a challenging research topic that is attracting the attention of academics. In this sense, qualitative and quantitative data sources and complementary modeling techniques can provide a more comprehensive perspective for CE in ASC analysis, and thus provide more and better contributions for the implementation of circularity practices in the ASC.

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Management Letters / Cuadernos de Gestión 25/2 (2025) 21-36

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Management Letters / Cuadernos de Gestión

journal homepage: https://ojs.ehu.eus/index.php/CG
ISSN: 1131-6837 / e-ISSN: 1988-2157

The impact of omnichannel dimensions on purchase intention through consumer benefits: A Peruvian approach

El impacto de las dimensiones de la omnicanalidad en la intención de compra a través de los beneficios del consumidor: Una aproximación desde Perú

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ARTICLE INFO

Received 02 June 2024,
Accepted 04 February 2025

Available online 3 April 2025

DOI: 10.5295/cdg.242226mm

JEL: M31

ABSTRACT

Omnichannel strategies continue to play a fundamental role in the evolution of consumer behavior in Peru. In response, retailers are integrating physical and digital spaces by implementing omnichannel strategies. However, the specific impact of omnichannel experiences on consumer behaviour remains uncertain, particularly regarding perceived benefits and purchase intention. This study aims to demonstrate the relationship between the omnichannel experience and the benefits perceived by consumers, as well as their influence on purchase intention. The hypotheses were tested using structural equation modeling with the partial least squares (PLS-SEM) technique. Data were collected through an online survey of 420 Peruvian consumers with experience in omnichannel shopping. The main findings confirm that the omnichannel experience influences perceived convenience and variety and, to a lesser extent, purchase intention. Furthermore, the results demonstrate that perceived variety affects purchase intention, whereas perceived convenience is less decisive in this regard. Mediation analysis further confirms that perceived variety has a positive and significant mediating effect, suggesting that an improved omnichannel experience influences purchase intention through a greater perception of variety. This research provides both theoretical and practical contributions to the study of omnichannel consumer behavior in emerging markets, offering strategic insights for retailers seeking to optimize the customer experience and drive purchase conversion through a more attractive and diversified offering.

Keywords: Omnichannel Experience, Perceived Variety, Perceived Convenience, Purchase Intention, PLS-SEM, Peru.

R E S U M E N

Las estrategias omnicanal continúan desempeñando un papel fundamental en la evolución del comportamiento del consumidor en Perú. En respuesta a esta tendencia, los minoristas han intensificado la integración de los entornos físicos y digitales a través de estrategias omnicanal. Sin embargo, persiste la incertidumbre sobre el impacto específico de la experiencia omnicanal en la conducta del consumidor, particularmente en relación con los beneficios percibidos y la intención de compra. Este estudio tiene como objetivo demostrar la relación entre la experiencia omnicanal y los beneficios percibidos por los consumidores, así como su influencia en la intención de compra. Las hipótesis se respondieron utilizando el modelamiento de ecuaciones estructurales usando la técnica de mínimos cuadrados parciales (PLS-SEM). Los datos fueron recopilados mediante una encuesta en línea a 420 consumidores peruanos con experiencia en compras omnicanal. Los resultados evidencian que la experiencia omnicanal influye en la conveniencia y variedad percibida y, en menor medida, en la intención de compra. Asimismo, se demostró que la variedad percibida influye en la intención de compra; sin embargo, la conveniencia percibida resultó no ser tan decisiva sobre esta. En cuanto al análisis mediador, se pudo confirmar que la variedad percibida tiene un efecto mediador positivo y significativo, lo que sugiere que una mejor experiencia omnicanal influye en la intención de compra a través de una mayor percepción de variedad. Esta investigación aporta una contribución teórica y práctica al estudio del comportamiento del consumidor omnicanal en mercados emergentes, proporcionando información estratégica para minoristas que buscan optimizar la experiencia del cliente y fomentar la conversión de compra a través de una oferta más atractiva y diversificada.

Palabras clave: Experiencia Omnicanal, Variedad Percibida, Conveniencia Percibida, Intención de Compra, PLS-SEM, Perú.

1. INTRODUCTION

In recent years, e-commerce has become a key element of the global retail sector (Huang & Jin, 2020). Like many other industries, the retail landscape has undergone a substantial transformation following the emergence of the internet. Thanks to the digitization of modern life, consumers now benefit from the advantages of online transactions (Pasquali, 2023). The number of digital buyers continues to grow annually as internet access and adoption expand worldwide (Petrosyan, 2023).

In the United States, 46% of retailers have increased their focus on omnichannel investments following the impact of the COVID-19 pandemic. The dramatic decline in in-store purchases has motivated a strategic shift to adapt to new consumer behaviors (Yang *et al.*, 2022). Consequently, retail shops face the challenge of determining the value they can offer their clientele and identifying key attributes in the digital age (Kupfer *et al.*, 2024).

In Latin America, there are 300 million digital buyers, a figure expected to grow by more than 20% by 2027 (Del Vecchio *et al.*, 2023). Meanwhile, in Peru, consumers are increasingly turning to online options for their purchases, resulting in a 50% increase in retail e-commerce revenue by 2020 (Chevalier, 2022).

In this context, the omnichannel experience is becoming increasingly important in the multichannel interactions offered by retailers (Shi *et al.*, 2020). Omnichannel strategies will continue to gain significance in the coming years (Juaneda-Ayensa *et al.*, 2016). To respond to this shift, some retailers are integrating physical and digital spaces and implementing technological innovations to enhance consumer experience (Del Vecchio *et al.*, 2023; Sheth, 2020). Because consumers respond differently to the same marketing efforts, retailers need to tailor their messages to different consumer segments (Ansari *et al.*, 2008).

Consumers use multiple channels simultaneously in the purchasing process (Chakraborty *et al.*, 2016; Rodríguez-Torrico *et al.*, 2017; Swoboda & Winters, 2021). Therefore, the omnichannel consumer experience is a broad concept encompassing various dimensions (Shi *et al.*, 2020). Previous research has identified models that relate integration (Lee *et al.*, 2017; Shakir *et al.*, 2020) and connectivity (Emrich *et al.*, 2015; Zhu *et al.*, 2018) to consumer loyalty (Shakir *et al.*, 2020). Furthermore, consistency (Ganesh, 2004; Shi *et al.*, 2020) and flexibility have been studied in relation to purchase intention (Shen *et al.*, 2018). Meanwhile, customization has been identified as a factor that enhances the omnichannel experience and fosters loyalty toward the retailer (Hickman *et al.*, 2020; Tyrväinen *et al.*, 2020). Finally, convenience (Chang & Li, 2022; Sun *et al.*, 2020) and perceived variety (Mejía *et al.*, 2021; Prassida & Hsu, 2022) have both been linked to repurchase intention (Yurova *et al.*, 2017).

Despite several studies on the causal relationship between the omnichannel experience and purchase intention (Chang & Li, 2022; Mejía *et al.*, 2021; Prassida & Hsu, 2022; Sun *et al.*, 2020), further research is necessary to investigate these variables within the retail sector (Cuesta *et al.*, 2023).

The lack of a comprehensive framework identifying the key benefits sought in the market (Haley, 1968), along with the need for an integrated analysis of all omnichannel elements (Shi *et al.*, 2020), presents an opportunity to develop more robust models. This would facilitate a deeper understanding of omnichannel retail and allow for the expansion of research to include additional variables such as customer experience, repurchase potential, and loyalty. Such advancements would contribute to a more comprehensive theoretical framework for understanding this phenomenon (Zhang *et al.*, 2024).

Consequently, the objective of this research is to empirically analyze how the omnichannel experience influences consumers' perceived variety and perceived convenience in relation to their purchase intention. To accomplish this objective, data on purchases made by users in an omnichannel environment will be used, enabling a comprehensive analysis and extrapolation of results. Thus, the study seeks to validate the existence of these relationships and their implications in the retail environment, with the goal of positioning a comprehensive omnichannel experience as an effective and profitable sales strategy.

Moreover, several significant findings were identified concerning the omnichannel experience and the benefits perceived by consumers, which have the potential to enhance purchase intention. The main finding supports the importance of adequately developing the dimensions of the omnichannel experience, as these have a direct and significant influence on purchase intention. This finding aligns with prior studies, yet it also paves the way for future research in the field, especially in the context of ongoing digital transformation and the adaptation processes necessary for business success in an increasingly digitized retail environment. Consequently, this study highlights the importance of its application in marketing as a foundation for migrating toward a seamless omnichannel retail model, where the shopping experience plays a crucial role (Zhang *et al.*, 2024).

2. LITERATURE REVIEW

2.1. Omnichannel experience

The retail industry has evolved from a multichannel approach, characterized by multiple points of contact operating independently, to an omnichannel model (Hossain *et al.*, 2020). Omnichannel retail is defined as the unification of interconnected channels to offer consumers a seamless experience (Shen *et al.*, 2018), satisfy their needs, and increase sales in various ways (Lewis *et al.*, 2014; Saghiri *et al.*, 2018).

Unlike multichannel retailers, which do not establish full integration between their channels, omnichannel retailers provide total connectivity and a personalized shopping experience across all available points of contact (Ameen *et al.*, 2021; Piotrowicz & Cuthbertson, 2014). Thus, maintaining information and experience consistency is essential in omnichannel design (Acquila-Natale & Iglesias-Pradas, 2020; Burford & Resmini, 2017).

From an omnichannel perspective, the shopping experience varies for each customer depending on the type of product or service sought (Mosquera *et al.*, 2017). Therefore, retailers must integrate their primary channels based on the methods by which their customers make purchase decisions (Hoogveld & Koster, 2016). The design and provision of a distinctive and dynamic consumer experience significantly influence user's perceptions of the service received (O'Cass & Carlson, 2012).

Shi *et al.* (2020) study omnichannel retail by analyzing five dimensions: connectivity, integration, consistency, personalization, and flexibility, which form part of a broader research model. However, other authors, such as Quach *et al.* (2022), examine the omnichannel process through critical variables such as channel quality, consumer experience, and the efficacy of multichannel sales strategies.

Finally, authors such as Gao *et al.* (2021) propose a model characterized by three distinct qualities: transparency, convenience, and fluidity between channels. In this study, the omnichannel experience variable is used as a reference (Shi *et al.*, 2020) because it encompasses the five omnichannel dimensions and structures the theoretical framework for future research.

Table 1
Multichannel vs. Omnichannel

	Multichannel strategy	Omnichannel strategy
Concept	Division among channels	Integration of all channels
Degree of integration	Partial integration	Full integration
Channel scope	Shop, website, and mobile channel	Shop, website, mobile channel, social networks, and customer contact points
Approach to customer relations: Brand vs. channel	Customer-retail channel approach	Customer-retail channel-brand approach
Goals	Goals by channel: Sales by channel Experience by channel	All channels work together to offer a comprehensive customer experience
Channel management	By channel: Management of channels and points of contact with the customer, oriented toward optimizing the experience with each Perception of interaction with the channel	Through all channels: Synergic management of channels and points of contact Personalized experiences aimed at optimizing the holistic experience Perceived interaction with the brand
Customers	No possibility of activating interaction Use of channels in parallel	Can trigger full interaction Use of channels simultaneously
Retailers	No possibility of controlling the integration of all channels	Control over the integration of all channels
Salespeople	No adaptation of sales behavior	Adaptation of sales behavior using different arguments, depending on the needs of each customer and their knowledge of the product

Source: Own elaboration based on the cited references: Piotrowicz and Cuthbertson (2014), Beck and Rygl (2015), Verhoef *et al.* (2015), Picot-Coupey *et al.* (2016), and Juaneda-Ayensa *et al.* (2016).

2.1.1. Connectivity

Connectivity in a multichannel environment refers to the integration of content and information from different points of contact with the consumer (Ailawadi & Farris, 2017; Shi *et al.*, 2020). Given that customers switch between channels, they expect a smooth transition facilitated by retailers (Cotarelo *et al.*, 2021; Zhang *et al.*, 2023). This interconnection can be achieved, for example, through QR codes or barcodes in physical stores (Beck & Rygl, 2015) or by providing addresses of the nearest physical stores (Williams *et al.*, 2015). Along these lines, digitalization disrupts the monopolistic ownership of direct commerce and creates opportunities for new interconnected channels to emerge (Reinartz *et al.*, 2019).

To offer an efficient omnichannel experience, it is essential to establish strategic links between different channels to optimize the flow of customers (Piotrowicz & Cuthbertson, 2014; Zhang *et al.*, 2018). In this regard, physical channels have limitations in terms of tools availability for information retrieval, underscoring the need to integrate them with virtual platforms (Gao & Su, 2017; Shi *et al.*, 2020).

Several studies have linked connectivity to variety and perceived convenience (Emrich *et al.*, 2015; Zhu *et al.*, 2018). According to Clemes *et al.* (2014), the incorporation of new channels by retailers significantly increases the perception of variety compared to when they are presented in isolation. Similarly, Zhu *et al.* (2018) argue that retailers with a strong connection to digital channels enhance the perception of convenience in the purchasing process.

2.1.2. Integration

According to Cheah *et al.* (2022) and Shi *et al.* (2020), integration refers to the degree to which consumers perceive that information, services, and content are seamlessly integrated across channels. Furthermore, Lee *et al.* (2019), Lu *et al.* (2017), and Yin *et al.* (2022) emphasize that integration is also related to retailers' ability to provide consistent shopping experiences at all points of contact.

According to Cui *et al.* (2022), Zhang *et al.* (2018), and Hult *et al.* (2019), integrated retailers are more likely to increase purchase intention, which, in turn, can lead to customer loyalty and positive word-of-mouth (Lee *et al.*, 2019; Savila *et al.*, 2019; Shakir *et al.*, 2020). Thus, channel integration enhances perceived variety and perceived convenience (Emrich *et al.*, 2015; Neslin, 2022; Pantano & Viassone, 2015), which subsequently increases purchase intention.

2.1.3. Consistency

Consistency refers to the extent to which customers experience coherence in content and information throughout the purchasing process (Shi *et al.*, 2020), thereby fostering a deeper understanding of the characteristics that define an omnichannel shopping environment (Tueanrat *et al.*, 2021).

Consistency in information, services, and experiences across an omnichannel retailer's channels has a positive impact on purchase intention (Lee *et al.*, 2019; Shen *et al.*, 2018). Moreover, this variable comprises two dimensions —service and content— both of which must maintain the same attributes and information across all channels (Shen *et al.*, 2018). Additionally, consistency in both information and services is one of the key factors influencing customer satisfaction and purchase intention (Ganesh, 2004).

Previous research has found that consumers highly value consistency, particularly in a retailer's ability to maintain the same level of customer service (Chang & Wu, 2016). This consistency improves perceived variety (Shi *et al.*, 2020) and, in the long run, enhances purchase intention (Patel *et al.*, 2020).

2.1.4. Flexibility

According to Shi *et al.* (2020), flexibility is defined as retailers' ability to offer consumers adaptable options and ensure a seamless experience when switching between different channels. This concept is reflected in the implementation of various payment solutions and the use of interconnected platforms that enable omnichannel integration (Hoogveld & Koster, 2016; Lewis *et al.*, 2014; Shen *et al.*, 2018).

Flexibility not only ensures continuity in the transition between channels but also enhances consumers' perceived convenience (Juaneda-Ayensa *et al.*, 2016; Shen *et al.*, 2018). Furthermore, several studies suggest that retailers that embrace and experiment with flexible technologies can better deliver an integrated and successful shopping experience (Alexander & Kent, 2022; Hübner *et al.*, 2021).

2.1.5. Personalization

Personalization refers to the extent to which customers receive customized care and service during the purchasing process within an omnichannel environment (Shi *et al.*, 2020). Additionally, customization is considered as a key metric for assessing the omnichannel customer experience. Adomavicius and Tuzhilin (2005) define personalization as a means of delivering tailored content and services based on consumer data.

With technological advancements, retailers can analyze this data to better understand customer behavior and provide relevant shopping recommendations, such as targeted promotions and personalized sales notifications (Oh & Teo, 2010).

Recent studies emphasize that the integration of digital technologies plays a crucial role in adopting and refining omnichannel strategies aimed at optimizing the overall consumer experience. Technologies such as artificial intelligence (AI), machine learning, and the Internet of Things (IoT) have demonstrated their ability to significantly enhance the effectiveness of these strategies (Vhatkar *et al.*, 2024).

Since personalization enriches the customer experience, retailers must leverage technology and data to gain insights their purchasing behavior and tailor the shopping journey accordingly (Hickman *et al.*, 2020; Hsia *et al.*, 2020). Moreover, personalized service fosters the perception that the omnichannel retailer values its customers, thereby increasing trust (Schramm-Klein *et al.*, 2011).

Table 2
Definition of the dimensions of the omnichannel experience

Construct	Definition	Example	Reference
Connectivity	The extent to which the content and information of the multichannel service are interconnected.	When a consumer scans a QR code or barcode in a physical store and is directed to the online shop.	Ailawadi & Farris (2017) Shi *et al.* (2020) Shen *et al.* (2018)
Integration	The degree to which the consumer perceives that information and content are well unified across channels.	When the launch of new products is synchronized across different channels.	Cheah *et al.* (2022) Li *et al.* (2018) Beck & Rygl (2015) Shi *et al.* (2020)
Consistency	The degree to which customers experience uniformity in content and information throughout the purchasing process.	When the price and promotional details of products remain consistent across all channels.	Shen *et al.* (2018) Shi *et al.* (2020) Beck & Rygl (2015)
Flexibility	The extent to which consumers are provided with adaptable options and a seamless transition between channels.	When a customer purchases a product online and receives after-sales service in a physical shop.	Shen *et al.* (2018) Hoogveld & Koster (2016) Lewis *et al.* (2014) Shi *et al.* (2020)
Customization	The level to which customers receive tailored care and service throughout the purchasing process.	When a retailer offers customized recommendations based on the customer's online purchase history.	Adomavicius & Tuzhilin (2005) Shi *et al.* (2020)

Source: Own elaboration based on the cited references.

2.2. Perceived convenience

Perceived convenience refers to the time and effort consumers save during the purchasing process (Pham *et al.*, 2018; Seiders *et al.*, 2007). Factors such as distance, scheduling inconsistencies, or limited payment options can present significant barriers, leading consumers to abandon a retailer in favor of a competitor (Keaveney, 1995; Rapp *et al.*, 2015).

In academic literature, perceived desirability is often examined as a mediating variable influencing purchase intention in retail contexts (Emrich *et al.*, 2015; Zhu *et al.*, 2018). In an omnichannel environment, perceived convenience is characterized by the ability to make purchases smoothly, easily, and effortlessly (Verhoef *et al.*, 2015), which significantly impacts consumers' purchasing intention (Clemes *et al.*, 2014; Mpinganjira, 2015).

Previous research has demonstrated that simplifying the purchasing process enhances convenience, increases user satisfaction, and ultimately drives purchase decisions (Emrich *et al.*, 2015; Zhu *et al.*, 2018). Moreover, Haley (1968) emphasized the importance of segmenting markets based on specific benefits sought by consumers. This approach enables companies to enhance customer satisfaction, boost sales, and establish a sustainable competitive advantage.

2.3. Perceived variety

Perceived variety refers to consumers' assessment of the number and diversity of available products (Emrich *et al.*, 2015). Retailers' distribution strategies should focus not only on replenishing inventory but also on ensuring accurate and efficient order fulfillment (Prassida & Hsu, 2022). This guarantees that consumers receive the necessary information to form an accurate perspective of the variety offered by the retailer (Mejía *et al.*, 2021).

Additionally, perceived variety is considered a key consumer benefit and is often studied as an intermediate variable influencing purchase intention (Emrich *et al.*, 2015; Zhu *et al.*, 2018).

In an omnichannel purchasing process, having access to a broad selection of products can facilitate decision-making and enhance the shopping experience (Bilgicer *et al.*, 2015; Kahn & Wansink, 2004). Furthermore, researchers suggest that expanding information channels can increase perceived variety, thereby positively affecting purchase intention (Omar *et al.*, 2023; Zhu *et al.*, 2018).

2.4. Purchase Intention

Purchase intention is defined as the conscious decision to buy from a certain brand (Lewandowska *et al.*, 2018; Spears & Singh, 2004). Similarly, Chang and Wu (2016) conceptualize omnichannel purchase intention as a person's decision to purchase products or services provided by a store with multiple sales channels.

Consumers' purchase intention is influenced by the quality of the retailer's omnichannel experience (Frasquet *et al.*, 2019; Kazancoglu & Aydin, 2018; Picot-Coupey *et al.*, 2016). In general, this quality and adaptation are the main elements impacting purchase intention and determining the success of an omnichannel business (Saghiri *et al.*, 2018; Yurova *et al.*, 2017). Therefore, it is essential for companies to understand customers' expectations regarding the omnichannel experience and provide them with appropriate service (Harrigan *et al.*, 2018; Shi *et al.*, 2020).

Regarding previous studies, authors such as Emrich *et al.* (2015) affirm that the perception of purchasing benefits, such as variety and perceived convenience, in addition to the channel structure, mediate purchase intention (Gao *et al.*, 2021). Other authors have discovered that these perceptions not only have an impact but also alter the purchasing process (Borle *et al.*, 2005; Ophuis & Van Trijp, 1995).

This research is organized as follows. First, the five omnichannel dimensions are conceptualized as a theoretical model called omnichannel experience, with a specific focus on the retail sector. Then, the role of consumer benefits, such as perceived variety and perceived convenience, in relation to omnichannel experience is analyzed. Furthermore, purchase intention is examined through consumer benefits and omnichannel experience.

The development of the quantitative method, the theoretical model from the consumer's perspective, and the adjustment of the scales are presented below. The model of Shi *et al.* (2020) was adapted for the omnichannel dimensions, along with the consumer benefits framework of Emrich *et al.* (2015) and the purchase intention model of Zhu *et al.* (2018). Finally, the data were analyzed, relevant factors were identified, and conclusions, limitations, and possible directions for future research were provided.

3. HYPOTHESIS FORMULATION

3.1. Relationship between omnichannel experience and perceived convenience

Omnichannel retailers tend to focus on their customers' expectations regarding physical and digital channels, leading them to make significant investments in the development and improvement of these integrated channels (Banik & Gao, 2023; Muchardie *et al.*, 2023). That is, they concentrate their efforts on increasing the convenience, simplicity, and coherence of their sales strategy (Chang & Li, 2022).

Thus, retailers can establish a solid relationship with consumers by developing a consistent and customized information service that is accessible across all channels (Lim *et al.*, 2022). This facilitates customers' perception of a well-structured and coherent omnichannel environment, making their purchasing process more convenient (Sun *et al.*, 2020).

Based on these research findings, the following hypothesis is proposed:

H1. The omnichannel experience has a direct impact on perceived convenience.

3.2. Relationship between omnichannel experience and perceived variety

The omnichannel consumer experience is based on the integration of several aspects, such as stock structure, order fulfillment, and the variety and availability of inventory (Goedhart *et al.*, 2023; Zhang *et al.*, 2018). Without effectively integrating these elements, consumers may question retailers' ability and capacity, negatively affecting satisfaction during the purchasing process (Li *et al.*, 2018).

Therefore, this structure must be strengthened, as consumers use the available information available to assess perceived variety (Mejía *et al.*, 2021). Studies have shown that good omnichannel integration encourages customers to make repeat purchases and recommend the brand to others (Xie *et al.*, 2023). Furthermore, Alang and Nguyen (2022) argue that buyers in an omnichannel environment can easily search for a product across the retailer's different channels, reinforcing consumers' perception of variety.

Based on these research findings, the following hypothesis is proposed:

H2. The omnichannel experience has a direct influence on perceived variety.

3.3. Relationship between omnichannel experience and purchase intention

During the omnichannel purchasing process, consumers choose the most convenient channel, allowing them to switch between channels without difficulty and contributing to a smooth shopping experience. This experience provides the retailer with a competitive advantage over competitors (Gao & Huang, 2021; Rakhmanita *et al.*, 2023).

Furthermore, a positive first omnichannel experience creates a differential advantage, encouraging consumers to make repeat purchases, provided that the retailer develops digital strategies that enable purchasing from any device (Cuesta *et al.*, 2023).

Based on these research findings, the following hypothesis is proposed:

H3. The omnichannel experience has a direct influence purchase intention.

3.4. Relationship between perceived convenience and purchase intention

Convenience enhances the consumer experience through integrated channels, both in product presentation and in the range of services offered, thereby increasing the likelihood of purchase. This is achieved through standardized distribution and the ability to make returns, which facilitates the purchasing process (Mirzabeiki & Saghiri, 2020).

Similarly, the omnichannel shopping experience and retailers' sales success depend on their ability to seamlessly integrate different channels as a key step in maintaining competitiveness (Pantano & Viassone, 2015). Moreover, time saving is one of the main advantages of omnichannel shopping, along with the ease of making returns (Sombultawee & Wattanatorn, 2022).

Based on these research findings, the following hypothesis is proposed:

H4. Perceived convenience has a direct impact on purchase intention.

3.5. Relationship between perceived variety and purchase intention

The variety offered by today's retailers is mediated by logistics and supply chains, which are key elements of any successful omnichannel strategy. The ability to effectively manage supply and inventory in an integrated manner across channels has a significant impact on the purchase intention of omnichannel consumers (Ben *et al.*, 2022; Lin *et al.*, 2022).

In this context, the omnichannel experience depends largely on consistency between channels, as this allows that the range of products, special sales, and services are displayed clearly, using the same information at all points of contact with the consumer (Alang & Nguyen, 2022; Cocco & Demoulin, 2022).

Based on these research findings, the following hypothesis is proposed:

H5. Perceived variety has a direct impact on purchase intention.

Subsequently, the conceptual framework of this study, based on the proposed hypotheses, is presented.

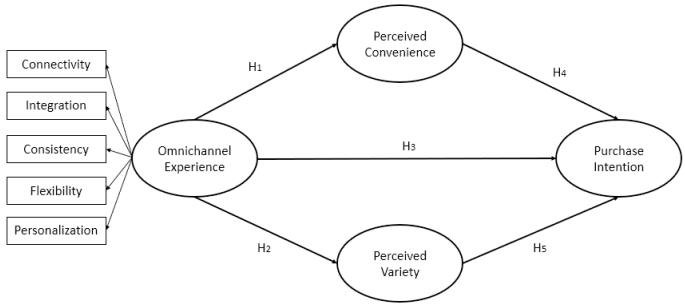

Figure 1
Research model

Source: Own elaboration based on theoretical review.

4. METHODOLOGY

4.1. Method

To address the study objective, a structured research study was conducted with a quantitative approach, allowing hypotheses to be tested and results to be obtained that can serve as a basis for future adaptations and studies. The scope was explanatory in nature, as it allowed the determination of the causes of the relationship between one or more variables and the conditions under which they occurred. The sampling method used was non-probabilistic, which helped control characteristics, reduce time, and identify the individuals who would participate in the research study. The study population consisted of individuals residing in Metropolitan Lima who are of legal age and were filtered based on their purchasing behavior. This means they had made online purchases with in-store pickup and/or home delivery and had also shopped in physical stores after visiting the websites of various retailers applying omnichannel methods (Falabella, Oechsle, Ripley, Sodimac, and Promart) within the last six months. These companies were selected due to their market prominence and status as industry standards. In Peru, they are also implementing omnichannel strategy, utilizing multiple channels to market and promote their business in a fluid and consistent manner.

The sample population comprised 452 individuals, of whom 420 responses were deemed valid following the elimination of

responses that lacked complete information or had significantly lower response times than the mean. The sample was nearly evenly split between men (49.76%) and women (50.24%). In terms of age, the largest group of participants was between 18 and 35 years old, making up 57.38% of the total respondents. Similarly, when asked to choose their preferred channel, 71.19% selected both the website and the physical store. Regarding the amount spent, the second spending range, from PEN 101 to PEN 300, was predominant, representing 59.52% of the total.

The data was collected using a self-administered online questionnaire via the QuestionPro platform, recognized for its effectiveness in gathering self-reported data. The survey was distributed through key social networks such as Facebook, LinkedIn, and Instagram, where a high proportion of omnichannel shoppers are concentrated. The entire data collection process strictly followed protocols to ensure participant anonymity and response reliability. The methodological process is shown in Table 3.

Table 3
Design summary

Focus	Quantitative
Location	Peru
Population	People with omnichannel experience
Sample size	420 people
Sample design	Non-probabilistic sampling
Data collection method	Online
Statistical technique	SEM (structural equation modeling)
Statistical software	SmartPLS 3.2.8

Source: Own elaboration.

4.2. Measurements

The indicators for each of the variables were adapted from measurement scales used in previous studies and translated from English into Spanish. A pilot test was then conducted on 30 shoppers with omnichannel experience to assess whether the language adaptation was understandable according to local criteria.

The instrument was divided into three sections. The first section comprised survey screening questions to confirm that respondents had recent omnichannel shopping experiences. This was followed by questions on demographic profiles and purchasing behavior. Finally, the scales measuring the dimensions of the omnichannel experience (OEX) were adapted from Shi *et al.* (2020): Connectivity (CON) with six indicators, integration (INT) with four indicators, Consistency (CONS) with five indicators, Flexibility (FLE) with three indicators, and Personalization (PER) with four indicators. Consumer benefits, as well as perceived convenience and perceived variety, were taken from Emrich *et al.* (2015), each measured with three indicators. Purchase intention (PI) was adapted from Zhu *et al.* (2018) and included three indicators. All indicators were measured using a 7-point Likert scale, where 1 corresponded to "strongly disagree" and 7 to "strongly agree."

5. RESULTS

In order to answer the hypotheses, a PLS-SEM model was developed. It is a multivariate analysis technique for complex latent variables, designed to test structural models and explain variance in the dependent variables (Henseler *et al.*, 2014). The study used the SmartPLS 3.3.8 software.

Because the OEX is a higher-order reflective construct, a two-stage approach was adopted. Thus, the model was assessed in three stages: reliability analysis of the first-order model, reliability analysis of the second-order model, and structural model assessment (Sarstedt & Cheah, 2019).

5.1. Analysis of the first-order measurement model

First, the reliability analysis of the individual loadings for each item was conducted using the criterion of Hair *et al.* (2019), that the loadings should be greater than 0.7 and that every loading less than 0.4 should be excluded. The results presented in Table 4 demonstrate values that comply with this standard.

Construct reliability was gauged using Cronbach's alpha and composite reliability metrics, adhering to the criteria established by Fornell and Larcker (1981), who state that the value should be equal to or greater than 0.70 to be considered reliable. As shown in Table 4, both instrument analyses fall within the established ranges. Moreover, convergent validity was analyzed through the average variance extracted (AVE), which should be equal to or greater than 0.5 (Hair *et al.*, 2019). As shown in Table 4, the values indicate high levels of convergent validity.

Table 4
Reliability and validity of the first-order model

	Loadings	Cronbach's alpha	rho_A	Composite reliability (CR)	Average variance extracted (AVE)	VIF
CON1	0.726					
CON2	0.728					
CON3	0.735	0.861	0.862	0.896	0.591	2.548
CON4	0.834					
CON5	0.801					
CON6	0.784					
CONS1	0.631					
CONS2	0.764					
CONS3	0.840	0.812	0.815	0.870	0.575	2.407
CONS4	0.765					

	Loadings	Cronbach's alpha	rho_A	Composite reliability (CR)	Average variance extracted (AVE)	VIF
CONS5	0.778					
FLE1	0.802					
FLE2	0.831	0.763	0.763	0.864	0.679	2.518
FLE3	0.838					
INT1	0.700					
INT2	0.787	0.793	0.796	0.866	0.620	2.716
INT3	0.872					
INT4	0.780					
PER1	0.809					
PER2	0.847	0.850	0.854	0.899	0.691	2.548
PER3	0.876					
PER4	0.789					
PI1	0.859					1.844
PI2	0.899	0.847	0.849	0.908	0.766	2.387
PI3	0.867					2.121
PC1	0.823					1.517
PC2	0.834	0.808	0.814	0.886	0.722	1.973
PC3	0.890					2.229
PV1	0.840					1.664
PV2	0.879	0.824	0.825	0.895	0.740	2.209
PV3	0.860					1.956

Note: CON = Connectivity; CONS = Consistency; PC = Perceived Convenience; FLE = Flexibility; INT = Integration; PI = Purchase Intention; PER = Personalization; PV = Perceived Variety

Source: Own elaboration based on estimation results in Smart PLS 4.0.

Finally, discriminant validity was evaluated using the Heterotrait-Monotrait Ratio (HTMT) correlation coefficient, as established by Henseler *et al.* (2014), which applies a more sensitive simulation criterion. The results in Table 5 show that all values are below 0.9, thus confirming adequate discriminant validity.

Table 5
Discriminant validity of the first-order model

	CON	CONS	PC	FLE	PI	INT	PER	PV
CON								
CONS	0.805							
PC	0.652	0.695						
FLE	0.822	0.867	0.623					
PI	0.637	0.646	0.489	0.670				
INT	0.863	0.831	0.656	0.782	0.615			
PER	0.780	0.727	0.647	0.837	0.661	0.857		
PV	0.743	0.713	0.692	0.762	0.692	0.751	0.722	

Source: Own elaboration based on estimation results in Smart PLS 4.0.

5.2. Analysis of the second-order measurement model

Once the reliability and validity of the first-order model had been verified, the next step was to validate the higher-order model through the OEX variable. In this case, consistent PLSc-SEM estimation was used, as it provides an effective solution for addressing issues related to consistency, the coefficients of the relationships between variables, and the correlations between constructs, thereby reducing both parameter overestimation and underestimation (Dijkstra & Henseler, 2015). Consequently, PLSc was chosen as the primary approach for parameter estimation in this study. Cronbach's alpha (0.908) and composite reliability (0.908) were above 0.70. The convergent validity (AVE = 0.663) exceeded the threshold of 0.5, as recommended by Dijkstra and Henseler (2015). Therefore, the reliability and validity of OEX were verified.

Finally, discriminant validity was assessed using the HTMT for all constructs in the second-order model. Table 6 shows that the values are below 0.9 (Henseler *et al.*, 2014), thus confirming the discriminant validity of second-order model.

Table 6
Discriminant validity of the second-order model

	PC	OEX	PI	PV
PC				
OXE	0.722			
PI	0.489	0.718		
PV	0.692	0.820	0.692	

Source: Own elaboration based on estimation results in Smart PLS 4.0.

5.3. Analysis of the structural model

First, the measurement scale was validated, and the structural model was analyzed to verify the hypotheses proposed through the algebraic sign, magnitude, and statistical significance of the path coefficients, beta, R^2 (coefficients of determination), and f^2 (effect size) (Hair *et al.*, 2019).

Any presence of approximate multicollinearity was ruled out using the VIF (variance inflation factor). Table 1 shows values lower than 5, thus confirming the absence of multicollinearity (Hair *et al.*, 2019).

Analysis of the coefficient of determination (R^2) shows that the proposed model has a remarkable explanatory capacity. Specifically, the results indicate that the OEX explains 52.3% of the variance in PC and 67.6% of the variance in PV. Additionally, 55.6% of the variance in PI can be attributed to the combination of OEX, PC, and PV. These results highlight the robustness of the model in capturing the relationships between the variables studied, supporting its applicability in similar contexts (Cohen, 1988).

The PLSc algorithm was applied, followed by bootstrapping with 5,000 subsamples and a p-value of less than 0.005 to determine the path coefficients and their respective levels of significance (Dijkstra & Henseler, 2015).

The results presented in Table 7 highlight the importance of the coefficients estimated in the model. First, the OEX shows an effect on PC, with a positive coefficient of β = 0.723 and a significance of P = 0.000, supporting hypothesis H1. Similarly, OEX impacts PV, with a positive coefficient of β = 0.822 and P = 0.000, thus confirming hypothesis H2. Furthermore, OEX also influences PI, as shown by the values (β = 0.512; P = 0.000). However, the analysis indicates that the effect of PC on PI is neither positive nor significant (β = −0.124; P = 0.168), leading to the rejection of hypothesis H4. Finally, PV affects PI, with a positive coefficient of β = 0.359 (P = 0.000).

Table 7
Results of the structural model

		Beta	T statistics	P-values Sig. less than 0.05	Hypotheses	f^2
H1	OEX -> PC	0.723	18.963	0.000	Accepted	1.094
H2	OEX -> PV	0.822	26.558	0.000	Accepted	2.089
H3	OEX -> PI	0.512	4.127	0.000	Accepted	0.164
H4	PC -> PI	−0.124	1.379	0.168	Rejected	0.015
H5	PV -> PI	0.359	2.620	0.000	Accepted	0.088

Source: Own elaboration based on estimation results in Smart PLS 4.0.

5.4. *Mediated analysis*

This study also analyzed the mediating effect of PC and PV on the relationship between OEX and PI to understand how these variables explain the relationship between the proposed variables in the omnichannel context. To assess the mediating role of PC and PV, the approach proposed by Nitzl *et al.* (2016) was applied. This approach includes the calculation of indirect effects, the evaluation of the significance of these effects through bootstrapping, and the determination of mediation type and size.

The first step was to calculate the direct effect of OEX on PI in the absence of intermediaries. The results showed that the direct effect of OEX on PI is significant, with a coefficient of β = 0.512 and p < 0.000, suggesting a direct relationship between the two (H3). However, when the mediating variables PC and PV were introduced, the direct relationship between OEX and PI decreased, indicating that a significant part of OEX's influence on PI is explained by the mediating variables. The next step was to calculate the indirect effects of OEX on PI through PC and PV. The analysis of the indirect effect of OEX on PI through PC resulted in a negative value:

$$\beta = 0.723 \times \beta = -0.124 = \beta{-}0.0897$$

This suggests a negative indirect effect, although this result is not significant, as the direct relationship between PC and PI was rejected. Therefore, this indirect effect is not relevant in the model.

In contrast, the indirect effect of OEX on PI through PV was positive and significant, calculated as:

$$\beta = 0.822 \times \beta = 0.359 = \beta = 0.295$$

This result highlights the key role of PV as a mediator in the relationship between OEX and PI, indicating that OEX affects the behavioral intentions of omnichannel consumers indirectly through value perceptions.

Finally, the total effect of OEX on PI was calculated by adding the direct and indirect effects. The direct effect of OEX on PI is β = 0.512, while the significant indirect effect through PV is β = 0.295. Thus, the total effect is:

$$\beta = 0.512 + \beta = 0.295 = \beta = 0.807$$

This indicates that OEX has a significant total effect on PI. H3 is thus accepted, as the direct effect is significant and the indirect effect through PV is also significant.

5.5. *Measurement of VAF mediation*

The VAF is calculated as the ratio between the total indirect effect and the total effect. It is interpreted as follows: if the VAF is less than 0.20, there is no mediation; if it is between 0.20 and 0.80, there is partial mediation; and if it is greater than 0.80, there is full mediation.

In this study, the VAF was calculated as 0.295/0.807 = 0.365, suggesting that the mediation of PV is partial in the relationship between OEX and PI. From these calculations, it can be seen that in the case of OEX -> PI, the indirect effect through PV represents approximately 36.5% of the total effect, while the direct effect accounts for 63.5%. The other hypotheses with direct effects and no mediators (OEX -> PC, OEX -> PV, and PV -> PI) have direct effects of 100%.

This means that although the direct relationship between OEX and PI remains significant, an important part of this effect is conveyed through PV, indicating that perceived variety is a relevant mediator but not the only one.

Subsequently, the effect size (f2) was evaluated to examine the strength of the relationship between the constructs. According to Cohen (1988), the values of f^2 are interpreted as follows: 0.02 represents a small effect, 0.15 a medium effect, and 0.35 a substantial effect. The results of the effect size analysis in Table 7 show that the effect sizes of all the exogenous variables on their respective endogenous variables were positive and greater than 0.02, except for the effect of PC on PI.

6. DISCUSSION

This research work studies the relationship between the dimensions of the omnichannel experience and the perceived benefits of consumers in relation to their purchase intention within the retail omnichannel context. Based on the results, the following points are worth highlighting.

First, it was found that the omnichannel experience has a direct and significant impact on perceived convenience. This finding is consistent with the results of Chang and Li (2022), Muchardie *et al.* (2023), and Sun *et al.* (2020), who also conducted research in the retail sector, where sales channels are integrated consistently. However, Ansari *et al.* (2008) and Zhu *et al.* (2018) offer a different perspective, pointing out that in traditional contexts without digital integration, consumers do not perceive the benefits of saving time and effort. This suggests that unless retailers improve the efficiency of the purchasing process, consumers will not experience the convenience of the omnichannel experience. It is therefore recommended that management implement key technologies for omnichannel marketing and enhance the brand experience, such as databases with customer information, search and purchase history, and real-time chatbots.

Similarly, the relationship between the omnichannel experience and PV was verified with almost the same intensity, aligning with the findings of Clemes *et al.* (2014) and Goedhart *et al.* (2023), who based their studies on smaller-scale retail sectors, focusing on marketing strategies tailored to their target audience and their preferences in the purchasing process. However, Mejía *et al.* (2021) and Prassida and Hsu (2022) present a contrasting view, arguing that the organization of omnichannel strategies in certain retail sectors is not sufficiently integrated with consumer needs. In these cases, retailers limit themselves to marketing through a single channel, whether traditional or digital. Therefore, it can be concluded that consumers perceive greater connectivity, flexibility, and personalization of sales channels, as well as a wider variety of available products, as beneficial. Consequently, it is recommended that management reinforce communication and information integration within inventories and the supply chain by implementing tracking and tracing technologies throughout the entire process, especially after each purchase.

Similarly, the impact of the omnichannel experience on purchase intention was verified, aligning with the findings of Gao and Huang (2021), Quach *et al.* (2022), and Rakhmanita *et al.* (2023), who researched consumers in large-scale retail sectors. However, Yin *et al.* (2022), Horáková *et al.* (2022), and Huang and Jin (2020) claim the opposite, arguing that there is no significant impact on purchase intention in a monopolistic environment, as retailers do not adopt a competitive omnichannel approach and consumers are constantly migrating. This suggests that consumers respond favorably to purchasing as long as consistency and connectivity in information are maintained, along with the integration, flexibility, and personalization of available channels. Based on this, it is recommended that management develop physical and virtual showrooms with the help of AI, allowing consumers to carry out simulations using their own image. Additionally, the integration of payment methods —such as enabling payments directly linked to the application or website— is essential.

Moreover, it was found that perceived convenience has no direct or significant effect on purchase intention, consistent with the findings of Kim *et al.* (2023), who assert that the new generation, as digital natives, does not find having multiple interconnected and easy-to-use shopping channels particularly appealing or novel. This contradicts Zhu *et al.* (2018), who suggest that adding new channels increases the likelihood of purchase, depending on the age range of the audience surveyed. It can therefore be inferred that retailers sometimes fail to properly understand the profiles of their target audience, preventing them from effectively meeting their purchasing needs. Thus, it is recommended that management offer services more aligned with consumer expectations, encouraging participation and fostering the creation of personalized consumer experiences. An example of this would be displaying the most sought-after products both in physical stores and on the retailer's websites. This strategy could attract consumers who typically shop in physical stores to explore virtual stores and vice versa, as most consumers are willing to use two or more purchasing channels.

The proposed model emphasizes the importance of perceived variety as a driver of purchase intention. This is also evident in the studies of authors such as Alang and Nguyen (2022) and Zhu *et al.* (2018), which show that customers tend to make purchases when they perceive a greater range of products across available channels. This contrasts with the findings of Wang *et al.* (2016) and Xie *et al.* (2023), who claim that if the necessary information is available in just one channel, purchase intention decreases (Hu *et al.*, 2023; Timoumi *et al.*, 2022). In this context, management is advised to implement a user experience that allows consumers to filter the retailer's product stock according to characteristics, attributes, and features. This would not only enhance consumer perception but also increase actual purchase intention.

To conclude, the relationships between the five dimensions of the omnichannel experience and consumer benefits, variety, and perceived convenience were analyzed, followed by their impact on purchase intention. It was found that retailers who implement strategies to enhance the omnichannel experience, while considering consumer perception, are more likely to increase sales and gain a competitive advantage.

7. IMPLICATIONS

Based on research on existing literature, the main theoretical contribution of this article lies in verifying the relationship between omnichannel dimensions —considered as an integrated variable called the omnichannel experience and consumer benefits (perceived variety and perceived convenience) in relation to purchase intention.

Previous studies analyze omnichannel retail in fragmented parts; therefore, this research seeks to expand the existing literature by conducting a multidimensional analysis of omnichannel variables in relation to consumer benefits and purchase intention. This approach addresses a notable limitation in the literature, as most available studies consider only three dimensions of omnichannel retail (Lee *et al.*, 2017; Wang *et al.*, 2016). However, the present study incorporates five dimensions, contributing to consumer knowledge and marketing strategies within an

omnichannel environment, It also highlights the implications of this study and builds upon the research conducted by Chang and Wu (2016), Quach *et al.* (2022), and Shi *et al.* (2020) in different contexts, particularly in relation to emerging markets.

In terms of practical implications, this study was conducted within a local omnichannel context and represents a significant advancement in research on the retail consumer experience, addressing an ongoing area of exploration. The findings suggest that an effective omnichannel experience positively impacts sales, providing retailers with an opportunity to enhance this experience and thereby increase purchase intention (Alang & Nguyen, 2022). Therefore, omnichannel managers are advised to optimize connectivity across all channels to ensure seamless integration and minimize disruptions in the purchasing process. Furthermore, it is essential to ensure consistency in communication by providing customers with truthful, accurate, and reliable information and facilitating seamless interactions across all channels to prevent customer service issues. Flexibility is also a key aspect, which entails offering diverse purchasing options, such as multiple payment solutions, as suggested by Shen *et al.* (2018). This integration should encompass both channels and payment alternatives, ensuring a coherent and smooth promotional experience, including on social networks. Given that younger generations are digital natives, the lack of interconnection between physical and digital channels, as well as the absence of consistent communication, represents a competitive disadvantage in today's market; in fact, most consumers prefer to use multiple channels (Kim *et al.*, 2023). Finally, it is essential that omnichannel retailers adopt the latest AI technologies to adapt to and anticipate customer preferences. By leveraging algorithms based on browsing histories, retailers can offer personalized promotions and recommendations that enhance the shopping experience. Regarding perceived variety, it is advisable to maintain a broad and diverse stock to facilitate product selection, coupled with an efficient payment process that saves time, thus providing a successful and integrated shopping experience, as proposed by Alexander and Kent (2022).

8. LIMITATIONS AND FUTURE RESEARCH

With regard to the limitations of the present study, the main constraint is that it is a non-probabilistic study. Furthermore, there is a paucity of studies validating the relationships previously proposed in the model, given that the Peruvian context is a developing market in terms of omnichannel retail, with relatively few stores implementing this strategy. As a result, the limited number of stores restricts the scope of the study, consequently limiting the potential sample size for survey participation. Therefore, longitudinal research should be conducted to analyze market trends and retailer commitment within an omnichannel environment.

It is also recommended that the study be replicated in other countries in the region to determine whether the results remain consistent or, if they different, to enable comparisons using a more probabilistic method. Expanding the sample size in a broader investigation would be ideal for future studies. Finally, it is advised that this study be replicated while assessing whether the variables should be retained or modified.

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ANNEX 1

Variables Indicators

Connectivity	**CON1**	I can check product availability across different channels (website, app, physical store).
	CON2	I can access product information through multiple channels (website, app, physical store).
	CON3	I can verify in-store stock availability through online channels (website, app).
	CON4	My browsing experience is continuous and synchronized across different channels (website, app, physical store).
	CON5	My registered username is synchronized across multiple channels (website, app).
	CON6	My interactions with customer service are interconnected across different channels (website, app, physical store).
Integration	**INT1**	My search history is considered for each purchase across different channels (website, app).
	INT2	The quantity of products available is consistent across all channels (website, app, physical store).
	INT3	New products are launched simultaneously across different channels (website, app, physical store).
	INT4	Promotions and discounts are applicable across all channels (website, app, physical store).
Consistency	**CONS1**	Brand names and slogans remain consistent across different channels (website, app, physical store).
	CONS2	My impression of the sales service remains the same across all channels (website, app, physical store).
	CONS3	I receive consistent information across different channels (website, app, physical store).
	CONS4	Product quality remains the same across all channels (website, app, physical store).
	CONS5	Service performance is equally effective across different channels (website, app, physical store).
Flexibility	**FLE1**	I can choose between different channels for specific services (e.g., delivery, after-sales support).
	FLE2	After-sales service is available across multiple channels (website, app, physical store).
	FLE3	I can perform various actions through my preferred channels (e.g., purchase options, order tracking).
Customization	**PER1**	My purchase recommendations are based on my purchase history and personal information.
	PER2	Discounts and purchasing privileges are offered based on my purchase history and personal information across different channels (website, app, physical store).
	PER3	Websites are personalized based on my purchase history and personal information across different channels (website, app, physical store).
	PER4	Member rewards (e.g., CMR points, bonus points) are offered based on my purchase history across different channels (website, app, physical store).
Perceived convenience	**PC1**	In general, I can select a product quickly and easily in any format (both physical and virtual).
	PC2	Choosing a product requires minimal time and effort in both physical and virtual stores.
	PC3	It is easy to find the product I am looking for, whether in a physical or virtual store.
Perceived variety	**PV1**	There is a wide variety of products available in stores (both physical and virtual).
	PV2	The product stock in stores (both physical and virtual) offers me a broad selection to choose from.
	PV3	The products stock in stores provides me more ways to enjoy my shopping experience (both physical and virtual).
Purchase intention	**PI1**	I prefer stores that offer multiple purchasing channels (website, app, physical store).
	PI2	I would prefer to buy products from stores that expand their purchasing channels in the coming years (website, app, physical store).
	PI3	I would recommend this store because of the benefits it offers through its new channels (physical and digital).

Management Letters / Cuadernos de Gestión 25/2 (2025) 37-52

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Fundación Emilio Soldevilla para la Investigación y Desarrollo de la Economía de la Empresa

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Management Letters / Cuadernos de Gestión

journal homepage: https://ojs.ehu.eus/index.php/CG

ISSN: 1131-6837 / e-ISSN: 1988-2157

Bricoleur mindset in sales: Empowering trade fair performance

Mentalidad resolutiva en ventas: Potenciando el desempeño en ferias comerciales

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ARTICLE INFO

Received 12 January 2025,
Accepted 18 April 2025

Available online 2 June 2025

DOI: 10.5295/cdg.252346pm

JEL: M10; M31

ABSTRACT

A significant advantage in a constantly evolving trade fair environment is the bricoleur mind set. This is particularly relevant for a company deserving to participate in a trade fair but face challenges such as intense competition, resource allocation problems, and the need for adaptability. This research investigates the impact of bricoleur behaviour and problem-solving confidence on exhibitor performance at trade fairs offering valuable information about the dynamics of salespeople behaviour on a trade fair environment and the impact on the performance of company's trade fair participation. Therefore, the study addresses the gap in the literature regarding the bricoleur behaviour of salespeople at trade fairs, investigating how they creatively use available resources to navigate the complexity of these events and improve their performance. Grounded in the Bricolage and Stressor Event theories, the study explores the swift and effective adaptation required at trade fairs, offering managerial insights and directions for future research. The study adopts a quantitative approach, by examining a sample of 304 Portuguese and Kosovar companies by a covariance-based Structural Equation Modelling (CB-SEM). The study results confirm the importance of bricoleur behaviour and confidence in problem-solving for exhibitor performance at trade fairs. The findings align with supporting theories, and the integrated approach of these skills culminates in a "bricolage thinking", which is essential for navigating complex and high-pressure environments such as trade fairs, thereby contributing to the overall success of these business platforms.

Keywords: Bricoleur, Sales, Trade fairs, Performance, Problem solving confidence.

R E S U M E N

Una ventaja significativa en un entorno de feria comercial en constante evolución es la mentalidad resolutiva. Esto es especialmente relevante para empresas que, pese a merecer participar en ferias comerciales, enfrentan desafíos como la competencia intensa, problemas de recursos y la necesidad de adaptabilidad. Esta investigación analiza cómo el comportamiento resolutivo y la confianza en la resolución de problemas afectan el desempeño de los expositores, aportando información valiosa sobre la dinámica de los vendedores en estos entornos y su impacto en el éxito empresarial. Por lo tanto, el estudio aborda la brecha en la literatura sobre el comportamiento resolutivo de los vendedores en ferias comerciales, investigando cómo utilizan creativamente los recursos disponibles para navegar por la complejidad de estos eventos y mejorar su desempeño. Fundamentado en las teorías de Resolutivo y Eventos Estresantes, el estudio explora la adaptación rápida y efectiva requerida en ferias comerciales, ofreciendo ideas de gestión y direcciones para investigaciones futuras. El estudio adopta un enfoque cuantitativo, examinando una muestra de 304 empresas portuguesas y kosovares mediante un Modelo de Ecuaciones Estructurales basado en Covarianza (CB-SEM). Los resultados del estudio confirman la importancia del comportamiento resolutivo y la confianza en la resolución de problemas para el desempeño de los expositores en ferias comerciales. Los hallazgos se alinean con las teorías de apoyo, y el enfoque integrado de estas habilidades culmina en un «pensamiento resolutivo», esencial para navegar en entornos complejos y de alta presión como las ferias comerciales, contribuyendo así al éxito general de estas plataformas empresariales.

Palabras clave: Resolutivo, Ventas, Ferias comerciales, Desempeño, Confianza en la resolución de problemas.

1. INTRODUCTION

In recent years, the notion of bricoleur has attracted increasing attention in sales literature, particularly considering its potential implications for navigating high-pressure environments and promoting adaptive behaviours among sales professionals (Epler & Leach, 2021; Epler *et al.*, 2023). During the competitive landscape of trade fairs, where companies compete for attention, leadership and market share (Silva *et al.*, 2021; 2022), the ability to improvise, innovate and take advantage of available resources might be the difference between success and obscurity.

In the dynamic settings of trade fairs, marked by interactions with various stakeholders and relevant levels of competition and uncertainty (Gerschewski *et al.*, 2020; Silva *et al.*, 2022), bricoleurs stand out in exploring unexpected opportunities, adapting to evolving circumstances and designing innovative solutions to achieve goals (Epler & Leach, 2021; Epler *et al.*, 2023; Wu *et al.*, 2024). This adaptability can be essential to success at trade fairs, where companies invest significant resources and efforts to ensure sustained engagement and fruitful results over time (Lee *et al.*, 2021; Nayak, 2019). In this sense, it is also worth highlighting the crucial role of salespeople, particularly in the context of trade fairs, where their proactive and adaptable approach is critical (Gerschewski *et al.*, 2020; Silva *et al.*, 2022). Given the competitive nature of trade fairs and the diverse needs of attendees, salespeople should adopt the mindset of a bricoleur – continuously adapting their strategies, tactics, and approaches to effectively leverage available resources and meet the unique demands of each customer (Epler & Leach, 2021). This focus on tailored engagement highlights the crucial role of salespeople's performance at trade fair booths in driving success.

Despite this growing recognition of the relevance of bricoleur in sales contexts (Epler & Leach, 2021; Epler *et al.*, 2023), empirical studies exploring its manifestation and impact at trade fairs are practically non-existent. This study seeks to address this gap by investigating the role of bricoleur behaviour among salespeople at trade fairs which seems to be an unexplored territory in the literature. By examining how salespeople leverage bricoleur to navigate the complexities of trade fairs, this investigation aims to shed light on the mechanisms through which bricoleur behaviour influences problem-solving confidence, and exhibitor performance. The objectives of this study are holistically supported by three fundamental theories: the Resource-Based View Theory, Bricolage Theory and the Stressor Event Theory. The Resource-Based View theory proposes that rather than relying on external resources or costly solutions, a company should maximize the potential of its existing assets (Sivathanu & Pillai, 2020). The Bricolage Theory, initially developed by Claude Lévi-Strauss in the field of anthropology (Lévi-Strauss, 2021), was later adapted to explain phenomena in organisational and sales contexts by Epler and Leach (2021). This theory emphasises the ability to solve problems creatively by using available resources in innovative and unconventional ways (Lévi-Strauss, 2021). In the sales context, this translates into the ability of salespeople to improvise and adapt quickly to meet customer needs with the resources at hand (Epler & Leach, 2021). Given the highly dynamic business world today, salespeople must be trained to use improvisation to respond to unforeseen situations (Charoensukmongkol & Suthatorn, 2021).

On the other hand, the Stressor Event Theory examines how certain events can act as stressors for individuals and organisations, challenging their ability to cope with changes and unexpected demands (Lerman *et al.*, 2020). Trade fairs, while powerful in attracting customers, are characterised by a constant need for rapid adaptation, complex interactions, and measurable outcomes. These characteristics make trade fairs challenging events that require agile and effective responses from the salespeople present at the stands, as pointed out in studies by Li (2020), Gerschewski *et al.* (2020) and Silva *et al.* (2022).

The bricolage theory can be seen as an application of the Resource-Based View in the sales context, where companies creatively utilise available resources to overcome challenges (Epler & Leach, 2021; Epler *et al.*, 2023; Sivathanu & Pillai, 2020). This process is particularly relevant in environments such as trade fairs and business events, which are characterised by high-pressure contexts, challenging the ability of salespeople to cope with unexpected changes and demands, as highlighted by the Stressor Event Theory (Lerman *et al.*, 2020). Trade fairs require salespeople to quickly adapt to different types of customers, market conditions, and unexpected situations, making bricolage a crucial skill for integrating resources in a creative and efficient manner. Thus, the study of salespeople's bricolage at trade fairs fills existing gaps in the literature, offering significant contributions to both the theoretical and practical advancement of bricolage understanding within business contexts, as emphasised by Mateus and Sarkar (2024), including the context of small and medium-sized enterprises (SME), as noted by Gerçek (2024).

The paper begins by establishing a theoretical framework and rationale for the proposed hypotheses, followed by a description of the methodology and presentation of research findings. These findings are then discussed, providing managerial insights and guidance. Finally, the paper addresses limitations and suggests avenues for future research.

2. LITERATURE REVIEW

2.1. The bricoleur mindset of the salesperson

The concept of bricolage, introduced by Claude Lévi-Strauss in 1962 in "The Wild Thought" (Lévi-Strauss, 2021), describes spontaneous problem-solving akin to a handyman using available resources. Kincheloe defines a bricoleur as someone who utilizes available tools to complete tasks (Kincheloe, 2001). Markham similarly refers to a bricoleur as a "tinkerer or handyman" (Markham, 2018).

Kincheloe also highlights the bricoleur's ability to understand interconnected contexts (Kincheloe, 2005), aligning with Bricolage Theory, which emphasizes creative resource use for problem-solving. This adaptability has led researchers to explore the bricoleur mindset in various fields, such as entrepreneurship (Wu *et al.*, 2024) and in sales context (Epler & Leach, 2021).

Bricolage demonstrates resourcefulness and proficiency, allowing individuals to navigate challenges across different contexts. As a vital capability, it enhances business resilience, particularly during crises (Baier-Fuentes *et al.*, 2023). The ability to improvise and adapt makes bricolage an essential skill for organizations facing stress and limitations (Baier-Fuentes *et al.*, 2023; Epler & Leach, 2021; Santos

et al., 2022). The use of bricolage behaviours by salespeople can be an effective strategy for overcoming resource constraints (Epler & Leach, 2021). Furthermore, according to the Resource-Based View theory, companies can creatively recombine their existing resources to gain a competitive advantage (Sivathanu & Pillai, 2020). The key is not merely having more resources but knowing how to use them efficiently, especially in unexpected and challenging moments.

Stress is a common issue in sales, influenced by various intrinsic factors. Sales supervisors often face pressure to meet goals, exceed quotas, and expand market share (Brown *et al.*, 2022), leading to work overload and potential burnout (Franck & Dampérat, 2022). Emotional exhaustion can arise from a mismatch between available resources and the demands placed on salespeople (Peasley *et al.*, 2020). High-stress periods, such as during the pandemic, highlighted the importance of a "bricoleur attitude" (Epler & Leach, 2021). This adaptability helps mitigate stress by fostering proactive problem-solving rather than paralysis in the face of challenges (Baier-Fuentes *et al.*, 2023; Epler & Leach, 2021; Santos *et al.*, 2022). Thus, the concept of the "salesperson as bricoleur" emphasizes their ability to creatively and flexibly utilize available resources to address specific customer needs and sales situations (Epler & Leach, 2021).

2.2. Salesperson as bricoleur in trade fair environment

In the context of trade fairs, which involve interactions with numerous exhibitors, customers, and competitors amidst high competitiveness and uncertainty (Silva *et al.*, 2022), bricoleurs can identify unexpected opportunities, adapt to changing conditions, and devise innovative solutions to meet their goals (Wu *et al.*, 2024). This aligns with Bricolage Theory (Lévi-Strauss, 2021), emphasizing creative resource use for problem-solving.

The dynamic nature of trade fairs also connects to Stressor Event Theory (Lerman *et al.*, 2020), which explores how stressors like competition impact performance and adaptation strategies. Hosting a trade fair requires substantial financial investment and effort, often demanding a commitment spanning at least three years for sustained success (Nayak, 2019; Lee *et al.*, 2021). The benefits of participating in trade fairs typically manifest gradually over time (Kim *et al.*, 2020).

These challenges are especially pertinent for resource-limited companies that frequently attend trade fairs (Display Wizard, 2024; Silva *et al.*, 2022). Furthermore, trade fairs are evolving into demanding environments requiring omnichannel experiences, both physical and virtual (Silva *et al.*, 2023). Consequently, while trade fairs offer significant rewards for exhibitors, they also present considerable challenges (Silva *et al.*, 2022).

Trade fairs are competitive events where interactions before and during the event, along with staff motivation, play a key role in building trust between exhibitors and visitors (Jia & Wan, 2022). Gerschewski *et al.* (2020) and Silva *et al.* (2022) emphasize the critical role of salespeople, who must be proactive and capable of initiating relationships with strangers. Given that many participating companies are SMEs with limited resources (Display Wizard, 2024), it is essential for salespeople to adapt their approaches and strategies creatively to meet each visitor's unique needs, embodying the qualities of a bricoleur (Epler & Leach, 2021). Thus, the selection, supervision, and management of sales personnel before and during trade fairs are crucial (Jia & Wan, 2022).

2.3. Conceptual model and formulation of hypotheses

2.3.1. Bricoleur mindset and problem-solving confidence in trade fair

A salesperson's bricoleur mentality helps them navigate unexpected challenges in negotiations, develop innovative solutions for customer needs, and adapt to various sales situations (Epler & Leach, 2021). This adaptability enables them to effectively address issues during trade fairs by creatively utilizing available resources. Exhibitors face several challenges at trade fairs, including high costs, extensive preparation, and intense competition, all of which require them to stand out and manage resources efficiently (Gerschewski *et al.*, 2020; Silva *et al.*, 2022). Additionally, the complexity of trade fairs is heightened by the need to navigate dynamic environments, seize international networking opportunities (Gerschewski *et al.*, 2020), adapt to digitalization challenges (Silva *et al.*, 2023; Vitali *et al.*, 2022), and manage unexpected situations while engaging with unfamiliar attendees (Jia & Wan, 2022).

Promoting bricoleur behaviour among salespeople is beneficial and can be developed within a sales team, as it helps address the challenges of the sales function (Epler *et al.*, 2023). In trade fairs, innovation and proactive measures enhance communication and social interaction (Kim *et al.*, 2020). Improvisation skills can lead to improved performance (Carlson & Ross, 2022) and help salespeople take risks while boosting their confidence to complete projects (Ahmed & Lucianetti, 2024). Proactiveness empowers salespeople to effectively navigate the unique dynamics of trade fairs (Gerschewski *et al.*, 2020; Silva *et al.*, 2022) by shifting away from rigid, scripted sales pitches toward more spontaneous and adaptive approaches (Carlson & Ross, 2022). It is important to note, however, that in today's competitive and globalized environment, where differentiation and corporate responsibility are crucial, an ethical approach to sales is key to enhancing customer satisfaction and building lasting relationships (Román-Nicolás & Rodríguez-Herrera, 2018). Thus, in challenging scenarios, bricolage skills enable resourceful problem-solving, allowing salespeople to manage resources creatively and effectively (Baier-Fuentes *et al.*, 2023). This adaptability is underpinned by key traits such as creativity, a learning orientation, and grit, which together foster agility and resilience (Epler & Leach, 2021). Consequently, bricoleur behaviour positively influences a salesperson's problem-solving confidence, which encompasses both the belief in one's problem-solving ability and the practical skills to tackle challenges (Soliman, 2014; Sturm & Bohndick, 2021; Heppner *et al.*, 2012). This confidence is crucial for achieving desired outcomes during trade fairs. Based on this discussion, the following hypothesis is proposed:

H1. In the context of a trade fair, the bricoleur behaviour exhibited by the salesperson exerts a positive influence on their problem-solving confidence.

2.3.2. Bricoleur confidence, problem-solving and exhibitor performance

The adaptability, creativity, resilience, and improvisation skills of a bricoleur salesperson (Epler & Leach, 2021) enhance their confidence in solving problems. Self-confidence is essential for effective communication and collaboration in problem-solv-

ing (Hendriana *et al.*, 2018) and fosters a learning environment (Clegg & Diller, 2018). Confident individuals better understand problems, create solutions, and assess outcomes (Favorina *et al.*, 2023). Confidence is typically higher when dealing with clear, specific issues (Scheibe *et al.*, 2022). At trade fairs, bricoleur salespeople help exhibitors navigate challenges like competition and communication, leading to improved performance through agility, innovation, and resilience (Silva *et al.*, 2022).

Regarding performance, Hansen (2004) identifies five key salesperson activities at trade fairs: sales, information gathering, relationship building, image building, and motivation. These align with Rai and Nayak (2020), who suggest trade fairs enhance well-being and go beyond sales, also focusing on sharing knowledge and building brand reputation (Katie *et al.*, 2022).

First, "Sales-related activities" focus on increasing sales from trade events (Hansen, 2004). Sales are a primary goal for exhibitors, and the salesperson's confidence in problem-solving plays a key role in performance (Silva *et al.*, 2022). Bricoleur salespeople, with their adaptability, resourcefulness and self-confidence, make quick, effective decisions, which boosts business performance (Epler & Leach, 2021; Maczulskij & Viinikainen, 2023). Salespeople must build strong relationships and adapt strategies to customer needs, which improves sales outcomes (Good & Schwepker, 2022). Engaging in problem-solving helps salespeople guide customers through the buying journey, leading to better overall performance (Panagopoulos *et al.*, 2017).

Second, "Information-gathering activities" involve collecting data on the market, competitors, trends, and potential customers at trade fairs (Hansen, 2004). Trade fairs offer valuable insights (Silva *et al.*, 2021), and confident salespeople are more effective in engaging customers and stakeholders, establishing meaningful connections. Customers often prefer human interaction for solving complex issues over artificial intelligence (Xu *et al.*, 2020), making trade fairs ideal for strengthening relationships. Usually, participants actively seek information and engage with technical staff, who reciprocate this interest (Haon *et al.*, 2020; Jha *et al.*, 2019). These events facilitate knowledge exchange and offer exhibitors the chance to stay updated on industry trends and innovations, enhancing their innovation capacity (Wu *et al.*, 2022). Thus, salespeople with bricolage behaviours are key in this dynamic environment, proactively gathering critical market intelligence (Epler & Leach, 2021).

The third dimension, "relationship-building activities", aims to establish long-term connections with customers and partners (Hansen, 2004), giving exhibitors a competitive advantage through value co-creation (Zhang *et al.*, 2023). Effective networking boosts exhibitors' knowledge (Li *et al.*, 2022), and bricolage is crucial at trade fairs, where new contacts are common (Silva *et al.*, 2022). The unpredictable environment makes adaptability vital (Mormile *et al.*, 2023), and bricoleurs excel in creatively tackling challenges (Epler & Leach, 2021). Despite technological advances, face-to-face interactions remain key for trust and relationship-building (Zhang *et al.*, 2023; Yu & Benson-Rea, 2024). Salespeople are key in creating value and building customer trust, which is essential for the success of trade exhibitions (Arditto *et al.*, 2020).

The fourth dimension, "image-building activities", focuses on enhancing a company's reputation through trade fair participation (Hansen, 2004). A strong reputation is a key resource for navigating challenges (Cavazos *et al.*, 2023) and adapting to business changes (Chaudhary *et al.*, 2021). Salespeople, especially those with a bricolage approach, play a crucial role by addressing customer needs and challenges at trade fairs. Their ability to improvise and solve problems boosts the company's image (Epler *et al.*, 2023). Autonomy in sales can improve customer perceptions, especially when promoting new products (Endres *et al.*, 2022), further strengthening the company's reputation and network (Kang *et al.*, 2019).

Lastly, "motivation activities" focus on inspiring both the exhibition team and potential customers (Hansen, 2004). Bricoleur salespeople excel at problem-solving and optimizing resources (Epler & Leach, 2021), helping to filter opportunities at trade fairs. While focusing too much on sales can overwhelm salespeople (Claro *et al.*, 2023), a bricoleur's adaptability helps them choose the best prospects. Handling rejection and staying motivated are key to success in high-pressure environments (Ewe & Ho, 2023). Salespeople are crucial in fostering relationships and achieving non-sales goals at trade fairs, benefiting both exhibitors and visitors (Jha *et al.*, 2019).

Trade fairs present challenges like intense competition, limited resources, and the need for adaptability. In this dynamic environment, salespeople are crucial, not just for transactions but for navigating complexities. Their roles in gathering information, building relationships, and representing the company are key. Bricoleur behaviours —adaptability, creativity, resilience, and improvisation— boost problem-solving confidence and help handle unexpected situations (Epler & Leach, 2021). These skills enable them to devise solutions and evaluate outcomes effectively (Favorina *et al.*, 2023). The following hypotheses explore how these traits impact exhibitor performance at trade fairs:

H2. In the context of a trade fair, the problem-solving confidence exhibited by the salesperson exerts a positive influence on exhibitor performance.

H3. In the context of a trade fair, the bricoleur behaviour exhibited by the salesperson exerts a positive influence on exhibitor performance.

2.3.3. Multi-dimensional exhibitor performance

Hansen (2004) categorizes exhibitor performance into five dimensions, which Zhang *et al.* (2023) recently used to assess exhibitor outcomes, demonstrating their continued relevance. Both studies treat "exhibitor performance" as a second-order construct, where multiple first-order factors represent the overall performance. This approach is widely supported in the literature (Chen *et al.*, 2005). These five dimensions —sales, information-gathering, relationship-building, image-building, and motivational activities— align with Rai and Nayak's (2020) view that trade fairs are not just for business goals but also enhance participants' well-being. Exhibitors aim to share knowledge, build relationships, and boost brand reputation (Katie *et al.*, 2022). Effective booth interactions are key to achieving these objectives (Li, 2020).

The adaptability and resourcefulness of a bricolage salesperson (Epler & Leach, 2021) enable them to respond to changes, adjust strategies, and maximize exhibitor performance across all dimensions. Whether handling sales, gathering information, fostering relationships, or enhancing the company's image, the bricolage salesperson is a vital asset. These subconstructs of Hansen (2004) highlight how each dimension contributes to exhibitor success at trade fairs. The following hypotheses are specified:

H4A: The dimension of sales-related activities contributes positively to enhance the exhibitor's performance.

H4B: The dimension of information-gathering activities contributes positively to enhance the exhibitor's performance.

H4C: The dimension of relationship-building activities contributes positively to enhance the exhibitor's performance.

H4D: The dimension of image-building activities contributes positively to enhance the exhibitor's performance.

H4E: The dimension of motivational activities contributes positively to enhance the exhibitor's performance.

2.3.4. Conceptual model

The proposed model examines the relationship between bricoleur behaviour and salespeople's problem-solving confidence at trade fairs, and its impact on exhibitor performance. The model identifies bricoleur behaviour —characterized by adaptability, creativity, resilience, and proactive improvisation (Epler & Leach, 2021; Epler *et al.*, 2023)— as the independent variable. It suggests that this behaviour enhances both problem-solving confidence and exhibitor performance. Problem-solving confidence, which is driven by creativity, determination, and improvisation, serves as both a dependent and independent variable, playing a crucial role in overcoming challenges (Epler & Leach, 2021). The dependent variables include five dimensions of exhibitor performance: sales, information gathering, relationship building, image building, and motivation (Hansen, 2004). This model allows for a detailed analysis of each performance dimension, offering targeted recommendations for improvement. Figure 1 illustrates the model.

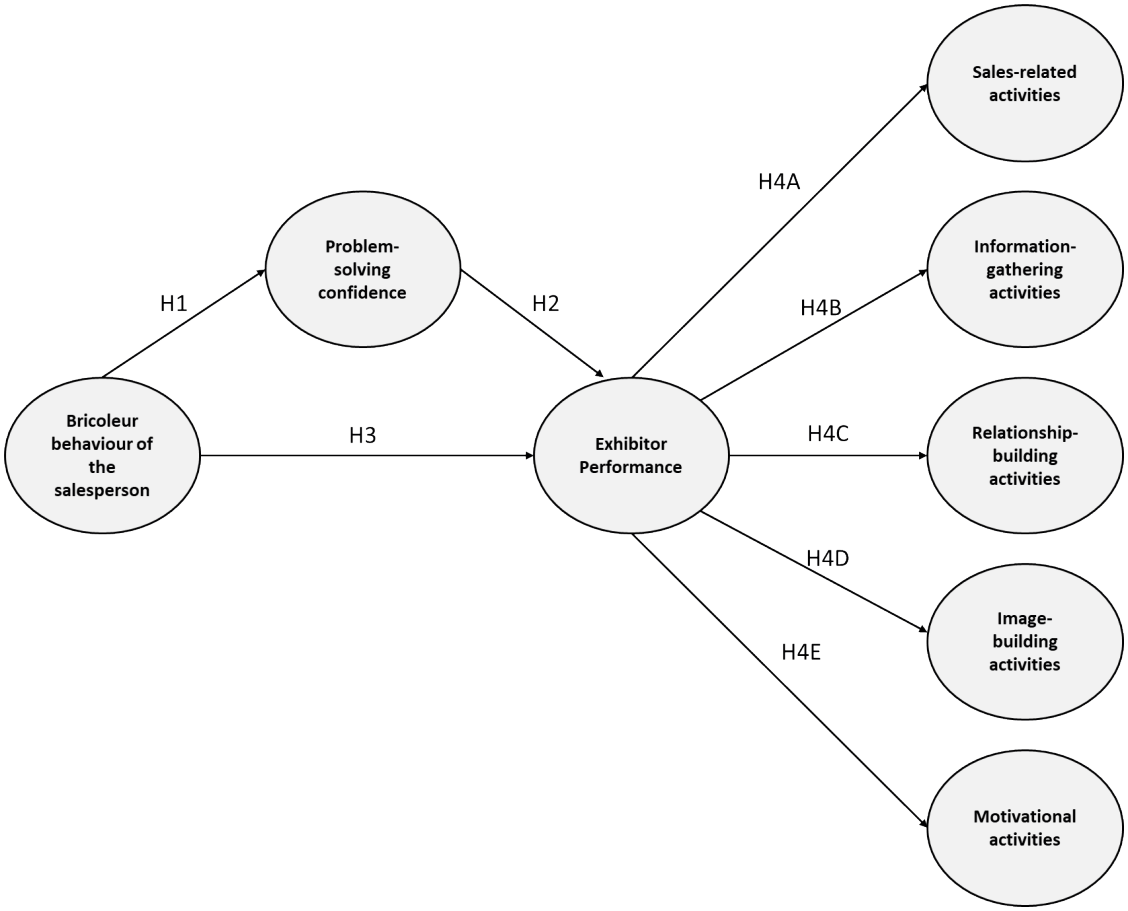


Figure 1
Conceptual Model
Source: Own elaboration.

2.4. Control variables

To better understand how the profiles of salespeople and the companies they work for influence exhibitors' performance, this study incorporates various control variables. Widely used in sales research, these variables include gender, age or generation, education and years of experience (Gao *et al.*, 2020; Liu *et al.*, 2020). Regarding the characteristics of the companies, categories such as type of company, company size, export level, and level of participation in trade fairs were considered, following approaches from previous studies (Silva *et al.*, 2022; Silva *et al.*, 2023).

The inclusion of control variables in the analysis adds depth and reliability to the findings by accounting for factors that may influence exhibitors' performance. Additionally, their inclusion provides valuable insights that could guide future research (Nielsen & Raswant, 2018).

3. METHODOLOGY

3.1. Data collection

Data was collected via a structured questionnaire based on the literature review and research objectives. The questionnaire was sent to companies at trade fairs in Portugal and Kosovo. Combining these samples aligns with Ghemawat's (2001) view that globalization enhances the relevance of cross-country studies, offering insights for both emerging and mature economies. Business associations in both countries provided access to random databases of 1450 Portuguese and 1560 Kosovar companies, and all 3010 were contacted by email in January 2024. In total, 304 valid responses from salespeople were received. All companies listed in the databases had an equal opportunity to respond. Table SF1 (supplementary file) presents the characteristics of the respondents and the companies they represent.

The sample comprises three hundred and four (304) sales professionals, with 59.54% from Portuguese companies, 26.97% from Kosovar companies, and 13.49% from companies of other nationalities but located in Portugal and Kosovo. In terms of gender, it is observed a similar distribution between male and female professionals. Regarding age, more than 90% of the participants were born after 1966. The work experience is mostly over 10 years of experience (under 50%), while the other respondents have less. Over 70% have university education. More than 50% are salespeople from industrial companies. Over 60% are salespeople from micro or small companies. 48% of the salespeople represent companies that export more than 25% of their turnover. More than 50% of the salespeople represent companies that participate in at least one trade fair per year.

3.2. Research Instrument

The questionnaire consisted of two sections. The first section pertained to respondent characterization questions, as depicted in Table SF1 (supplementary file). The second section included questions about latent and observable variables, with an emphasis on the relationships proposed by the theoretical model. Most constructs for this study were measured using established scales that were modestly adapted to fit the research context. Specifically, the measures of "bricoleur behaviour of the salesperson" and "problem-solving confidence" are based on Epler and Leach (2021) and Soliman (2014), respectively. The exhibitor performance measurement is based on Hansen (2004) and integrates various dimensions, namely "sales-related activities", "information-gathering activities", "relationship-building activities", "image-building activities", and "motivational activities". Hansen (2004) suggests this construct as a second-order reflective model. In this type of modelling, the first-order latent variables are manifestations of the second-order construct, reflecting its characteristics and maintaining a positive correlation with each other.

Table SF2 (supplementary file) shows the items used as observed variables to measure the respective constructs, as well as the sources of these same scales, as mentioned above. All variables were measured on a five-point Likert scale, ranging from: one (1) - totally disagree to five (5) - totally agree, except for the Exhibitor Performance measures which were assessed according to the level of satisfaction, where: one (1) - totally dissatisfied and five (5) - totally satisfied. Typically, as noted by McKelvie (1978), five-point scales exhibit higher reliabilities.

To bolster content validity, a panel comprising six experts (three from academia and three managers representing companies participating in trade fairs) was invited to assess the initial items of the questionnaire. The collaboration of these experts proved to be beneficial, contributing to the development of a suitable questionnaire for the study. The research utilized a t-test to compare the initial 135 responses (from the first half of January 2024) with the subsequent 169 responses (from the second half of January 2024). Nevertheless, no statistically significant variances were observed between these two groups, indicating the absence of response bias (Armstrong & Overton, 1977).

3.3. Data analysis

The collected data was analysed using covariance-based Structural Equation Modelling (CB-SEM), following Collier (2020) and Dash and Paul (2021). SPSS version 26 and IBM® SPSS® Amos version 24 were used. CB-SEM, which focuses on analysing covariances between variables to test hypotheses about their relationships, is well-suited for studies involving theoretical models and latent variables (Collier, 2020). An initial exploratory data analysis examined the distribution and coherence of responses (Watkins, 2021). Model parameters were estimated in AMOS using the Maximum Likelihood method, and a second-order construct was applied to exhibitor performance (Chen *et al.*, 2005). Fit indices were assessed to ensure model suitability, and hypotheses were tested via Path Analysis (Collier, 2020). Finally, potential group differences in exhibitor performance dimensions were evaluated using One-Way ANOVA (George & Mallery, 2021).

4. RESULTS

4.1. Exploratory Factor Analysis

Before analysing the CB-SEM model, it is essential to first assess the data (Collier, 2020; George & Mallery, 2021; Watkins, 2021). Normality was evaluated through skewness and kurtosis values, with all falling between –1 and +1, indicating a normal univariate distribution (George & Mallery, 2021). Table 1 provides the mean, standard deviation, and anti-image correlation matrix (Table SF3 in the supplementary file), which confirmed no issues of multicollinearity (Watkins, 2021). The Kaiser-Meyer-Olkin (KMO) values (above 0.8) and Bartlett's test ($p < 0.001$) supported the suitability for factor analysis. Principal Component Analysis with Varimax rotation revealed factor loadings above 0.50, except for two items (P_IMA5 and P_IMA6), which were removed. Cronbach's alpha values exceeded 0.8 for all constructs, confirming high reliability and internal consistency (Collier, 2020; George & Mallery, 2021; Watkins, 2021). For more details, see Table 1.

Table 1
Exploratory Factor Analysis

Constructs and items code	Mean	Stand. Dev.	Factor loadings	Skewness	Kurtosis	KMO	Cronbach's alpha
Bricoleur behaviour of the salesperson							
BRIC1	3.51	0.961	0.564	−0.387	−0.172	0.866	0.890
BRIC2	3.77	0.979	0.705	−0.516	−0.249		
BRIC3	3.82	0.933	0.621	−0.656	0.196		
BRIC4	3.69	0.993	0.643	−0.508	−0.109		
BRIC5	3.45	1.023	0.668	−0.210	−0.580		
BRIC6	3.64	1.046	0.571	−0.624	−0.162		
BRIC7	3.70	0.929	0.685	−0.562	0.142		
Problem-solving confidence							
PSC1	3.76	0.960	0.696	−0.718	0.260	0.880	0.836
PSC2	4.02	0.858	0.751	−0.708	0.148		
PSC3	4.12	0.920	0.746	−0.909	0.380		
PSC4	3.96	0.971	0.761	−0.858	0.314		
PSC5	3.93	0.961	0.666	−0.783	0.147		
PSC6	3.87	0.895	0.664	−0.600	0.110		
Exhibitor performance						0.933	0.944
Sales-related activities							
P_SAL1	3.62	1.015	0.703	−0.488	−0.233	0.826	0.854
P_SAL2	3.66	0.941	0.647	−0.416	−0.179		
P_SAL3	3.49	1.111	0.749	−0.310	−0.713		
P_SAL4	3.68	1.072	0.648	−0.719	−0.139		
P_SAL5	3.13	1.201	0.708	−0.209	−0.817		
Information-gathering activities							
P_INF1	3.69	1.030	0.813	−0.604	−0.097	0.815	0.866
P_INF2	3.95	0.925	0.715	−0.676	0.034		
P_INF3	3.88	0.949	0.732	−0.747	0.150		
P_INF4	3.71	1.037	0.583	−0.458	−0.448		
Relationship-building activities							
P_REL1	3.84	1.047	0.643	−0.808	0.141	0.825	0.869
P_REL2	3.91	1.059	0.736	−0.903	0.249		
P_REL3	3.75	0.947	0.590	−0.508	0.013		
P_REL4	3.99	0.975	0.679	−0.834	0.323		
Image-building activities							
P_IMA1	3.89	1.085	0.587	−0.788	−0.073	0.899	0.886
P_IMA2	4.10	0.949	0.711	−0.944	0.436		
P_IMA3	4.02	0.988	0.664	−0.949	0.546		
P_IMA4	4.11	0.912	0.637	−0.801	0.036		
P_IMA5	3.89	1.066	*0.473**	−0.840	0.103		
P_IMA6	3.89	1.066	*0.475**	−0.994	0.581		
Motivational activities							
P_MOT1	3.67	1.043	0.717	−0.690	0.000	0.809	0.872
P_MOT2	3.75	0.941	0.764	−0.612	0.160		
P_MOT3	3.83	0.944	0.772	−0.547	−0.120		
P_MOT4	3.88	0.935	0.660	−0.670	0.209		

Source: Own elaboration.

4.2. Confirmatory factor analysis

A confirmatory factor analysis (CFA) was conducted, incorporating all the measurement items in the hypothesised model. To do so, various indicators were utilised, including x^2/DF, CFI, NFI, TLI, IFI, GFI, RMR, and RMSEA, to assess the model fit. These tests aids in understanding how well the overall structure of the model aligns with the data (Collier, 2020). The results of the CFA indicated a good fit, therefore, all indicator values analysed met the requirements for a model well-suited to the data (Collier, 2020), as illustrated in Figure 2 and Table SF4 (supplementary file).

Convergent and discriminant validity were assessed. As evident from Table 2, the composite reliability (CR) coefficients of each construct in all models exceed the recommended guideline of 0.70 (Collier, 2020; Fornell & Larcker, 1981). Similarly, the average variance extracted (AVE) of each construct in all models meets the recommended threshold of >0.50 (Collier 2020; Fornell & Larcker 1981). Additionally, the Maximum Shared Variance (MSV) and Average Shared Variance (ASV) indicators were analysed for all constructs in each model, and the results demonstrate compliance with the recommended values of MSV < AVE and ASV < AVE (Fornell & Larcker, 1981). Hence, convergent validity is supported across all models.

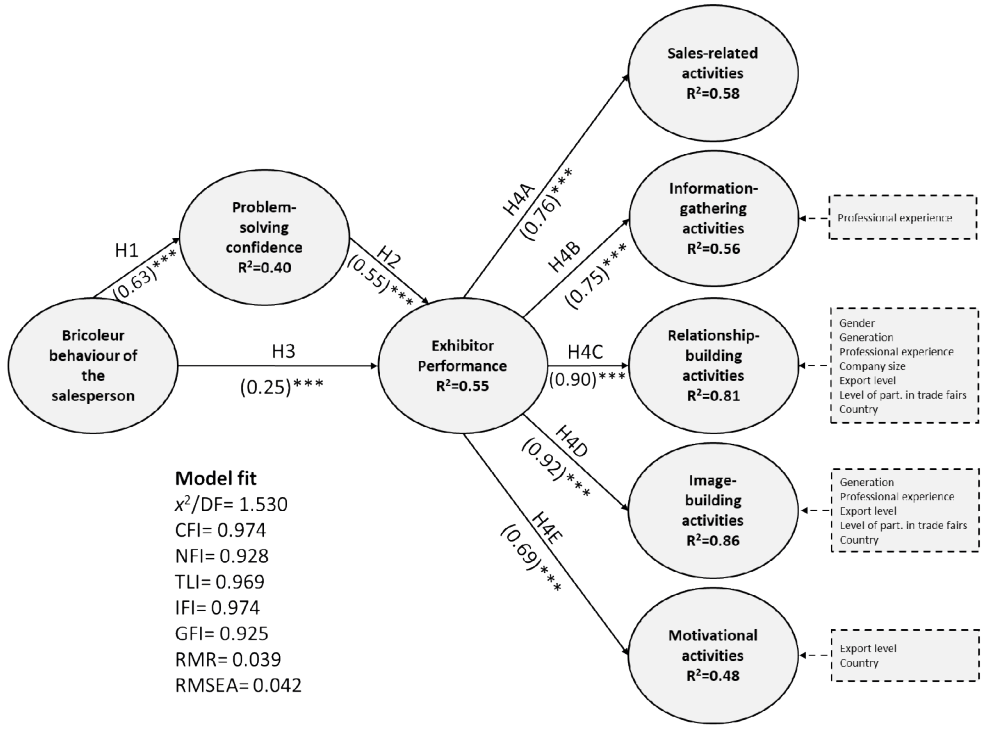
Furthermore, to ensure discriminant validity, the square root of the AVE measures should exceed all correlations between all constructs (Fornell & Larcker, 1981). As observed from Table 2, discriminant validity is substantiated by the data obtained.

In summary, evaluating CR, AVE, MSV, and ASV has helped ensure that the constructs measure what they are intended to measure, that the items in each construct are reliable, and that there is no excessive redundancy or overlap between the constructs of the model. These measures are crucial for validating the model structure and interpreting the results of a CFA analysis (Collier, 2020; Fornell & Larcker, 1981).

Table 2
Convergent and discriminant validity

Constructs	CR	AVE	MSV	ASV	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Image-building activities (1)	0.875	0.700	0.650	0.462	***0.837***						
Bricoleur behaviour of the salesperson (2)	0.727	0.574	0.398	0.263	0.553	***0.758***					
Problem-solving confidence (3)	0.833	0.555	0.486	0.335	0.697	0.631	***0.745***				
Sales-related activities (4)	0.760	0.613	0.460	0.356	0.659	0.460	0.520	***0.783***			
Information-gathering activities (5)	0.794	0.661	0.496	0.337	0.704	0.445	0.530	0.577	***0.813***		
Relationship-building activities (6)	0.850	0.654	0.650	0.433	0.806	0.575	0.608	0.678	0.659	***0.809***	
Motivational activities (7)	0.876	0.640	0.425	0.299	0.633	0.365	0.455	0.652	0.528	0.593	***0.800***

Note: Diagonal elements (bold and italic) represent the square root of average variance extracted (AVE).
Source: Own elaboration from AMOS.



Note:
(Standardized estimation); *** represent the usual significance levels of 1%.
Control variables that showed statistically significant differences between their categories in the respective constructs analyzed.

Figure 2
Structural model
Source: Own elaboration.

4.3. Hypothesis test-Path analyses

After analysing the measurement model, the focus shifts to examining the structural model, which aims to investigate the relationships between constructs, corresponding to the hypothesized relationships in this study (Collier, 2020). Consequently, the direct effects indicate that H1 (0.63***) is statistically supported. Additionally, the results demonstrate that H2 (0.55***) is also statistically supported. In the same sense, the results reveal that H3 (0.25***) is statistically supported. Finally, the findings reveal that H4A (0.76***), H4B (0.75***), H4C (0.90***) H4D (0.92***) and H4E (0.69***) are statistically supported. Table SF5 (supplementary file) summarizes the results of the hypothesis test.

Moreover, the R^2 values, which depict the influence of one construct over another (Collier 2020), are also displayed in Figure 2. The results (R^2=0.55, R^2=0.58, R^2=0.56, R^2=0.81, R^2=0.86 R^2=0.48) show a strong influence of the antecedents over the subsequent constructs is observed across all models (Collier, 2020).

4.4. Differences in exhibitor performance.

In this section, the analysis will focus on the variables where significant differences were observed, as these provide relevant insights for discussion. This analysis may reveal additional information by identifying how different characteristics can influence the relationships we are investigating (Nielsen & Raswant, 2018).

ANOVA is a statistical technique that allows for comparing the means of three or more groups to determine if there are significant differences between them (George & Mallery, 2021). Based on various control variables, groups were formed from response categories. The first step was to assess if there were significant differences between groups, for which the test of variance homogeneity was applied (George & Mallery, 2021). Table SF6 (supplementary file) reveals differences in "information-gathering activities" among groups generated by professional experience. In "relationship-building activities", significant differences were observed between groups generated by gender, generation, professional experience, company size, export level, level of participation in trade fairs, and country. In "image-building activities", significant differences were found between groups displayed by generation, professional experience, export level, level of participation in trade fairs, and country. Lastly, in "motivational activities", significant differences were identified between groups generated by export level and country. Based on these results, multiple comparison tests were conducted for a more detailed analysis (George & Mallery, 2021).

Table 3
Multiple comparison tests

			MEAN DIFFERENCE (I-J) and Sig.			
Control Variables	**(I)**	**(J)**	**Information-gathering activities**	**Relationship-building activities**	**Image-building activities**	**Motivational activities**
Gender	Male	Female	—	0.24589**	—	—
		Others	—	0.31782	—	—
Generation	Between 1966-1980	Before 1946	—	–0.41000	–0.73333	—
		Between 1946-1965	—	0.16292	0.15556	—
		Between 1981-1994	—	0.42553***	0.32807**	—
		Between 1995-2012	—	0.63442***	0.53526***	—
Professional experience	More than 20 years	< 3 years	0.27376**	0.68621***	0.46705***	
		Between 4 - 10 years	0.38682***	0.58182***	0.53263***	
		Between 10 - 20 years	0.26673*	0.26563*	0.28152*	
Company size	Medium	Micro		0.36261***		
		Small		0.14939		
		Large		0.05238		
Export level	> 50%	0%		0.43828**	0.56491***	
		<25%		0.27698**	0.29489**	
		25% - 50%		0.36416**	0.32109**	
	25% - 50%	0%				0.42607**
		<25%				0.24801**
		> 50%				0.07994
Level of participation in trade fairs	Several fairs per year	Sporadically		0.37143***	0.47611***	
		1 trade fair every 4 years		0.59475***	0.64739***	
		1 trade fair every 2 years		0.37131**	0.25260*	
		1 trade fair per year		0.26385**	0.22585*	
Country	Portugal	Kosovo		0.64484***	0.39681***	0.10607
		Other		0.52594***	0.74031***	0.35302**

Note: *. **. and *** represent the usual significance levels of 10%. 5% and 1%. respectively.

Source: Own elaboration from SPSS (one-way ANOVA). Posteriori test - LSD (least significant difference).

Multiple comparison tests were conducted using the LSD (Least Significant Difference) method with a 95% confidence interval (George & Mallery, 2021). The results obtained are presented in Table 3. In "information-gathering activities", professionals with over 20 years of experience tend to be more competent in information-gathering activities than the other groups. In "relationship-building activities", male salespeople tend to be more competent than female salespeople in relationship-building activities. Professionals born between 1966-1980 tend to be more competent in the same activities than those born between 1981-2012. Professionals with over 20 years of experience tend to be more competent in relationship-building activities than the other groups. Salespeople from medium-sized companies are statistically more competent in relationship-building activities than salespeople from micro companies. Salespeople working in companies that export more than 50% of their turnover are more competent in these activities than salespeople from companies that export less than 50%. Salespeople from companies that participate in several trade fairs per year are more competent in relationship-building activities than salespeople from companies that participate sporadically, 1 trade fair every 4 years, 1 trade fair every 2 years, and 1 trade fair per year. Lastly, still in "relationship-building activities" salespeople from Portuguese companies are more competent in relationship-building activities than salespeople from Kosovo companies or other nationalities.

In "image-building activities", salespeople born between 1966-1980 tend to exhibit greater competence in image-building activities compared to those born between 1981-2012. Professionals with over 20 years of experience also demonstrate higher competency in these activities compared to other groups. Additionally, salespeople employed in companies exporting more than 50% of their turnover display greater competence in image-building activities than those from companies exporting less than 50%. Furthermore, salespeople from companies participating in several trade fairs per year exhibit higher competency in image-building activities compared to those from companies participating sporadically and/or attending one trade fair every 4 years. Moreover, salespeople from Portuguese companies demonstrate greater competence in image-building activities compared to salespeople from Kosovo companies or other nationalities.

Finally, in "motivational activities", salespeople employed in companies exporting 25%-50% of their turnover demonstrate greater competence in motivational activities compared to salespeople from companies exporting less than 25%. Additionally, salespeople from Portuguese companies exhibit greater competence in motivational activities compared to salespeople from other nationalities.

5. DISCUSSION AND INTERPRETATION OF RESULTS

5.1. Alignment with the theoretical model

In summary, the results indicated that all hypotheses (H1, H2, H3, H4A, H4B, H4C, H4D, and H4E) were statistically supported. The findings of the study align closely with the theoretical underpinnings and expectations outlined in the literature review regarding the influence of bricoleur behaviour and problem-solving confidence on exhibitor performance at trade fairs.

In the literature review, it was argued that sales professionals embracing the bricoleur mentality exhibit adaptability, creativity, and resilience, which enable them to effectively navigate the unforeseen challenges and pressure situations (Epler & Leach, 2021), as often happens in the context of trade fairs (Gerschewski *et al.*, 2020; Li, 2020; Silva *et al.*, 2022). This adaptive approach was expected to enhance problem-solving confidence, enabling salespeople to address issues creatively and efficiently during the event. Hence, the capacity to improvise, adapt, and devise creative and innovative solutions using existing resources correlates with the belief and confidence in effectively resolving challenges. This common trait among salespeople demonstrates a bricoleur behaviour (Epler & Leach, 2021) and seems to prove why improvisational skills of salespersons can lead to outstanding performance (Carlson & Ross, 2022) and aid in the realization of projects (Ahmed & Lucianetti, 2024). The results of the study corroborated this hypothesis, demonstrating that the bricolage behaviour displayed by salespeople had a positive impact on their confidence in problem solving (H1). As salespeople engage in bricolage, they develop a sense of resourcefulness and creativity (Epler & Leach, 2021; Epler *et al.*, 2023). Also, successfully finding solutions with limited resources builds their confidence in their ability to tackle problems. Each successful improvisation reinforces their belief in their capability to handle challenges, thus boosting their overall problem-solving confidence (Soliman, 2014; Sturm & Bohndick, 2021).

Furthermore, the literature review highlighted the multidimensional nature of exhibitor performance at trade fairs, encompassing activities such as sales-related efforts, information gathering, relationship building, image building, and motivational activities (Hansen, 2004). It was proposed that the problem-solving confidence and bricoleur behaviour of salespersons would positively impact exhibitor performance (H2 and H3 respectively).

Regarding H2, which suggests significant positive effects of problem-solving confidence on exhibitor performance, the study's findings indicate that individuals with high problem-solving confidence tend to approach challenges proactively and find effective solutions without hesitation. This confidence can lead to quicker resolution of issues, better customer interactions, and improved decision-making (Soliman, 2014), all of which contribute to better exhibitor performance. When salespersons feel capable of solving problems, they are more likely to engage positively with customers and handle complex sales situations effectively. Consequently, interactions at a trade fair are crucial for professionals to establish connections, exchange knowledge, and significantly enhance their business activities. (Li, 2020; Li *et al.*, 2022). Across contexts, self-confidence emerges as a paramount factor, facilitating effective communication and collaboration in problem-solving efforts (Favorina *et al.*, 2023; Hendriana *et al.*, 2018). Moreover, confidence creates a secure space for experimentation and learning, fostering a proactive approach to problem-solving (Maczulskij & Viinikainen, 2023).

Observing H3, which suggests that bricoleur behaviour exerts a positive influence on exhibitor performance, salespersons who exhibit this behaviour can quickly adapt to changing

conditions and make the most of the available resources at the exhibition. They can handle unexpected issues, such as changes in customer demand or logistical problems, in a flexible and innovative manner (Epler & Leach, 2021). This adaptability can lead to smoother operations and better customer experiences, ultimately enhancing exhibitor performance. Additionally, bricoleur salespeople can establish and strengthening lasting relationships with customers and partners (Arditoo *et al.*, 2020). The ability of these salespersons to adapt to individual needs and create innovative solutions contributes to the building of genuine connections and mutual trust (Jia & Wan, 2022). This, in turn, reinforces the public perception of the company as a reliable, creative, and customer-oriented, because autonomy (Endres *et al.* 2022) and proactivity of salespeople (Gerschewski *et al.*, 2020; Silva *et al.*, 2022) are fundamental ingredients for a positive connection between the exhibitor and the visitor. Finally, these salespeople also contribute to an energised and productive working environment during the trade fair, creating a positive atmosphere that benefits both employees and customers (Jung *et al.*, 2023). Therefore, exhibitors benefit greatly from the presence of bricoleur salespeople, who adeptly tackle challenges such as intense competition, resource management, effective communication, and adaptability to unforeseen circumstances commonly encountered at trade fairs (Silva *et al.*, 2022).

It is also worth mentioning that the results suggest that bricoleur behaviour, combined with confidence in problem-solving, enhances the salesperson's influence on exhibitor performance more than bricoleur behaviour alone. This combination of skills can be translated into a new competency, labelled "bricolage thinking". In practice, this is an integrative approach that combines the creative use of available resources (Epler & Leach, 2021) with self-confidence in problem-solving (Soliman 2014), allowing for quick and innovative responses to complex challenges. At a trade fair, a salesperson who combines bricoleur behaviour with confidence in problem-solving can improvise solutions to overcome logistical challenges, adapt to changes in customer demand, and make the most of the available resources. This ensures a positive experience for visitors and significantly improves the exhibitor's performance. These salespeople possess the expertise for spotting sales opportunities even in adverse circumstances and are experts at gathering pertinent market information, competitor insights, and emerging trends. Their capacity to improvise and swiftly adapt to customer demands often translates into successful sales. Moreover, their proactive view and intrinsic curiosity frequently yield valuable insights (Gerschewski *et al.*, 2020; Silva *et al.*, 2022). Bricoleur salespeople who display confidence and determination in problem-solving at trade fairs boost the exhibitor's image, motivate the team, and build trust with customers (Kang *et al.*, 2019). These findings highlight that investing in the development of bricoleur salespeople can significantly improve exhibitor performance. By fostering a culture of confidence, adaptability, and proactive problem-solving, exhibitors can maximize their success at trade fairs, benefiting from opportunities for innovation, collaboration, and business growth.

Concerning the findings that corroborate H4A, H4B, H4C, H4D and H4E various implications arise. The results align with the theoretical understanding of exhibitor performance and are confirmed by the analysis of the dimensions that constitute exhibitor performance, as discussed by Hansen (2004) and Zhang *et al.* (2023). Indeed, performance at trade fairs is unequivocally multidimensional, encompassing a wide range of activities and objectives that extend beyond mere business transactions. They provide an environment conducive to developing and enhancing various aspects of a company's performance, from product sales to the strengthening of relationships and the building of a solid brand image (Hansen, 2004; Rai & Nayak, 2020; Zhang *et al.*, 2023).

Considering the specific context of this study, this combined approach of the bricoleur salesperson (Epler & Leach, 2021) and confidence in problem-solving (Soliman, 2014) enhances their ability to maximise exhibitor performance across multiple dimensions, from generating sales and gathering information to building strong relationships and promoting a positive brand image (Hansen, 2004). A creative, confident, and adaptable salesperson can highlight the exhibitor and attract customers' attention with unique sales approaches. Confidence allows for effective handling of objections, turning potential problems into sales opportunities, while bricoleur behaviour enables efficient use of resources to gather valuable information. This combination facilitates interaction with a wide range of customers and the collection of diverse insights, as well as building and maintaining strong relationships. Confidence in problem-solving helps to address conflicts and maintain a positive image for the exhibitor. The ability to resolve issues and adapt promotes a motivating environment, encouraging the team to achieve their goals.

Finally, the study's results significantly expand the theories of the Resource-Based View (Sivathanu & Pillai, 2020), Bricolage Theory (Lévi-Strauss, 2021), and Stressor Events Theory (Lerman *et al.*, 2020). All theories considered they explain how sellers' behaviours and resource utilisation contribute to sustainable business performance in challenging and stressful environments, such as trade fairs. Firstly, the findings corroborate the idea that creativity and the effective utilisation of available resources are fundamental to attain success in complex and challenging environments such as trade fairs. The results demonstrate that bricoleur behaviour not only enhances confidence in problem-solving but also optimises exhibitor performance. Secondly, the study provides a detailed insight into how demanding events, such as trade fairs, require specific skills to manage pressure and complexity. These theories justify the necessity for bricoleur behaviour (Epler & Leach, 2021) and confidence in problem-solving (Soliman, 2014) to tackle the unique challenges presented by these events, showing how these skills can mitigate the impact of stress on exhibitor performance. Collectively, these theories support the idea that the ability to use resources creatively and solve problems confidently is crucial for success in complex and high-pressure environments. Thus, they form an essential theoretical framework for understanding and defining the concept of "bricolage thinking". This concept represents an integrated set of competencies involving the creative use of resources and confidence in problem-solving, indispensable for effectively navigating complex and high-pressure environments such as trade fairs.

5.2. Insights from Trade Fair Performance

ANOVA analysis identified significant differences between groups across multiple control variables affecting the various di-

mensions of exhibitor performance. In "information-gathering activities", professionals with over 20 years of experience were more competent in these activities. In "relationship-building activities", male salespeople, those born between 1966-1980, and those from medium-sized companies exhibited greater competence in relationship-building activities. Similar trends were observed in "image-building activities", with additional significance found for salespeople from companies exporting over 50% of their turnover and those participating in multiple trade fairs annually. "Motivational activities" dimension indicated greater competence in these activities for salespeople from companies exporting 25% - 50% of their turnover and those from Portuguese companies.

These results suggest that salesperson experience can provide an advantage in identifying and obtaining relevant data about the market, competitors and trends during trade fairs. Typically, more experienced salespeople are more insightful when asking questions, have a more comprehensive knowledge of the market and have a larger network of contacts, which helps in collecting information. The results also indicate that certain demographic characteristics, such as gender and age, may play a role in salespeople's ability to establish and strengthen connections with customers and partners. Therefore, certain gender stereotypes can influence salespeople's behavioural expectations and customer perceptions. Additionally, age can be associated with different levels of experience, maturity, and interpersonal skills, all of which can influence how salespeople build relationships. The study also suggests that the organizational context, such as the focus on internationalization and participation in trade fairs, can influence the ability of salespeople to deal with challenges and take advantage of the opportunities presented at trade fairs. These companies are late exporters and usually participate in various fairs and are more exposed to diversified markets, cultures and business practices. This can provide sellers with a broader experience, offering networking, reputation and motivation.

Finally, the findings suggest that sales representatives originating from Portuguese firms exhibit greater proficiency in cultivating networks and enhancing the corporate image and reputation, surpassing their counterparts from Kosovo. This outcome likely stems from Portugal's status as a member of the European Union, affording it a lengthier legacy of engagement in sales and entrepreneurial endeavours in contrast to Kosovo. Consequently, Portuguese companies may benefit from a solid base of experience and established practices for developing networking and managing corporate image.

6. PRACTICAL IMPLICATIONS

This study offers some practical implications for salespeople and managers of companies participating in trade fairs. Regarding company managers, the study highlights the importance of nurturing a culture of trust, adaptability and proactive problem solving among sales teams. By investing in the development and training of bricoleur salespeople, exhibitors can significantly improve their performance. This could prove especially beneficial during high-pressure situations like trade fairs, where businesses frequently encounter severe competition and must positively distinguish themselves within this environment. Furthermore, apart from its applicability to resource-limited companies, adopting a bricoleur approach can serve as a potent strategy for maximizing impact and making the most of available resources. Exhibitors can thus capitalize on the numerous opportunities presented by trade fairs, taking advantage of the presence of bricoleur salespeople confident in their problem-solving skills. These salespeople positively influence several dimensions of exhibitor performance, including sales-related activities, information gathering, relationship building, image building, and motivational activities.

Regarding the organizational context, late exporters and companies that participate less in trade fairs will have to adjust their strategies. For example, if possible, increasing frequency and participation in trade fairs can provide more exposure to the company, its products and services. They can also invest in strengthening relationships with existing customers and business partners. These companies can seek support from trade fair organizations, chambers of commerce, and development agencies in order to get guidance and resources. It is also important for companies to recognize the differences between producers and service providers. For example, understanding the different needs and preferences of service customers versus product customers can inform the development of more effective sales approaches, such as emphasizing personalized solutions for service customers and product demonstrations for product customers.

Therefore, the interaction highlighted in this study between the Resource-Based View theory, Bricolage theory, and Stressful Events theory has direct implications for management, particularly in the context of trade fairs. The findings suggest that managers must consider the efficient allocation of resources, the encouragement of creativity and improvisation, and the implementation of effective stress management and resilience strategies to optimise exhibitor and sales team performance. In this regard, it is essential for managers to adopt a leadership style that fosters experimentation with innovative solutions without fear of failure, creating an environment that promotes the strategic use of available resources while providing emotional and strategic support to cope with the demanding pressures of trade fairs. By implementing this approach, salespeople develop greater autonomy, confidence, and improvisational ability, enhancing their capacity to solve problems quickly and effectively. Consequently, the overall performance of both the team and the exhibitor is significantly improved, ensuring greater success in the competitive trade fair environment.

Regarding salespeople, this study suggests that they should adopt the bricoleur mentality, which involves adaptability, creativity and resilience. This mindset allows them to effectively navigate unforeseen challenges and pressure situations typically found at trade fairs. Salespeople should also focus on increasing their confidence in problem solving. Therefore, this study encourages salespeople to develop an integrated competency in using resources creatively and solving problems confidently. This capability, referred to as "bricolage thinking", empowers them to respond innovatively to complex challenges encountered at trade fairs. By combining the bricoleur approach with problem-

solving confidence, salespeople can improvise solutions, adapt to dynamic customer demands, and optimize resource utilization. This improves exhibitor performance and promotes a proactive and innovative culture within the team, driving continuous improvement and success at trade fairs.

Finally, experienced salesperson can leverage their insights and should recognize the role of demographic characteristics, such as gender and age, in shaping customer perceptions and behavioural expectations. Thus, tailoring sales approaches based on these factors can lead to more effective relationship building and sales interactions. Salespeople must also adapt to the organizational context, including factors such as the focus on internationalization, type of company and participation in trade fairs. Understanding the unique dynamics of the company context where they work can help them deal with challenges and capitalize on opportunities more effectively.

7. CONCLUSIONS, LIMITATIONS, AND SUGGESTIONS FOR FUTURE STUDIES

The study findings support the hypotheses regarding the influence of bricoleur behaviour and problem-solving confidence on exhibitor performance at trade fairs. For salespeople and managers, the study highlights the importance of nurturing a culture of trust, adaptability, and proactive problem-solving. Investing in the development of bricoleur salespeople can significantly improve exhibitor performance at trade fairs. Salespeople should adopt the bricoleur mentality and focus on increasing their confidence in problem-solving, while also recognizing the role of demographic characteristics and organizational context in shaping sales approaches and interactions. The concept of " bricolage thinking" has emerged as an integrated and crucial competency for exhibitor performance at trade fairs, combining the bricoleur mindset with confidence in problem-solving.

Although the study offers valuable insights, it is essential to recognize its limitations. Firstly, the findings are derived from a particular context and sample, potentially restricting their applicability to other settings or demographics. Additionally, the study overlooks the industry context of the exhibitors. Hence, it would be prudent for future research to address this aspect since diverse sectors can stimulate distinct competition dynamics at the trade fair. Comparative studies spanning various industries or regions could yield profounder insights into the details of trade fair involvement. Future studies could also explore additional factors influencing exhibitor performance at trade fairs, such as organizational culture and leadership style. Longitudinal studies could also investigate the long-term impact of bricoleur behaviour and problem-solving confidence on exhibitor success. Finally, this study introduces the theoretical framework of "bricolage thinking", albeit in its nascent stage. Future research endeavours could delve deeper into this concept, offering practical insights that could be important for companies and professionals seeking to boost their performance at trade fairs through innovation and proficient problem-solving skills.

8. SUPPLEMENTARY FILE

A supplementary file with material related to the article can be accessed at the following URL: https://ojs.ehu.eus/index.php/CG/article/view/27591

9. ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the Centre for Organisational and Social Studies of the Polytechnic Institute of Porto (CEOS.PP) for the support provided throughout this research. The authors also extend our appreciation to the anonymous reviewers for their insightful comments and constructive suggestions, which have greatly contributed to the improvement of this article.

This work is financed by Portuguese national funds through FCT - Fundação para a Ciência e Tecnologia, under the project UIDB/05422/2020.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

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Management Letters / Cuadernos de Gestión 25/2 (2025) 53-72

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Management Letters / Cuadernos de Gestión

journal homepage: https://ojs.ehu.eus/index.php/CG
ISSN: 1131-6837 / e-ISSN: 1988-2157

Advances of Artificial Intelligence in Organizational Project Management: A Systematic Literature Review

Avances de la Inteligencia Artificial en la Gestión Organizacional de Proyectos: Una Revisión Sistemática de Literatura

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ARTICLE INFO

Received 03 December 2024,
Accepted 30 April 2025

Available online 2 June 2025

DOI: 10.5295/cdg.252329ws

JEL: L21

ABSTRACT

Organizational project management (OPM) encompasses three key domains: program management, portfolio management, and project management (PM), in addition to organizational enablers. Research indicates increasing application of artificial intelligence (AI) technologies within OPM. However, an analysis of published literature reviews on the topic reveals significant advancements primarily within the PM domain, with limited progress observed in program management, portfolio management, and organizational enablers. Therefore, this study seeks to identify progress in AI applications across all three domains and organizational enablers within OPM to establish emerging trends and highlight future research opportunities. A systematic literature review was conducted utilizing the SCOPUS and Web of Science databases. After applying a series of filters, 87 publications were selected for analysis. The study identifies AI applications in four types of tasks related to OPM: routine, decision-making, judgment, and problem-solving. Results indicate that while application of AI technologies remains primarily focused on PM, there are new advancements in program and portfolio management. However, they occur mainly in operational processes; strategic aspects remain largely underdeveloped. Regarding organizational enablers, similar to the previously published review papers, no AI applications are reported. This study identifies organizational challenges and research opportunities in four main areas: data collection, development of algorithms tailored to project requirements, human resource management, and ethical practices.

Keywords: Organizational Project Management, Artificial Intelligence, Project Management, Portfolio Management, Program Management.

R E S U M E N

La Dirección Organizacional de Proyectos (OPM) comprende tres dominios fundamentales: la gestión de proyectos (PM), la gestión de programas y la gestión de portafolios, además de los habilitadores organizacionales que facilitan su implementación. La literatura científica muestra un creciente interés en la aplicación de tecnologías de inteligencia artificial (IA) dentro de este campo. No obstante, al revisar los estudios existentes, se evidencia que los avances más notorios se han dado en el ámbito de la gestión de proyectos, mientras que la gestión de programas, la gestión de portafolios y los habilitadores organizacionales han recibido menos atención investigativa. Este estudio tiene como objetivo identificar el progreso en las aplicaciones de IA en los tres dominios de la OPM y en sus habilitadores, con el fin de reconocer tendencias emergentes y proponer nuevas líneas de investigación. Para ello, se realizó una revisión sistemática de la literatura en las bases de datos SCOPUS y Web of Science. Tras aplicar criterios de selección, se analizaron 87 publicaciones. El estudio clasifica las aplicaciones de IA en cuatro tipos de tareas: rutinarias, toma de decisiones, juicio y resolución de problemas. Los resultados muestran que, aunque el enfoque sigue centrado en PM, comienzan a aparecer desarrollos en programas y portafolios, principalmente en procesos operativos. Los aspectos estratégicos y los habilitadores organizacionales siguen poco explorados. Se identifican oportunidades de investigación en áreas clave como recolección de datos, desarrollo de algoritmos específicos, gestión de recursos humanos y consideraciones éticas.

Palabras clave: Gestión Organizacional de Proyectos, Inteligencia Artificial, Gestión de Proyectos, Gestión de Portafolios, Gestión de Programas.

1. INTRODUCTION

Organizational project management (OPM) integrates three key management areas: portfolios, programs, and projects, along with organizational enablers (PMI, 2017a). Among these three domains, project management (PM) —the most widely recognized— is defined as a temporary endeavor that employs knowledge, skills, tools, and techniques to meet project requirements (PMI, 2017a). To implement OPM, various processes and activities have been designed (PMI, 2017a). However, despite advancements, a significant number of projects fail to meet their objectives within the established time and budget, with failure rates ranging from 20% to 60% (Project Management Report, 2023). For instance, Portman (2021) reports a success rate of 31% in the software sector.

At the organizational level, these failures are attributed to various factors. These include a lack of alignment between the project portfolio and organizational strategy, and methodological deficiencies arising from poorly structured processes (Pakdaman *et al.*, 2021). Additionally, project complexity is exacerbated by inadequate collection and analysis of data, coupled with non-adaptation of management practices to project-specific requirements (Pakdaman *et al.*, 2021; Szalay *et al.*, 2017).

The advent of new technologies (artificial intelligence, data analytics, robotics), has led to performance enhancement across multiple domains of business management. According to the Global Artificial Intelligence Innovators survey, 81% of companies are being impacted by AI, and 85% of CEOs believe that this technology will transform the way business is conducted in the future (Skinner, 2021; Taboada *et al.*, 2023). AI is already being applied in numerous sectors, including computing, mathematics, engineering, medicine, and research. This technology is expected to drive a shift toward standards, processes, and tools that are more aligned with business strategy, rather than relying on traditional methods focused on operational outcomes (Holzmann *et al.*, 2017).

Organizations are integrating AI to automate both internal and external operations (Enholm *et al.*, 2022).

From an internal perspective, AI implementation aims to optimize organizational performance, enhance decision-making, and foster innovation (Przegalinska *et al.*, 2025). Externally, AI promotes companies' ability to identify new market niches and adapt to dynamic economic conditions (Uriarte *et al.*, 2025). However, its adoption involves multiple challenges, including appropriate technological infrastructure, employee competencies, management and leadership practices, organizational culture and structure (Tomaževič *et al.*, 2024), profitability (Prasad Agrawal, 2024), and scalability based on company size (Al-Kfairy, 2025). Additionally, there exist concerns regarding ethical and regulatory implications (Alawamleh *et al.*, 2024; Rezaei *et al.*, 2024), as well as the lack of a comprehensive understanding of its implementation in the business environment (Enholm *et al.*, 2022).

Evidence suggests that successful projects are intimately linked to organizational management capability; in other words, the greater the capability, the higher the success rate (Karim *et al.*, 2022). In the PM domain, Tariq *et al.* (2024) demonstrated that a higher level of AI implementation produces better results in terms of efficiency, compliance, product quality, and reduced human errors. However, merely 23% of projects worldwide have incorporated AI technologies, and in Latin America, this is slightly higher, at 25% (Skinner, 2021).

Regarding the review studies on AI applications in OPM, 21 contributions were identified in the literature. Despite this significant number of studies, our analysis reveals that most advancements have been reported within the PM domain (Belharet *et al.*, 2020; Hashfi & Raharjo, 2023; Mishra *et al.*, 2023; Taboada *et al.*, 2023). Research indicates that in this domain, AI has been particularly effective in automating and managing schedules and budgets. Gramberg *et al.* (2024) emphasize an adaptive evaluation system with new performance indicators and specialized methods to assist companies adjust their product portfolios in response to the challenges posed by disruptive technologies such as AI. The published review studies highlight a significant presence of AI applications in financial and construction projects. In finance, AI has primarily been applied for customer segmentation and resource allocation; however, adoption remains sluggish because of transparency concerns. In construction, AI has significantly advanced in the contexts of cost management, scheduling, quality control, and scope management.

Other applications include project selection, risk assessment, and enhancement of the overall success rate (Hashfi & Raharjo, 2023). Müller *et al.* (2024) emphasize that AI has primarily impacted improvements in efficiency, accuracy, and support for operational decision-making in PM. Generally, the published literature review studies indicate a concentration of AI applications in short- and medium-term planning and execution processes, while revealing gaps in long-term perspectives, including strategic organizational planning. Moreover, no review studies were identified that reported relevant advancements of AI in program management, portfolio management, or in the organizational enablers of OPM, highlighting the need for further research in these areas.

Therefore, this study aimed to conduct a broader review of AI advancements across the three domains of OPM: portfolios, programs, and projects, as well as their organizational enablers. To achieve this, two research questions are posed: (1) *In which processes of the three OPM domains and their enablers have AI tools been implemented*? and (2) *What are the future research areas related to AI applications in OPM*? To answer these questions, a systematic literature review was conducted using the Scopus and Web of Science (WoS) databases, following the checklist proposed by Williams *et al.* (2021) and Ferreira de Araújo Lima *et al.* (2020). After applying a series of filters, 87 publications were included, supplemented by a narrative review in areas with limited information.

Our literature review indicates that while most advancements in AI applications remain concentrated in the PM domain, progress has also been observed in program and portfolio management. AI has had the greatest impact on cost, time, and human resource management, largely driven by the availability of databases that facilitate algorithm implementation. However, challenges persist, including insufficient data collection throughout the project lifecycle and the lack of algorithms capable of integrating multiple AI tools into hybrid systems. Organizational challenges and future research opportunities were identified in four key areas: databases, algorithms, human management, and ethical concerns.

2. CONCEPTUAL FRAMEWORK

2.1. Organizational Project Management (OPM)

OPM serves as a veritable bridge between an organization's vision and mission and the ongoing portfolio, program, and project initiatives. Based on coordination, alignment, and implementation, it aims to achieve the strategic objectives of the organization, striving for sustainable competitive advantage. As illustrated in Figure 1, OPM integrates a conceptual framework where its three domains (portfolio management, program management, and project management) converge with organizational enablers to attain strategic goals. Processes represent a systematic series of activities aimed at producing an outcome, acting on one or more inputs to create one or more outputs. Practices refer to specific types of activities that contribute to the execution of a process and may employ one or more techniques or tools.

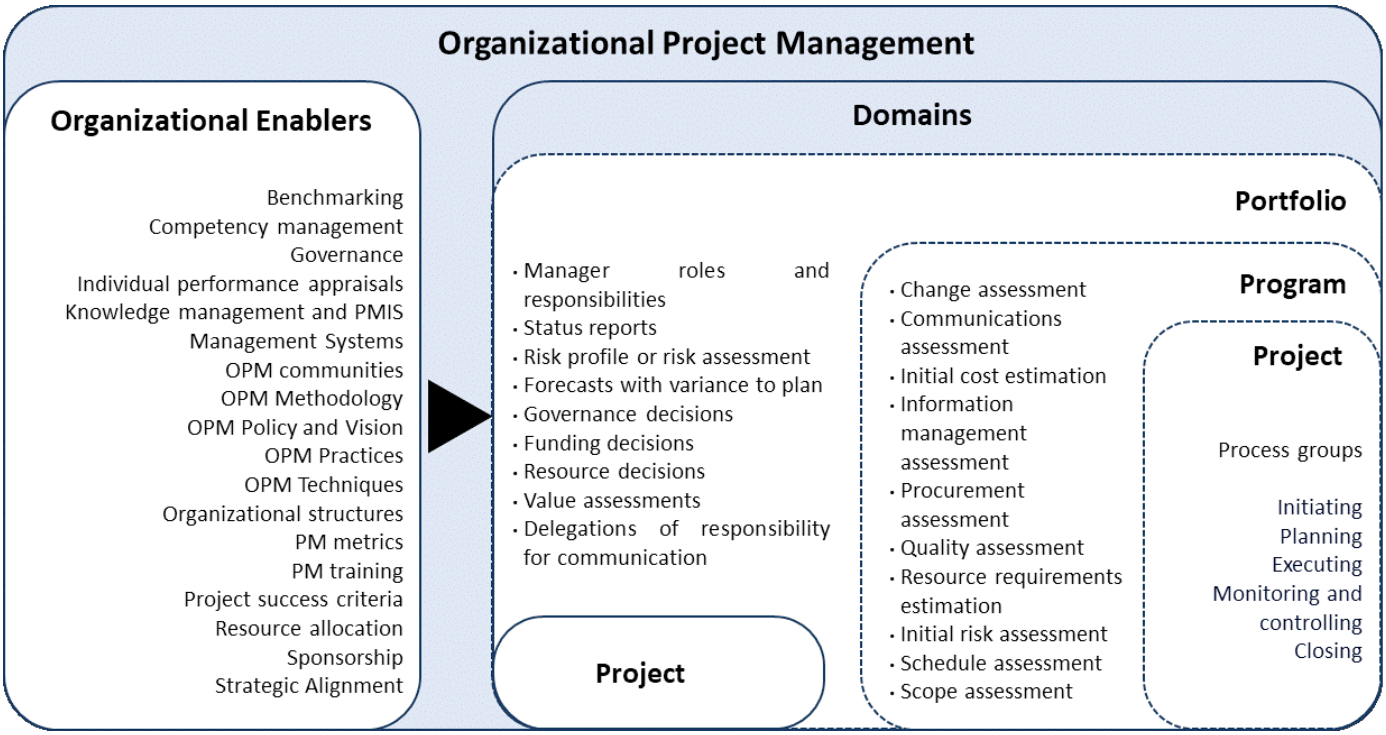

Figure 1
Domains and Organizational Enablers of OPM
Source: Author's own elaboration based on PMI (PMI, 2017b, 2017a, 2018, 2017c).

The portfolio encompasses a collection of programs, projects, and operations collectively managed to achieve strategic objectives. Portfolio management centralizes one or more portfolios to align activities with the organizational strategy, selecting and prioritizing the appropriate programs or projects while allocating the necessary resources (PMI, 2018). Programs consist of related projects and coordinated activities to achieve benefits that cannot be obtained by managing them individually. Program management harmonizes program components, controls their interdependencies, and manages transformational change to realize defined benefits (PMI, 2018). PM focuses on developing and executing plans to fulfill a specific scope, aligned with the objectives of the corresponding portfolio or program and the organizational strategy (PMI, 2018). This domain is organized into process groups (initiating, planning, executing, monitoring, controlling, and closing) and knowledge areas such as integration, scope, schedule, cost, quality, resources, communications, risks, procurement, and stakeholders (see Figure 2).

Mishra *et al.* (2023) proposed a typology to classify PM tasks based on their complexity: repetitive tasks, decision tasks, judgment tasks, problem tasks, and diffuse tasks. Repetitive tasks are straightforward and follow predefined steps, such as data entry or managing schedules and budgets. Decision tasks involve choosing among various options, while judgment tasks require analyzing information to forecast future events, such as assessing a project's viability. Problem tasks comprise evaluating different approaches to achieve a goal, such as adjusting targets during development. Diffuse tasks are the most complex, encompassing multiple objectives and methods, such as cost or risk assessment models using machine learning (ML). Conversely, organizational enablers represent the structural, cultural, technological, or human resource practices that an organization employs to achieve its strategic objectives (PMI, 2018). These enablers comprise 18 categories, involving practices that support process management across the three domains.

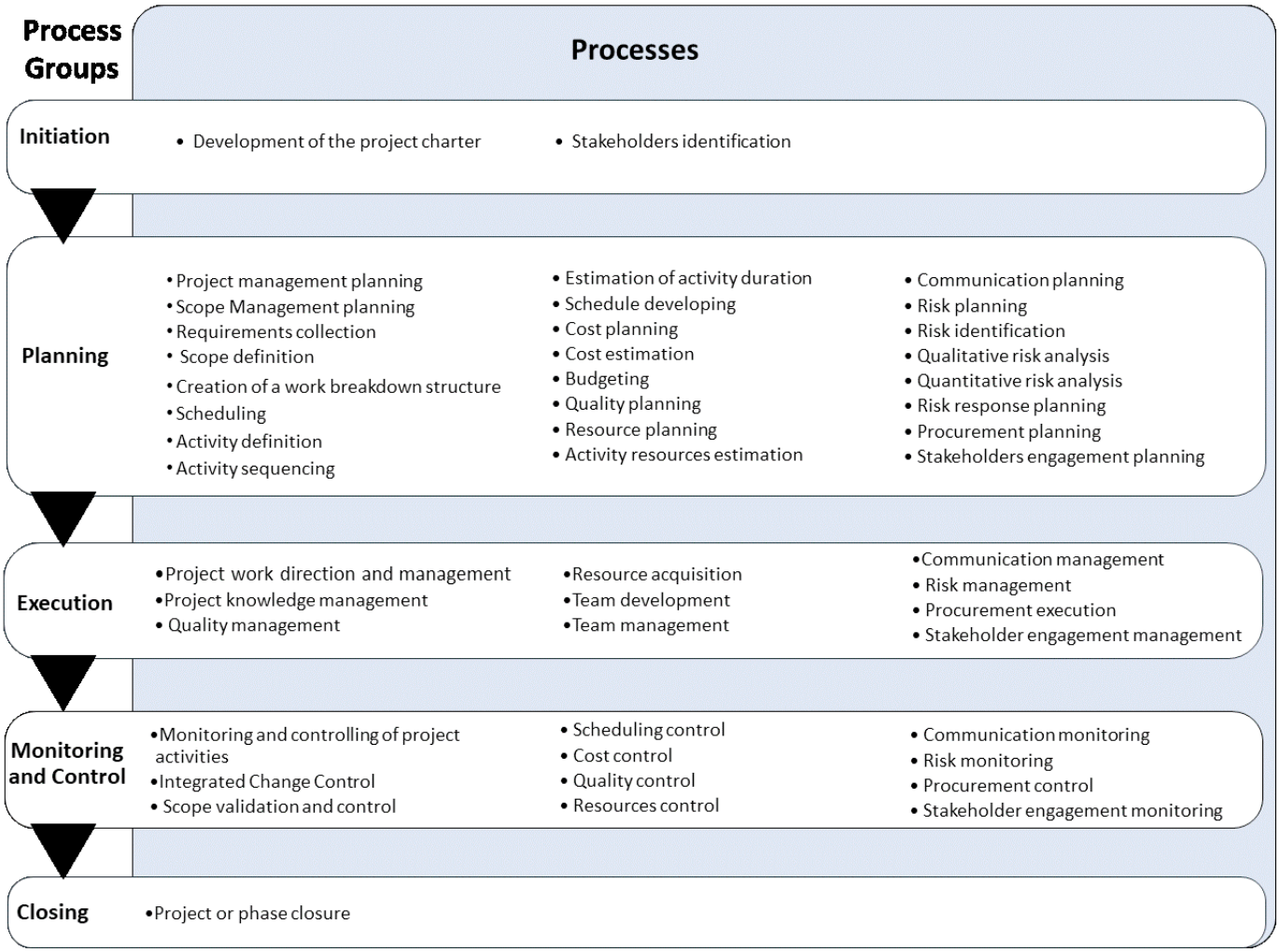

Figure 2
Processes and Process Groups in PM
Source: Author's own elaboration based on PMI (2017a).

2.2. Artificial Intelligence (AI)

AI replicates human knowledge to automate and expedite tasks traditionally performed using natural intelligence (AWS, 2024). AI systems comprise three primary software components: a database, an expert system, and a result-processing module (Radhakrishnan & Jaurez, 2021). The database serves as the foundational element, built from information gathered from similar projects and essential for any AI initiative. The expert system acts as the core engine, processing this data via integrated algorithms. Finally, the result-processing module either presents the outcomes to the user or archives them within the prediction system.

ML is a branch of AI that continuously improves models using data and algorithms, optimizing predictions (AWS, 2024). Based on mathematical and statistical processes, ML detects patterns in the data, which are then utilized to generate increasingly accurate predictions based on historical and new data. ML is categorized into two main types: supervised learning, where the model is trained with labeled data (with predefined inputs and outputs), and unsupervised learning, which seeks patterns in unlabeled data. Deep learning (DL) is a subcategory of ML that employs multi-layered neural networks, mimicking the functioning of the human brain to identify patterns and train models (AWS, 2024). DL architectures enable models to learn data representations at multiple levels of abstraction. Each processing layer transforms the input to enhance selectivity and accuracy in classification.

Big Data and data science are foundational pillars of AI, intimately inter-related and mutually reinforcing. Big Data encompasses the collection of voluminous information that necessitate rapid and sophisticated processing. The exponential growth of such data has driven the creation of novel methods to understand and leverage it, as traditional techniques are insufficient for effective management (Zabala-Vargas *et al.*, 2023). Conversely, data science is an interdisciplinary field that utilizes methods, algorithms, and systems to extract meaningful insights from both structured and unstructured data. AI leverages these processed insights to enhance its training (Zabala-Vargas *et al.*, 2023). As data collection continues to expand, AI algorithms —particularly those in ML and DL— become increasingly accurate, boosting efficiency, improving decision-making, and driving innovation.

3. LITERATURE REVIEWS OF AI APPLICATIONS IN OPM

Table 1 presents the literature reviews conducted over the past five years on AI applications in OPM. Of the 21 articles identified, 12 focus on AI applications within the PM domain and five within the portfolio domain. Notably, no review studies were identified reporting applications in the program management domain or in organizational enablers. Additionally, four studies explored application of AI technologies in construction projects. However, none of them classifies the applications within OPM domains or organizational enablers.

Table 1
Previous Literature Review of AI Applications in OPM

Author(s)	OPM domains*			Organizational enablers	Sector	Main contributions
	Pr	Po	PM			
Prasetyo *et al.* (2025)			x	Not addressed	Industry	Identification of the requirements for the successful application of AI in PM
Ongesa *et al.* (2025)			x	Not addressed	Health	A PM approach using AI for public health preparedness and response projects in urban health crises
Harnessing AI in Entrepreneurial Project Management, (2024)			x	Not addressed	Not declared	Identification of the potential and challenges of AI in business PM
Senescall & Low (2024)		x		Not addressed	Financial	Contributions of ML to predicting future asset behavior and addressing non-convex optimization challenges
Kiani (2024)			x	Not addressed	Not declared	Analysis of AI in replacing human functions and its impact on digital transformation
Aamer *et al.* (2024)			x	Not addressed	Not declared	Emerging technologies' effects on project management are analyzed, identifying benefits in schedule control and cost planning
Nenni *et al.* (2024)		x		Not addressed	Not declared	The intersection of project risk management and AI is explored
Amato *et al.* (2024)		x		Not addressed	Financial	The automation of customer segmentation techniques, focusing on credit portfolio management, is studied
Sutiene *et al.* (2024)		x		Not addressed	Financial	AI contributions to portfolio management are reviewed.
Zabala-Vargas *et al.* (2023)				Not addressed	Construction	The utilization of Big Data, data science, and AI in construction projects is reviewed
Taboada *et al.* (2023)			x	Not addressed	Not declared	The impact of AI application on PM performance is studied
Hashfi & Raharj (2023)			x	Not addressed	Not declared	The relationship between AI and PMBOK process groups is analyzed, highlighting AI's effectiveness in improving risk assessment, cost prediction, and decision-making throughout all PM phases
Mishra *et al.* (2023)			x	Not addressed	Not declared	The integration of AI and ML into IT project management to enhance decision-making, risk management, and efficiency is discussed
Bento *et al.* (2022)			x	Not addressed	Not declared	AI tools are identified as enhancing various aspects of PM across different phases of the project life cycle
Hanjing *et al.* (2022)				Not addressed	Construction	The impact of smart technologies on construction PM is explored
Borges *et al.* (2021)			x	Not addressed	Not declared	The main strategic applications of AI in PM are identified
Huang *et al.* (2021)				Not addressed	Construction	A comprehensive review of technological changes, resulting processes, and organizational modifications in the context of Big Data in PM is conducted
Belharet *et al.* (2020)			x	Not addressed	Not declared	The study explores the evolution and transformation of PM as it adapts to AI advancements
Gil-Ruiz *et al.* (2020)			x	Not addressed	Not declared	The trend of combining different AI tools in PM is demonstrated
Yamakawa *et al.* (2019)		x		Not addressed	Financial	Tools to support decision-making challenges involving optimization, statistical techniques, simulations, and AI are identified
Sharma and Goyal (2019)				Not addressed	Construction	The applications of fuzzy logic in construction projects are studied

Pr: Program Management; Po: Portfolio Management; PM: Project Management.

Source: Author's own elaboration.

In the PM domain, literature reviews have focused on the impact of AI across various processes, primarily in the phases of project planning, execution, monitoring/control, and closure (Aamer *et al.*, 2024; Belharet *et al.*, 2020; Hashfi & Raharjo, 2023; Mishra *et al.*, 2023). Specifically, Belharet *et al.* (2020) examined the knowledge areas and industry types where AI has been implemented in PM, highlighting its utilization in cost estimation, resource allocation, and quality and productivity management (Hashfi & Raharjo, 2023). Other applications include stakeholder management, team coordination, lifecycle planning, and uncertainty management (Aamer *et al.*, 2024; Taboada *et al.*, 2023). A common consensus among these studies is that AI has significantly improved decision-making within PM operational processes. Borges *et al.* (2021) and Prasetyo *et al.* (2025) emphasize aligning AI technologies with strategic decision-making, product and service management, and client and employee engagement to create competitive advantages. However, Taboada *et al.* (2023) indicate the lack of research into comprehensive AI-based PM frameworks that address lifecycle considerations, sustainability, and technology adoption by project managers.

In portfolio management, AI applications have been more prevalent in the financial sector, particularly for customer segmentation based on credit history and for mitigating risks associated with credit lending (Amato *et al.*, 2024; Nenni *et al.*, 2024; Senescall & Low, 2024). AI has also been utilized for resource allocation in financial projects (Yamakawa *et al.*, 2019). However, the adoption of AI in this sector has been sluggish, largely because of the need for transparency and explainability, which has induced uncertainty around its implementation (Sutiene *et al.*, 2024). In the construction industry, AI has made significant advances, driven by the complexity of projects that demand synchronized and real-time information. Algorithms such as fuzzy set, fuzzy logic, and fuzzy neural networks have supported decision-making, improved planning, automated tasks, and increased efficiency throughout project phases (Huang *et al.*, 2021; Sharma & Goyal, 2019). Key AI applications in this industry pertain to cost management, scheduling, quality, and scope (Hanjing *et al.*, 2022; Zabala-Vargas *et al.*, 2023).

Despite progress in PM, literature reviews indicate a concentration of AI applications in short- and medium-term planning and execution processes. Long-term perspectives, including strategic organizational planning, have remained underexplored. Furthermore, there exists an explicit need for continued research into AI implementation across other domains of OPM and its organizational enablers.

4. METHODOLOGY

The review method adhered to the checklist proposed by Williams *et al.* (2021) and Ferreira de Araújo Lima *et al.* (2020), aligned with the stages outlined in Figure 3. During the planning stage, the need was identified based on the following research questions: (1) *In which processes across the three OPM domains and their enablers have AI tools been implemented*? and (2) *What are the future research areas regarding AI applications in OPM*? During the direction stage, we defined the search strategy, selection criteria, quality assessment criteria, data extraction strategy, and data synthesis approach. Additionally, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist was utilized. It pertains to the information necessary to ensure the rigor of the review process (Briner & Denyer, 2012).

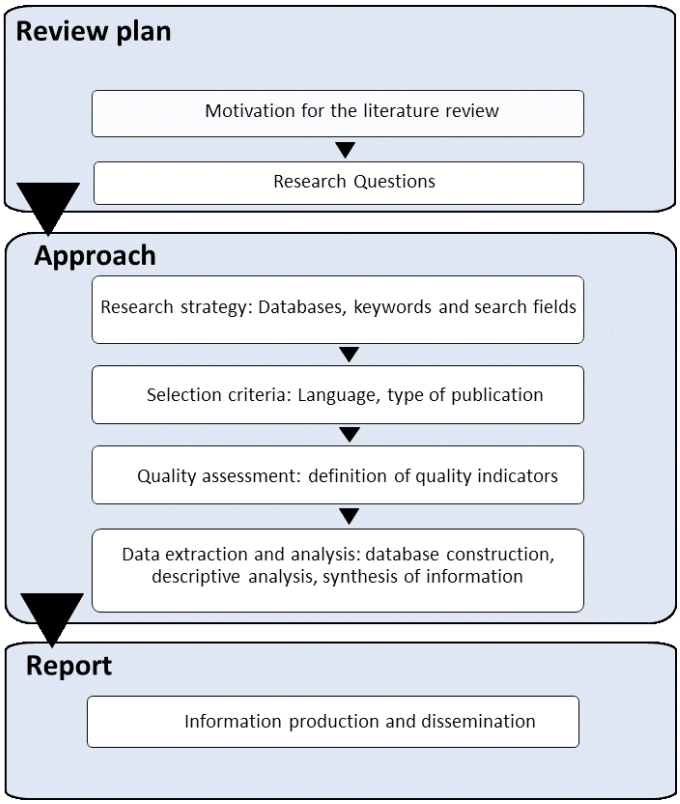

Figure 3
Systematic Literature Review Method

Source: Author's own elaboration based on Williams *et al.* (2021) and Ferreira de Araújo Lima *et al.* (2020).

The Scopus and WoS databases were chosen for the search because of their extensive breadth and coverage (Pranckutė, 2021). The formulated search equation, based on the intersection of the relevant topics, is presented in Figure 4. In both databases, only research articles and review articles published in English within the last 10 years (from 2014 to February 2025) were included.

Figure 5 illustrates the filtering process, while Table 2 outlines the inclusion and exclusion criteria applied in the review. As shown, out of the 838 documents identified in Scopus, 621 were excluded because they were book publications, theses, conference papers, out-of-date, or in another language. Consequently, only 217 documents were analyzed in the review phase. A similar process was followed for the WoS, starting with 217 publications, which, after filtering, resulted in 164 documents for the review phase. During this phase, an additional filter was applied based on a detailed abstract analysis, leading to a final selection of 163 articles from Scopus and 81 from the WoS, totaling 244 documents. Finally, after comparing both databases, 157 duplicate articles were identified, resulting in a final analysis of 87 unique articles.

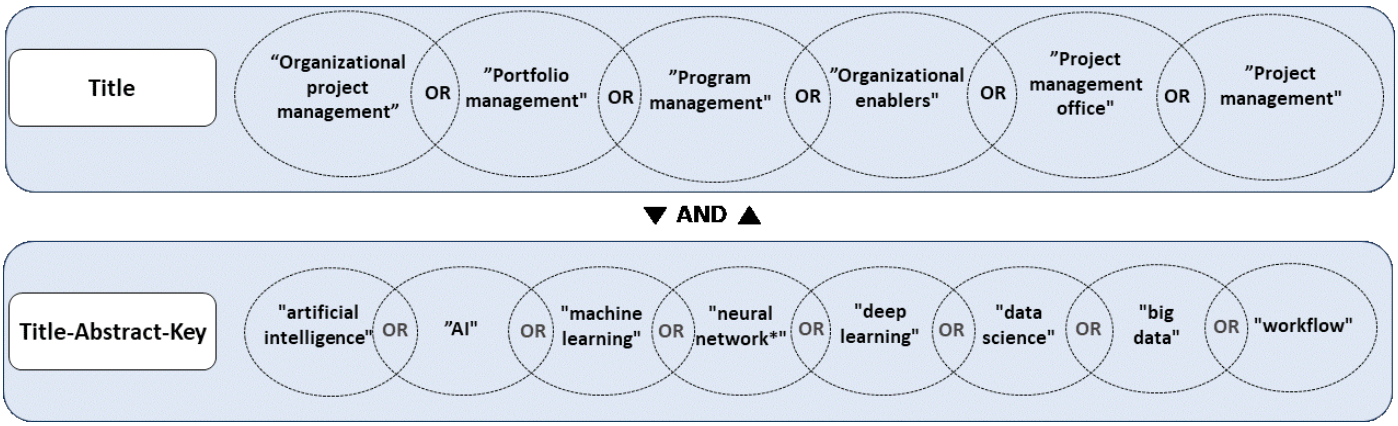

Figure 4
Search Equation for the Systematic Literature Review
Source: Author's own elaboration.

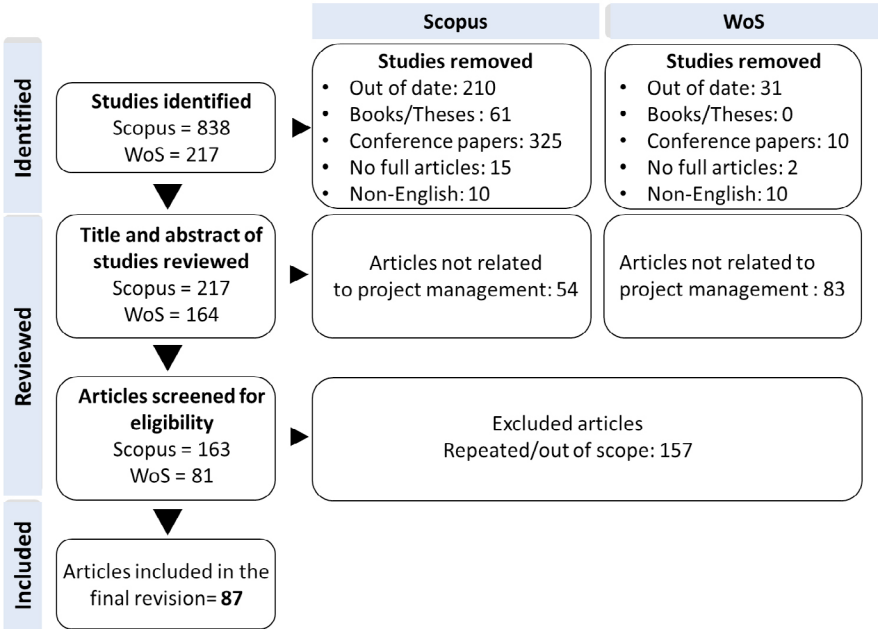

Figure 5
Document Search and Selection Process
Source: Author's own elaboration based on Briner and Denyer (2012).

Table 2
Inclusion and Exclusion Criteria Applied in the Literature Review

Inclusion Criteria	Exclusion Criteria
— Full-text availability — Published in English — Publication time frame: last 10 years (2014-February 2025) — Document type: articles and reviews — Articles related to the domains of OPM — Articles directly related to PM	— Abstract-only availability — Language other than English — Publication time frame: before 2014 — Document type: proceedings, book chapters, books, notes, short communications, among others — Articles not related to OPM or PM — Duplicate documents

Source: Author's own elaboration.

5. RESULTS: AI APPLICATIONS IN OPM PROCESSES

This section discusses the findings from the literature review aimed at addressing the first research question. Table 3 presents the processes categorized according to the task typology proposed by Mishra *et al.* (2023), along with the OPM domains where AI applications were identified. A total of 13 processes were impacted by AI, with the majority occurring in the PM domain, followed by portfolio and program management. Notably, no AI applications were identified within the organizational enablers, aligning with the literature review studies referenced in Table 1, nor in processes related to diffuse tasks.

Table 3
AI Applications in OPM Processes

		OPM domains*			
Task typology	**Processes**	**Pr**	**Po**	**PM**	**Author(s)**
Repetitive	Data entry		x		Pantović *et al.* (2024)
	Human resource management	x	x		Elkholosy *et al.* (2022)
		x			Yang *et al.* (2021)
				x	Alzeyani & Szabó (2024); Babu *et al.* (2024); Imeri and Imeri (2024)
	Time management / scheduling		x		Zhang *et al.* (2024)
				x	Alzeyani & Szabó (2024); Auth *et al.* (2021); Cinkusz *et al.* (2024); Ekanayake *et al.* (2024); Gil-Ruiz *et al.* (2020); Harish Kumar and Srinivas (2024); Hashfi and Raharjo, (2023); Jaafar *et al.* (2022); Liu and Hao (2021); Santos *et al.* (2023); Wang *et al.* (2012)
	Communication management		x		Müller *et al.* (2024);
				x	Cinkusz *et al.* (2024); Chen *et al.* (2021) Iordache & Marian (2024)
	Stakeholders		x		Müller *et al.* (2024)
				x	Chen *et al.* (2021)
	Document management		x		Müller *et al.* (2024)
				x	Chen *et al.* (2021)
	Cost management/ budgeting			x	Almahameed & Bisharah (2023); Alzeyani & Szabó (2024); Chen (2022); Farouq (2021); Harish Kumar & Srinivas (2024); Hashfi & Raharjo, (2023); Indhujaa & Jaisankar (2024); Jaafar *et al.* (2022); Ong & Uddin (2020); Santos *et al.* (2023); Wang *et al.* (2012); Wig & Martinez (2019)
Decision	Selection			x	Pantović *et al.* (2024); Sommer (2024); Sakka *et al.* (2023)
			x		Bai *et al.* (2022); Costantino *et al.* (2015); Ghapanchi *et al.* (2012); Rabbani *et al.* (2010); Wang *et al.* (2012)
		x			Singh (2015)
	Quality management, WBS/tasks			x	Aamer *et al.* (2024); Auth *et al.* (2021); Cinkusz *et al.* (2024); Hanjing *et al.* (2022); Holzmann *et al.* (2022); Si *et al.* (2023)
Judgment	Risk management		x		Bilgin *et al.* (2022) Zaidouni *et al.* (2024)
				x	Choi *et al.* (2021); Krichevsky *et al.* (2019); Mohamad *et al.* (2021); Mohite *et al.* (2023); Wei & Ding (2022); Wig & Martinez (2019); Taye and Feleke (2022)
	Planning control			x	Gil-Ruiz *et al.* (2020); Grabis *et al.* (2019); Hashfi & Raharjo (2023); Jaafar *et al.* (2022); Mostofi *et al.* (2024); Santos *et al.* (2023); Wei & Ding (2022); Yang (2024)
			x		Liu (2019)
		x			Yang *et al.* (2021)
Problem	Scope management			x	Kraiem *et al.* (2023); Merzouk *et al.* (2023)
	Strategic alignment			x	Antony-Ranesh & Samuel (2022); Jang (2022)
Diffuse	Not found	—	—	—	

Pr: Program Management; Po: Portfolio Management; PM: Project Management.
Source: Author's own elaboration.

Figure 6 depicts the distribution of studies by domain, task typology, and processes. The data indicate that the PM domain encompasses the majority of AI applications (79%), followed by portfolio management (16%) and program management (5%). Most applications are concentrated in repetitive or routine tasks (49%), especially in cost/budget management and scheduling. Significant advancements are also noted in risk management (judgment tasks) and project selection (decision tasks). Conversely, decision-making, problem-solving, and diffuse tasks exhibit less progress in terms of AI applications.

Figure 7 illustrates the most widely used AI algorithms in OPM. The most frequently applied algorithms include neural networks, fuzzy logic, and random forests, whereas digital twins and genetic algorithms are used less often. All identified algorithms have been implemented in the PM domain. In portfolio management, neural networks and fuzzy logic stand out, while program management employs only four algorithms, including

random forests. Figure 7 showcases the AI algorithms utilized according to task type. Most algorithms are predominantly utilized in repetitive tasks, with the exception of Bayesian networks and digital twins, which are mainly applied in judgment and decision-making tasks, respectively.

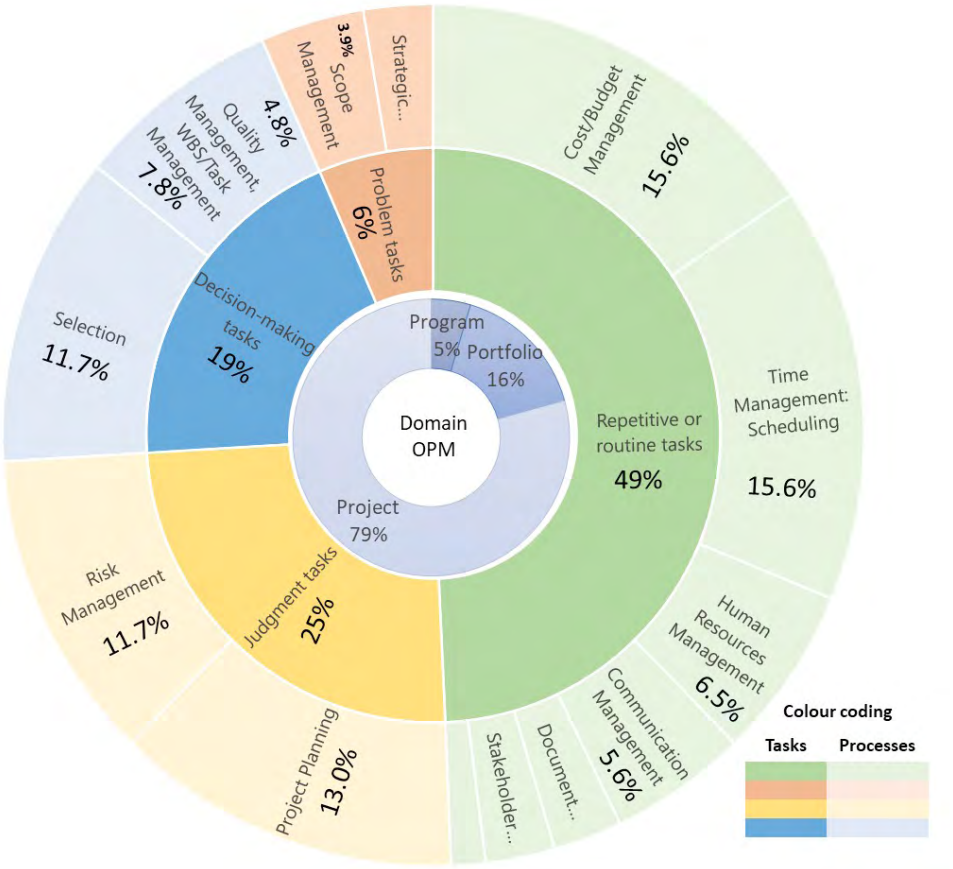

Figure 6
AI Applications in OPM Domains, Tasks, and Processes
Source: Author's own elaboration.

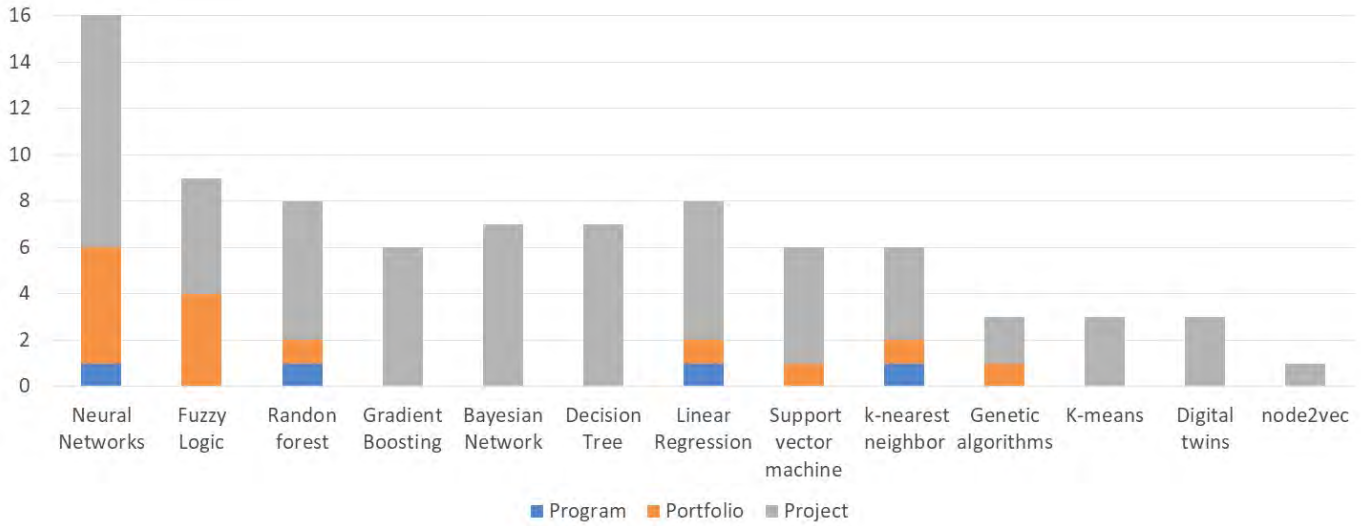

Figure 7
Most Utilized AI Algorithms in OPM Domains
Source: Author's own elaboration.

Figure 8 depicts the processes associated with repetitive tasks and the AI algorithms utilized. AI is pivotal in human resource management, cost management, and time management, with Bayesian networks being the most commonly applied algorithms across various processes.

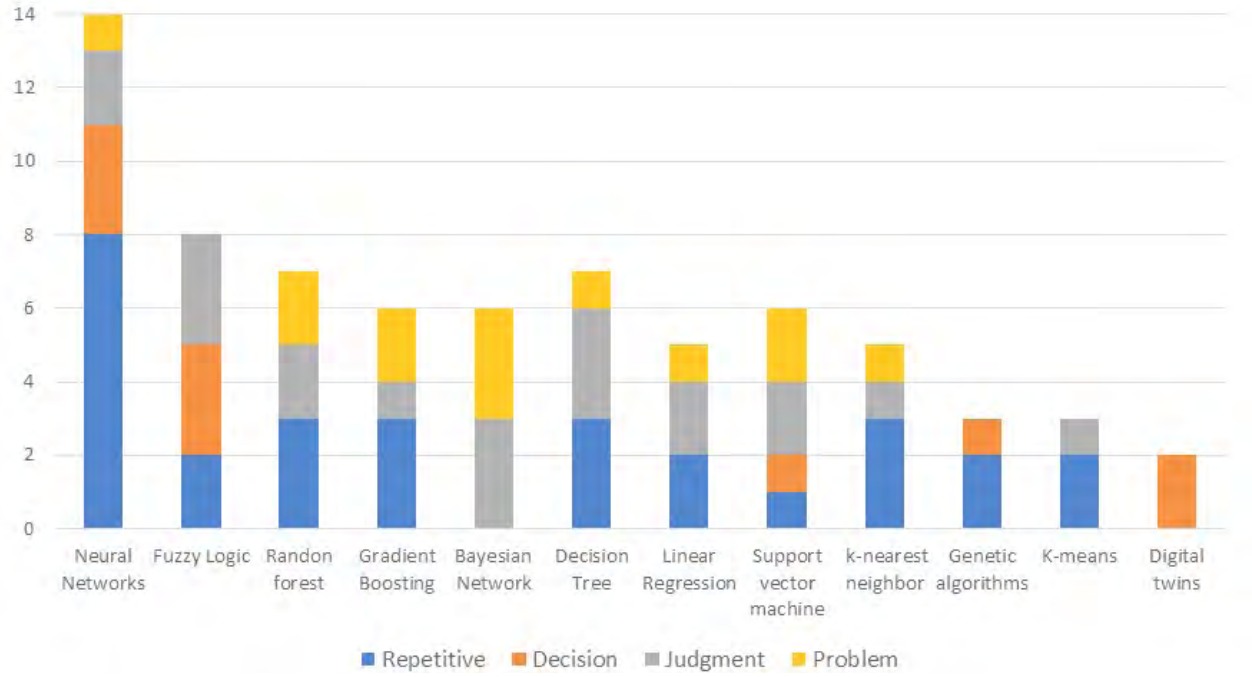

Figure 8
Most Utilized AI Algorithms by Task Type
Source: Author's own elaboration.

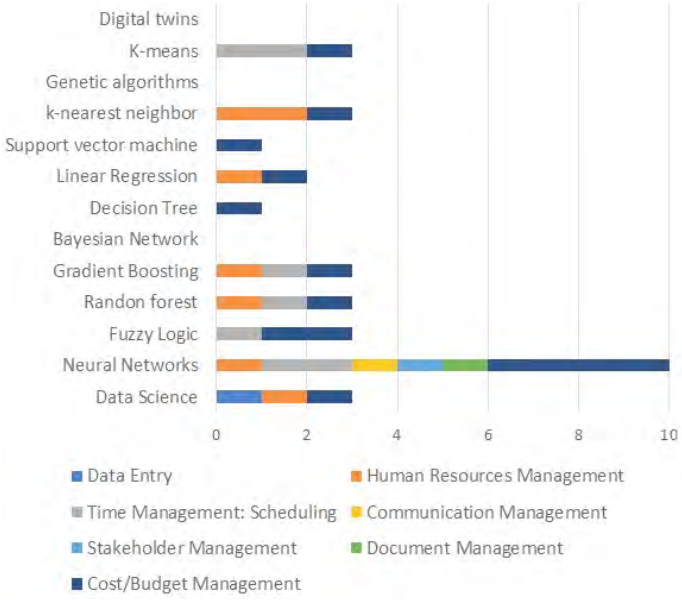

Figure 9
Most Utilized AI Algorithms by Process Type: Repetitive Tasks
Source: Author's own elaboration.

Neural network-based algorithms are the most commonly used for repetitive tasks (Figure 9). In decision-making tasks (Figure 10), digital twins are prominent in selection and quality management processes, while genetic algorithms are employed for selection and control in judgment tasks (Figure 11). Finally, Figure 12 shows that the most widely accepted algorithm for problem-solving tasks are Bayesian networks. Although not considered AI algorithms, data science is utilized for data entry and in human resource management, cost management, selection, and control. Overall, studies apply multiple algorithms to a dataset to identify which one produces the most favorable results.

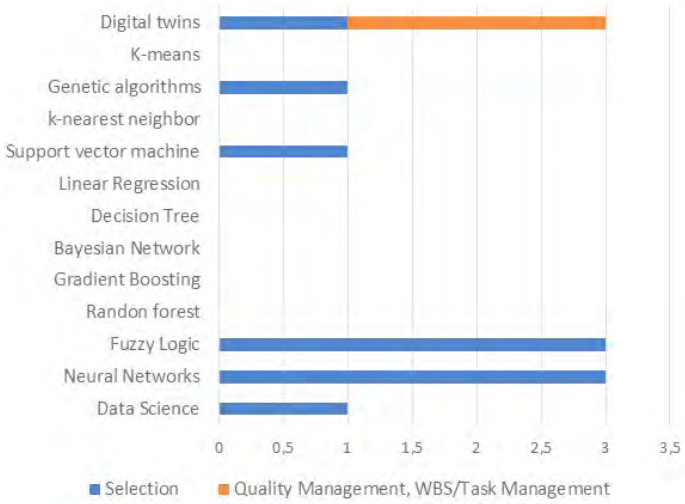

Figure 10
Most Utilized AI Algorithms by Process Type: Decision-making Tasks
Source: Author's own elaboration.

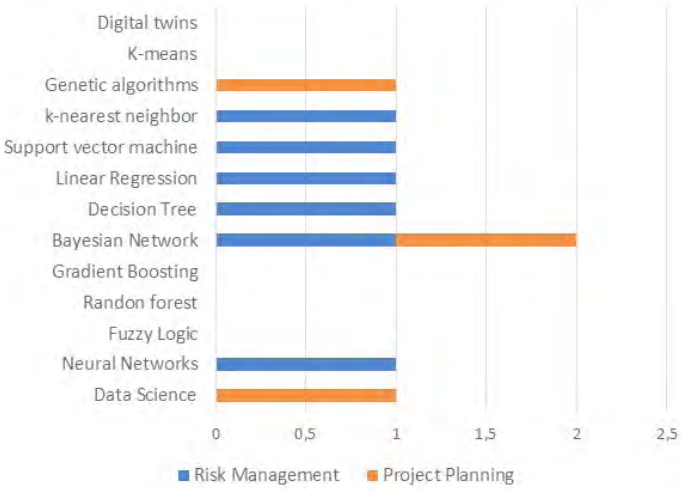

Figure 11
Most Utilized AI Algorithms by Process Type: Judgment Tasks
Source: Author's own elaboration.

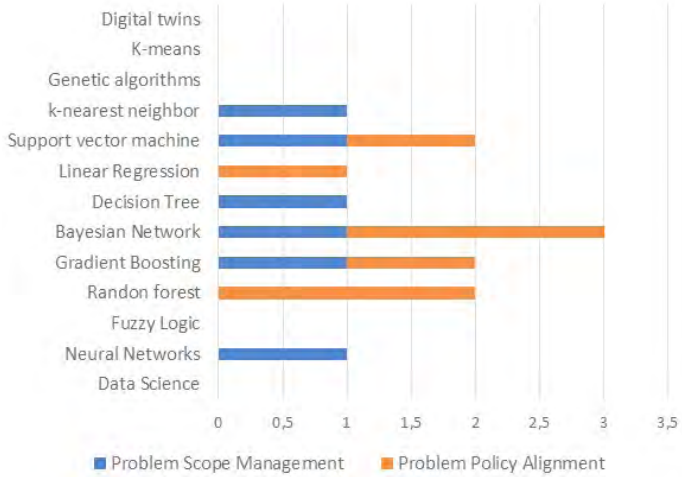

Figure 12
Most Utilized AI Algorithms by Process Type: Problem Tasks
Source: Author's own elaboration.

6. DISCUSSION

The discussion of the results from this literature review is structured around the four types of tasks where AI has been applied in OPM: repetitive or routine tasks, decision-making, judgment, and problem-solving. For each category, the literature's reported advancements are analyzed, considering the three OPM domains. As no contributions were identified regarding organizational enablers, this topic remains an open field for future AI applications.

6.1. AI Applications in Repetitive or Routine Tasks

In portfolio and program management, the most studied automation processes include information management and human resource allocation. Aligning information management with business objectives enhances project success and mitigates adverse impacts (Elkholosy *et al.*, 2022; Pantović *et al.*, 2024). Elkholosy *et al.* (2022) proposed a structured data acquisition model and an ML-based forecasting model to predict workforce requirements, improving project oversight. AI also enhances inter-project interactions; Zhang *et al.* (2024) developed an inter-project network based on graph neural networks and attention mechanisms to integrate project relationships dynamically. Yang *et al.* (2021) explored AI's role in agile program management, focusing on stage overlapping, shared resources, and knowledge transfer. Overall, AI enables data-driven decision-making, optimizes resource allocation, minimizes risks, and enhances adaptability in dynamic project environments.

AI has been applied across various PM process groups, including planning, execution, monitoring, control, and, to a lesser extent, project closure. In planning and execution, AI helps adjust parameters to predict outcomes and adapt to project environments. Studies have applied neural networks and variance analysis to forecast costs, timelines, and profit margins (Farouq, 2021; Ong & Uddin, 2020). Monte Carlo simulations have estimated budgets by assigning probabilities to costs (Wig & Martinez, 2019), while constraint-based algorithms have forecast project durations (Gil-Ruiz *et al.*, 2020). AI techniques, including fuzzy logic and historical data analysis, have improved cost budgeting and time projections (Auth *et al.*, 2021; Harish Kumar & Srinivas, 2024; Jaafar *et al.*, 2022). Automating cost and schedule processes enhances resource allocation, reduces errors, and improves timelines based on real-time data (Mohite *et al.*, 2023).

In monitoring and control, AI assesses progress and implements corrective actions. Real-time tracking enables stakeholders to review work details and track performance (Lordache & Marian, 2024). Big Data platforms and ML algorithms, such as linear regression, decision trees, and neural networks, optimize cost control (Almahameed & Bisharah, 2023; Chen, 2022; Indhujaa & Jaisankar, 2024). AI methodologies enable managers analyze deviations and make rescheduling decisions (Santos *et al.*, 2023). ML models, combined with Monte Carlo simulations, evaluate earned value metrics and predict shifts in execution timelines. At project closure, AI tools minimize waste, optimize resources, and improve decision-making efficiency (Hashfi & Raharjo, 2023).

AI significantly enhances PM by predicting outcomes and optimizing resources. Predictive analytics, utilizing gradient boosting and neighbor embedding, improves result accuracy and resource allocation (Babu *et al.*, 2024). AI-driven task assignments optimize human resource management (Elkholosy *et al.*, 2022), with workforce structure and size influencing project efficiency (Imeri & Imeri, 2024). However, challenges persist, including collection of inaccurate data, limited technical expertise, and reliance on data-driven decision-making. AI also enhances communication and document management. Natural language processing supports contract management and real-time document handling. AI-powered collaboration tools facilitate information sharing and streamline team communication, mitigating labor inefficiencies and human errors while improving stakeholder alignment (Chen *et al.*, 2021; Zabala-Vargas *et al.*, 2023).

6.2. AI Applications in Decision-making Tasks

In portfolio management, effective project selection should align with strategic objectives, managerial experience, and competitive factors while assessing risks to mitigate failures. Costantino *et al.* (2015) utilized artificial neural networks to improve project evaluation and risk analysis by linking success factors with key performance indicators and expert insights. Other methods include neural networks with entropy and analytic hierarchy processes for economic assessment (Bai *et al.*, 2022) and multicriteria analysis using genetic algorithms (Wang *et al.*, 2012) and particle swarm optimization (Rabbani *et al.*, 2010). Singh (2015) highlighted Big Data tools for planning and monitoring, reducing data overload, and classifying project success based on multiple criteria.

In PM, automating repetitive processes enables predictive and corrective analyses, providing essential data for decision-making. Auth *et al.* (2021) and Holzmann *et al.* (2022) highlighted the importance of AI tools in leveraging previous project data for planning and resource management. Si *et al.* (2023) applied digital twins to improve information analysis, data mining, state evaluation, and decision-making. Sommer (2024) introduced a five-level supervised decision model incorporating database construction and tool selection based on previous experience. Pantović *et al.* (2024) utilized historical data and performance metrics to assess strategies for business sustainability, integrating analytical techniques such as multiple linear regression. AI applications span all PM phases, including bidding, scheduling, quality control, cost estimation, and risk calculation (Hanjing *et al.*, 2022; Holzmann *et al.*, 2022). By integrating data-driven decisions, AI enhances adaptability and resilience in dynamic environments while reducing complexity, uncertainty, and risk interdependencies (Aamer *et al.*, 2024).

6.3. AI Applications in Judgment Tasks

Portfolio management evaluates risk, return, and project alignment with company objectives. Zaidouni *et al.* (2024) employed fuzzy factor analysis to predict portfolio risk based on historical data and expert input. Bilgin *et al.* (2022) developed a tool that integrates risk, return, and strategy, enabling contingency planning and alignment with corporate goals. Another key application is client management; Liu (2019) proposed a model based on fuzzy semantics and text mining to transform unstructured data into actionable insights, improving consumer behavior analysis and strategy development. These studies highlight the significant link between portfolio management and business strategy. However, AI applications in judgment-based tasks within program management remain limited, presenting opportunities for future research.

In PM, the initiation phase involves gathering key information for planning. AI-driven bid evaluation and probabilistic cost models help quantify risks and calculate bids (Gil-Ruiz *et al.*, 2020). Bayesian networks and vector models analyze historical project data complexity (Grabis *et al.*, 2019). AI also improves efficiency evaluation through neuro-fuzzy hybrid systems (Krichevsky *et al.*, 2019) and fuzzy logic for timeline estimation (Wig & Martinez, 2019). The node2vec algorithm aids in budgeting and task allocation (Mostofi *et al.*, 2024), optimizing resource planning by assessing risks and success rates (Hashfi & Raharjo, 2023).

Risk identification is crucial in PM. Timely and effective evaluation enhances project outcomes (Choi *et al.*, 2021; Mohite *et al.*, 2023). The Support Vector Machine algorithm predicts failures in software PM across 10 knowledge areas (Taye & Feleke, 2022). The Decision tree and Naïve Bayesian algorithms extract data to anticipate delays (Mohamad *et al.*, 2021). Real-time tracking of rejected requests with delay probabilities facilitate resource adjustments and scheduling corrections (Mohite *et al.*, 2023; Yang, 2024).

AI tools automate repetitive tasks and enhance risk analysis by processing large datasets. AI-driven prediction systems integrate with key PM process groups (Radhakrishnan & Jaurez, 2021). Studies show that AI adoption enables managers to detect risks early and implement mitigation strategies in dynamic environments where traditional tools prove insufficient (Mahdi *et al.*, 2021; Wei & Ding, 2022). AI insights help prevent overallocation or underutilization, improving resource allocation. However, challenges persist, including uncertainty, variability, and data quality, which are crucial for ensuring accurate PM predictions (Hashfi & Raharjo, 2023).

6.4. AI Applications in Problem-solving Tasks

In PM, the planning stage involves selecting methods and allocating resources. Kraiem *et al.* (2023) utilized ML-based tools to predict the most suitable PM method, identifying key variables via surveys and literature reviews. Merzouk *et al.* (2023) developed a model to determine the best management approach, focusing on Scrum, Scaled Agile Framework, and Dynamic Systems Development Method. Sakka *et al.* (2023) introduced a bottom-up decision analysis based on multicriteria evaluation to generate quantitative and qualitative insights. However, a key challenge remains: the availability of structured data. Other AI applications include commercialization and policy alignment. Jang (2022) applied ML models, such as logistic regression and random forest, to predict the commercial viability of research projects. Antony-Ranesh and Samuel (2022) applied Naïve Bayes to assess the alignment between government policies and project details, emphasizing the role of governance in project success. Overall, AI enhances method selection, commercialization, and compliance; however, data limitations pose challenges.

7. ORGANIZATIONAL CHALLENGES AND RESEARCH OPPORTUNITIES

This section discusses the results of the literature review addressing the second question posed. As mentioned earlier, AI applications in OPM have primarily focused on PM, with some advances in portfolio and program management. Most of the existing studies have mainly attempted to evaluate the predictive power of various algorithms. Literature synthesis (see Table 4) highlights the main organizational challenges and opportunities for future research, categorized into four main topics: 1) deficiencies in databases; 2) application of AI algorithms; 3) human management; and 4) ethical practices.

Table 4
Organizational Challenges and Opportunities for Future Research

Topics	Limitations	Challenges and Opportunities	References
Databases	Data inaccuracy	Create publicly accessible databases specifically designed for OPM to foster the development of AI tools Collect empirical, structured, and well-documented data focused on OPM to enhance the accuracy of analytical tools and improve the reliability of predictive models Develop advanced tools for data interpretation to transform large volumes of information	Auth *et al.* (2021); Babu *et al.* (2024); Bakici *et al.* (2023); Belharet *et al.* (2020); Choi *et al.* (2021); Elkholosy *et al.* (2022); Fridgeirsson *et al.* (2021); Guinhouya (2023); Harish Kumar & Srinivas (2024); Jaafar *et al.* (2022); Kim & Jang (2023); Li *et al.* (2021); Liu (2019); Liu & Hao (2021); Merzouk *et al.* (2023); Mishra *et al.* (2023); Müller & Klein (2020); Radhakrishnan & Jaurez (2021); Sommer (2024); Taye & Feleke (2022); Tereso *et al.* (2023) and Zhang *et al.* (2024).
Algorithms	Applications oriented to certain industrial sectors	Explore the effectiveness of AI tools across various industries and project types to identify patterns Develop customized algorithms tailored to the requirements of OPM domains and processes according to the industrial sector	Choquehuanca-Sánchez *et al.* (2024); Gil-Ruiz *et al.* (2020); Mahdi *et al.* (2021); Nenni *et al.* (2024); Radhakrishnan & Jaurez (2021); Taboada *et al.* (2023); Velezmoro-Abanto *et al.* (2024); Zabala-Vargas *et al.* (2023) and Zhang *et al.* (2024).
Human Management: Training and Skill Development	Insufficient AI and data analysis skills in project teams	Develop training programs for project teams focused on AI technologies and their applications in OPM Prepare the organizational structure and develop soft skills to minimize resistance to change and facilitate the successful implementation of AI technologies	Babu *et al.* (2024); Bahi *et al.* (2024); Bakici *et al.* (2023); Dam *et al.* (2019); Fridgeirsson *et al.* (2021); Gil-Ruiz *et al.* (2020); Müller *et al.* (2024); Nenni *et al.* (2024); Niederman (2021); Shang *et al.* (2023); Tominc *et al.* (2024) and Yang (2024).
Ethical Practices	Lack of specific ethical guidelines regarding AI applications in OPM	Develop ethical and legal frameworks that ensure data privacy and security in the implementation of AI in OPM	Babu *et al.* (2024); Bahi *et al.* (2024); Nenni *et al.* (2024); Yang (2024) and Zabala-Vargas *et al.* (2023).

7.1. Databases

The main deficiencies in databases for training algorithms pertain to availability, data quality, and inherent limitations of ML techniques. Databases such as MMLIB (Liu & Hao, 2021), COCOMO81, MAXWELL, China (Harish Kumar & Srinivas, 2024), Amazon2, Taobao3, and MIND_NEWS (Liu, 2019; Zhang *et al.*, 2024) are not sufficiently accurate for predictive applications. Mishra *et al.*, (2023) highlighted the challenge of accessing well-documented business data, while Choi *et al.* (2021) and Taye & Feleke (2022) indicated the scarcity of consistent data throughout the project lifecycle. Merzouk *et al.* (2023) emphasized the importance of collection models that account for project-specific limitations, such as in agile management and internet of things.

Furthermore, the lack of public and accepted databases limits the evaluation of PM approaches, impacting the effectiveness of AI algorithms, especially ML, which require comprehensive datasets for optimal performance (Auth *et al.*, 2021; Fridgeirsson *et al.*, 2021; Sommer, 2024). AI tools in OPM rely on accurate data, timely updates, and continuous adjustments (Belharet *et al.*, 2020). Data science and AI systems require frequent testing to detect errors and implement project-specific improvements (Radhakrishnan & Jaurez, 2021). Progress in OPM is sluggish because of the costs and time required to implement these technologies (Fridgeirsson *et al.*, 2021). ML techniques, despite their immense potential, experience significant challenges related to data quality and the need for robust infrastructure to manage voluminous data (Cinkusz *et al.*, 2024).

Rapid and effective data collection is crucial in OPM. The information modeling technology facilitates the extraction of valuable data from large volumes and their conversion into useful information utilizing specialized software (Li *et al.*, 2021). Elkholosy *et al.* (2022) developed a collection model; however, the paucity of training data affected accuracy. Many data points are obtained from project managers' recollections; other authors recommend case studies to capture empirical experiences instead of isolated interviews (Bakici *et al.*, 2023; Kim & Jang, 2023). Currently, databases are being created specifically for AI in PM, with voluntary contributions from organizations (Radhakrishnan & Jaurez, 2021). Predictive analysis will become increasingly important in OPM, driven by ML algorithms and evolving project data (Babu *et al.*, 2024).

This study could not identify any research that utilizing data specifically collected for this purpose. Data collection not only implies obtaining data; it also implies its effective application (Jaafar *et al.*, 2022). Project managers exhibit a greater willingness to employ AI systems that facilitate the interpretation and communication of collected data (Fridgeirsson *et al.*, 2021). However, a gap persists between data analysis tools and their application in PM, affecting decision-making and project progress (Alzeyani & Szabó, 2024; Guinhouya, 2023; Jaafar *et al.*,

2022; Tereso *et al.*, 2023). To address these challenges, innovative techniques are being developed, such as the utilization of social networks and AI systems that integrate narrative and electronic data, capturing real-time phenomena and accelerating the dissemination of results (Müller & Klein, 2020).

7.2. Algorithms

AI algorithms have limitations, which necessitates that project managers rely on their expertise to interpret results effectively (Gil-Ruiz *et al.*, 2020). This has driven the trend of integrating various AI tools into hybrid systems (Alzeyani & Szabó, 2024). Currently, autonomous PM systems do not fully consider the entire project environment, including client status, stakeholder involvement, and team performance (Gil-Ruiz *et al.*, 2020). Although a few companies have developed general AI algorithms, access to these remains limited (Radhakrishnan & Jaurez, 2021; Taboada *et al.*, 2023), and the sector's requirement for comprehensive technological models has yet to be fully addressed (Zabala-Vargas *et al.*, 2023). For future

AI developments in PM, several recommendations are suggested. Conducting case studies and pilot projects to validate in real-world contexts, and designing specific tools to integrate ML techniques into the industry. It is also crucial to create customized algorithms tailored to PM requirements (Velezmoro-Abanto *et al.*, 2024) and improve integration with existing PM systems, including intuitive interfaces that facilitate adoption. Additionally, optimizing the utilization of team feedback and incorporating external knowledge to offset the limited availability of data is recommended (Zhang *et al.*, 2024), along with managing stakeholders to reduce conflicts of opinion (Mahdi *et al.*, 2021).

7.3. Human Management: Training and Skill Acquisition

The exponential advancement of AI technologies has surpassed the learning curve of personnel in PM. Currently, professionals must acquire competencies in data science, access high-quality data, and adopt a data-driven approach in organizational decision-making (Babu *et al.*, 2024; Bahi *et al.*, 2024). However, AI implementation is challenging, primarily because of the high costs of infrastructure, training, and maintenance, limiting its adoption to large companies (Bakici *et al.*, 2023; Yang, 2024). Additionally, the lack of executive support and trained AI personnel complicates the process (Shang *et al.*, 2023). Overcoming these challenges requires continuous training efforts, stakeholder engagement, and investment strategies in security and skills for responsible and effective implementation (Nenni *et al.*, 2024).

Companies must have strong managerial backing, ensuring both adequate resources and employees trained in AI (Shang *et al.*, 2023; Tominc *et al.*, 2024). In addition to technical competencies, PM professionals must develop relevant soft skills. Cultural and generational impacts affect the perception and integration of AI, influencing managers' responsibilities, management processes, and interactions within the project (Müller *et al.*, 2024). Areas that require human leadership, empathy, and emotional intelligence will continue to demand human intervention, especially in managing human resources and stakeholders (Fridgeirsson *et al.*, 2021). Managers working with AI should adopt CRISP-DM interaction practices, as well as agile development methods, DevOps, etc., among other traditional approaches (Niederman, 2021). It will be crucial to define contextual frameworks that determine the level of autonomy in decision-making and data management (Müller *et al.*, 2024). While AI will optimize decisions and resources, the role of the project manager will evolve toward that of a data scientist, complementing the technology without replacing the human team (Gil-Ruiz *et al.*, 2020). Felicetti *et al.* (2024) recommended that to enhance the effective application of AI tools in PM, companies should implement specialized training programs and adopt explicit communication strategies that emphasize the direct benefits for task development in each project.

7.4. Ethical Practices

Finally, there are ethical concerns regarding data privacy and the potential for bias in predictive models. These concerns necessitate careful and responsible handling. Data security must be prioritized from the point of collection, ensuring that confidential information is not shared (Yang, 2024). It is essential to ensure that AI is utilized ethically, avoiding biases and adhering to privacy and security standards (Babu *et al.*, 2024; Bahi *et al.*, 2024). Appropriate management of data privacy and security, and training of personnel are key areas that must be addressed to maximize benefits and overcome limitations (Zabala-Vargas *et al.*, 2023). It is crucial to carefully review development contexts, the ethical and social implications of new strategies, and the potential risks of these technologies (Zabala-Vargas *et al.*, 2023). It is imperative that the tool meets data privacy and security standards (Nenni *et al.*, 2024).

8. CONCLUSIONS

The integration of OPM, encompassing program management, portfolio management, project management, and organizational enablers, is crucial for achieving an organization's strategic objectives. While AI has rapidly expanded in various sectors, this literature review highlights the need to extend its application within the realm of OPM. Recent findings indicate that AI has become increasingly valuable in OPM, particularly in automating repetitive tasks and supporting data-driven decision-making based on historical data. Research underscores that AI optimizes planning and estimation processes when reliable data is available. Moreover, applications such as digital assistants and intelligent management systems enhance efficiency, enabling managers to focus on collaborative and complex tasks.

In the context of OPM, the present literature review indicates that while most advancements in AI applications occur within the PM domain, progress has also been noted in program and portfolio management. However, they occur mainly in operational processes; the strategic aspects remain underdeveloped. Regarding organizational enablers, similar to the previously published review papers, no AI applications are reported. The processes most influenced by AI include cost, time, and human resource management, largely because of the availability of databases that enable the application of algorithms. However, challenges persist, such as insufficient data collection throughout the project lifecycle and the lack of algorithms capable of integrating different AI tools into

hybrid system. Therefore, research opportunities are identified in developing specific platforms for data collection and creating customized algorithms tailored to the requirements of each project. Moreover, despite AI's advancements in the PM domain, most of the analyzed articles focus on projects in the financial and construction sectors, highlighting an open field for developing applications in other industries and service sectors.

8.1. Future Research Lines

Despite these PM advancements, program and portfolio management processes continue to lag. The literature also identifies opportunities to apply AI to organizational enablers, which are essential for supporting strategy development at the organizational level. Studies addressing organizational enablers or diffuse tasks —those involving multiple objectives and several possible outcomes— remain unexplored, presenting unique challenges. The requirement for empirical data collection and structuring to optimize AI applications in OPM is evident. While AI offers significant opportunities to streamline processes, a comprehensive approach encompassing both operational and strategic levels is essential to maximize its potential and ensure project success. The low success rates in projects suggest inadequate adaptation of PM practices to organizational specificities.

In this study, future lines of research were categorized into several topics. The main deficiencies in databases for training algorithms pertain to availability, data quality, and inherent limitations of ML techniques. AI algorithms have limitations, which necessitates that project managers rely on their expertise to interpret results effectively. The exponential advancement of AI technologies has surpassed the learning curve of personnel in PM. Ethical considerations include challenges in data privacy, customer perceptions of privacy breaches, security, and potential biases in AI systems.

This study opens new avenues for OPM research, particularly in applying AI to strategic areas such as portfolio and program management. Key research areas include creating public and well-structured databases, developing customized algorithms for OPM, training in AI technologies, and implementing ethical data handling practices. This study contributes to the understanding of AI in OPM, and emphasizes a holistic approach to enhancing strategic decision-making in organizations.

9. ACKNOWLEDGMENTS

The authors thank the Ministry of Science, Technology, and Innovation of Colombia (Minciencias) for funding this research through the call for research Projects 932 /2022. Additionally, we thank the reviewers of this article, as their valuable contributions undoubtedly played a significant role in improving its content.

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Management Letters / Cuadernos de Gestión 25/2 (2025) 73-88

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Management Letters / Cuadernos de Gestión

journal homepage: https://ojs.ehu.eus/index.php/CG
ISSN: 1131-6837 / e-ISSN: 1988-2157

Driving sustainability: Green drivers and practices in the textile-fashion industry

Conduciendo la sostenibilidad: Impulsores y prácticas verdes en la industria de la moda textil

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ARTICLE INFO

Received 29 November 2024,
Accepted 10 July 2025

Available online 31 October 2025

DOI: 10.5295/cdg.252326jc

JEL: M11, Q56

ABSTRACT

This study aims to identify the main drivers that influence internal GSCM (Green Supply Chain Management) practices undertaken by companies in the textile-fashion sector in Spain. Additionally, it examines how these companies leverage these practices to enhance both economic and environmental performance. By using a survey-based methodology and applying the PLS-SEM technique, the analysis highlights that imposed regulatory requirements and company environmental awareness are not a direct precursor to product and process oriented internal GSCM practices. Instead, internal firm-level motivators are significant in internal GSCM practices. External stakeholder pressures are significant in internal GSCM practices and more influential in internal product GSCM practices (eco-design and green packaging). Furthermore, while process-oriented GSCM practices positively contribute towards environmental outcomes, they do not directly enhance economic performance. Conversely, product-oriented GSCM practices positively affect both environmental and economic performance. By distinguishing the effects of product versus process practices, this study provides nuanced insights on the literature regarding GSCM, particularly in resource-intensive sectors such as textile and fashion, where strategic decisions regarding green practices can lead to differentiated economic and environmental outcomes.

Keywords: GSCM, Drivers, Green supply chain management practices, Performance sustainability, Textile-fashion industry, PLS-SEM.

RESUMEN

Este estudio tiene como objetivo identificar los principales impulsores que influyen en las prácticas internas de GSCM (Gestión de la Cadena de Suministro Verde) llevadas a cabo por empresas del sector textil-moda en España. Además, examina cómo estas empresas aprovechan dichas prácticas para mejorar tanto el rendimiento económico como el ambiental. Mediante una metodología basada en encuestas y la aplicación de la técnica PLS-SEM, el análisis destaca que los requisitos regulatorios impuestos y la conciencia ambiental de la empresa no son un antecedente directo de las prácticas internas de GSCM orientadas al producto y al proceso. Sin embargo, los motivadores internos a nivel de empresa y las presiones externas de los grupos de interés son significativas en las prácticas internas de GSCM y tienen una mayor influencia en las prácticas de GSCM orientadas al producto (ecodiseño y embalaje verde). Asimismo, aunque las prácticas orientadas al proceso contribuyen positivamente a los resultados ambientales, no mejoran directamente el desempeño económico. Por el contrario, las prácticas orientadas al producto impactan positivamente tanto en los resultados ambientales como económicos. Al distinguir los efectos de las prácticas orientadas al producto frente a las orientadas al proceso, este estudio aporta una visión matizada a la literatura sobre GSCM, particularmente en sectores intensivos en recursos como el textil-moda, donde las decisiones estratégicas sobre prácticas verdes pueden generar resultados diferenciados en términos económicos y ambientales.

Palabras clave: GSCM, Impulsores, Prácticas de gestión de cadena de suministro verde, Rendimiento, Industria textil-moda, PLS-SEM.

1. INTRODUCTION

Climate change pressures and government regulations push companies towards environmentally friendly practices (Dou *et al.*, 2018). Strategic responses have evolved from controlling pollution to adopting preventive approaches focused on reducing pollution at the source (Daily *et al.*, 2012).

Green Supply Chain Management (GSCM) integrates environmental thinking throughout supply chain operations, encompassing the entire product life cycle, to reduce resource waste, minimize environmental pollution, and lower production costs (Abbas & Hussien, 2021; Fang & Zhang 2018; Wang *et al.*, 2022). GSCM emphasizes balancing economic and environmental performance to remain competitive (Gawusu *et al.*, 2022).

The textile-fashion industry embodies the urgent need for sustainable practices due to its substantial environmental footprint, characterized by intensive energy use, toxic chemicals, and natural resources consumption (Moazzem *et al.*, 2021; Sivaram *et al.*, 2019). It is responsible for 20% of water pollution worldwide (European Parliament, 2024) and ranks fourth in environmental impact in the EU (European Commission, 2022). Fast fashion has doubled fiber production from 58 million tons in 2000 to 124 million tons in 2023 (Textile Exchange, 2024).

Companies adopt green practices either proactively through top management, or reactively to external pressures (Srivastava, 2007; Tay *et al.*, 2015), with the European Commission recognizing green claims as competitive advantage (European Commission, 2023).

Despite extensive research on drivers of GSCM practices (Mojumder & Singh, 2021; Silva & Gomes, 2023), empirical studies that comprehensively identify the factors motivating firms to implement GSCM practices are limited (Fatima *et al.*, 2024), or tend to solely focus on specific functions, such as green purchasing or reverse logistics (Liu & Lu, 2023). Few studies have focused on GSCM practices within the textile-fashion industry, where its implementation presents difficulties (Bai *et al.*, 2017). To achieve sustainability goals, textile companies must incorporate sustainable supply chain practices (Kumar *et al.*, 2022).

Two types of green practices, namely intra- and inter-organizational practices have been identified (Fianko *et al.*, 2021). The adoption of internal GSCM practices often constitutes a logical and operational prerequisite towards the successful implementation of external practices. Effective implementation of GSCM, including customer and supplier collaboration, is facilitated by an initial adoption of green practices within the organization itself (Agyabeng-Mensah *et al.*, 2020). The development of internal resources and capabilities provides a solid foundation for extending environmental initiatives to external partners (Zhu *et al.*, 2013). For instance, before requiring suppliers to comply with specific environmental standards, a company must first internalize environmental management processes and demonstrated its own commitment to sustainability (Ahmed *et al.*, 2020).

According to Maditati *et al.* (2018), analyzing drivers and practice groups as an integrated system, rather than examining them in isolation, is crucial. A major challenge companies face is determining which GSCM practices to adopt and how to implement and coordinate them effectively. Many studies examine GSCM's internal and external factors without considering the interaction between GSCM pressures and drivers (El-Garaihy *et al.*, 2022).

Following recent recommendations in the GSCM literature highlighting the need for region- and industry-specific studies to better understand local dynamics, as well as the use of advanced methodological approaches, such as structural modeling (Rajkiran & Almeida, 2024), this study analyzes the drivers and performance outcomes of internal GSCM practices within the Spanish textile-fashion sector, addressing the following research questions:

RQ1: Which are the main drivers of internal GSCM practices in the fashion-textile sector?

RQ2: How are internal GSCM practices used to improve sustainability of economic and environmental performance?

Spain was selected as a case study, as within the textile and clothing industry, it ranks fourth in Europe in terms of turnover and exports, after Italy, Germany, and France (EURATEX, 2024). Its company' profiles mirror those of other European countries: 99.7% micro companies and SMEs and only 0.3% larger companies, including Inditex, one of the world's largest retailers. Although this study only analyzes Spanish companies (based on a sample of 166), many operate within global value chains or impact other countries through their sales, representing a broader spectrum. Hence, the results of this research could be replicable in other countries with comparable institutional contexts.

Thus, this study seeks to identify the most decisive drivers in implementing internal GSCM practices within the textile-fashion sector, to investigate their influence on economic and environmental performance, and test a model of the sector's environmental performance using the Partial Least Squares (PLS) technique.

2. LITERATURE REVIEW

2.1. GSCM practices

GSCM has advanced progress in academic publications, as observed in the analysis of its implementation, whilst a widely accepted definition has not yet been described (Islam *et al.*, 2017). GSCM extends traditional supply chain management by incorporating environmental considerations across all stages of product lifecycles (Mohamed *et al.*, 2023). This integration encompasses eco-design, green sourcing, sustainable production, distribution, and end-of-life management practices, as highlighted by Al-Shammari and Al-Maathidi (2024).

GSCM practices comprise a range of strategies aimed at minimizing the environmental impact of the supply chain (Islam *et al.*, 2024). According to Gera *et al.* (2022:535), GSCM practices "are a management technique to make supply chain eco-friendly, without adversely affecting organizational objectives".

Numerous studies have distinguished between two sets of green practices (intra- and inter-organizational) (Zaid *et al.*, 2018, Zhu & Sarkis, 2004; Zhu *et al.* 2008). Internal GSCM com-

prises environmentally oriented actions that do not require direct supplier or customer involvement. These can be managed and implemented by an individual manufacturer and include green manufacturing processes, green logistics, internal environmental management, eco-design, and green packaging (Zhu *et al.*, 2012). In contrast, external GSCM practices require partial cooperation and transactions with suppliers and customers in terms of green procurement, reverse logistics, and environmental cooperation with customers and suppliers (Zhu *et al.*, 2013).

Internal GSCM practices are those that a company can design, manage, and execute independently, without relying on external players. These practices reflect the organization's internal resources, capabilities, and strategic orientation towards sustainability (Geng *et al.*, 2017). Furthermore, empirical research has shown that strong internal environmental practices are often a necessary condition for successfully engaging in external GSCM collaborations (Zhu & Sarkis, 2004). Without well-established internal systems, firms may lack the credibility, data, or operational readiness needed to support green partnerships with upstream or downstream partners (Gavronski *et al.*, 2011).

GSCM practices can be divided into two categories (Kim *et al.*, 2021): product practices focus on reducing pollution and waste through product design and material selection, while process practices encompass all operational processes, from manufacturing to logistics and life-cycle management to reduce environmental impact. We classify internal GSCM practices into internal process practices (green production, green logistics, and internal environmental management), and internal product practices (eco-design and green packaging). Therefore, the selected practices capture both critical areas of environmental impact, and strategic opportunities for companies operating in this sector Sivaram *et al.*, 2019). These five practices have been consistently employed in prior empirical studies as representative indicators of internal GSCM efforts (e.g., Wong *et al.*, 2021; Zhu *et al.* 2008; Zhu *et al.*, 2012) ensuring both conceptual validity and comparability across studies.

Green production involves the development and implementation of manufacturing processes that incorporate environmental considerations by adhering to the principles of reducing, reusing, and recycling resources. Its primary aim is to minimize raw material consumption, lower total production costs, and mitigate environmental impacts, thereby enhancing the competitiveness and sustainability of firms. (Çankaya & Sezen, 2019; Isfianadewi *et al.*, 2025).

Green logistics refers to the adoption of environmentally friendly logistics practices throughout the supply chain (Bozhanova *et al.*, 2022): route optimization, low-emission vehicles, and shipment consolidation (Rehman Khan & Yu, 2020).

Internal Environmental Management (IEM) is the structured integration of environmental sustainability principles within an organization's internal processes and policies. It involves the commitment of managers at all levels to environmental goals, the implementation of environmental auditing programs, the establishment of clear environmental objectives and responsibilities, and the continuous monitoring and evaluation of environmental impacts (Alkandi *et al.*, 2025).

Eco-design, also known as green design, refers to the proactive integration of environmental considerations into the early stages of product development. Its aim is to minimize material and energy consumption, facilitate product recycling and reuse, reduce the use of hazardous substances, and enhance waste reduction throughout a product's lifecycle (Al Karim *et al.*, 2024). It ensures products are designed to be easily disassembled and recycled when reaching its lifecycle(Tseng & Chiu, 2013).

Green packaging involves the use of packaging solutions that minimize environmental impact (Islam *et al.*, 2017). This practice not only ensures product protection and functional performance during logistics and storage but also contributes to broader sustainability goals by enhancing energy efficiency and reducing emissions associated with packaging activities (Mohamed *et al.*, 2023).

2.2. GSCM drivers

The primary internal and external drivers of GSCM implementation identified in the literature include organizational factors, regulatory requirements, customer demands, competitor dynamics, and societal pressures (Paluš *et al.*, 2024). Regulatory and market pressures can enhance a company's environmental performance when they adopt eco-design and green purchasing practices in response to these pressures (Maditati *et al.*, 2018). Testa and Iraldo (2010) suggested that GSCM practices should supplement other advanced management practices. Implementing a green supply chain starts with internal or external drivers (Sharma, 2013). Internal drivers stem from proactive efforts initiated within organizations, whereas external drivers are shaped by the influence and demands of various stakeholder groups. Drivers are critical factors in implementing GSCM practices (Dhull & Narwal, 2016) that lead entrepreneurs to embark on sustainable supply chain management. These factors strengthen GSCM practices and positively impact environmental performance (Sarkis *et al.*, 2010).

Maditati *et al.* (2018) distinguish different groups of drivers of CSCM practices based on two dimensions: the responsibility dimension (environmental awareness/responsibility or demands/requirements) and the motivation source dimension (internal or external, depending on the type of stakeholder involved). Environmental awareness is the first category of enablers (Singh & Misra, 2022): it represents the company's self-awareness, self-imposed issues such as corporate image, social and environmental responsibility, or promotional activities on the green image. As regards legal regulatory requirements, environmental awareness imposed through regulatory pressures, government interventions, and required quality certifications, drives many GSCM practices. Internal motivators refer to company-specific demands involving levels of strategies and objectives that stimulate GSCM practices: company performance, cost-saving strategies, product/process development strategy, management, and worker support. Finally, external pressures refer to applying direct or indirect requirements from supply chain stakeholders, such as societal environmental awareness, market pressures, and collaboration with suppliers and customers.

Table 1 summarizes the main categories of drivers analyzed in the literature classified according to motivation source and responsibility dimensions.

Table 1
Main categories of drivers in a green supply chain

SOURCE OF MOTIVATION	External	*Regulatory requirements imposed* Legal regulatory pressures	*External pressure* Environmental awareness in society Market pressure Environmental collaboration with suppliers Environmental collaboration with customers
	Internal	*Environmental awareness* Corporate environmental awareness	*Internal motivators at the company level* Top management commitment Internal pressures Internal costs
		Consciousness/ Responsibility	Demands/Requirements
		RESPONSIBILITY	

Source: Own elaboration based on Maditati *et al.* (2018).

Corporate environmental awareness refers to the integration of ecological values into an organization's belief system, often requiring internal cultural and strategic transformation (Huang and Huang, 2021). Social values and ethics play a crucial role in successful collaboration, purchasing, and ethical sourcing, which makes them internal enablers of sustainability initiatives (Dubey *et al.*, 2017).

Regulatory requirements are one of the main driving forces to which companies have responded (Agan *et al.*, 2013; Eltalhi *et al.*, 2025) to adopt environmentally sustainable practices within their operations, enforcing compliance with environmental standards. In the European Union's textile and fashion industry, the regulatory framework was comparatively lenient until 2022, following which the EU Strategy for Sustainable and Circular Textiles was introduced, marking a significant legislative shift towards stricter environmental standards (European Commission, 2022).

Internal motivators encompass the organizational forces that originate within the company and drive the adoption of GSCM practices. Among these, top management commitment has been consistently recognized as a pivotal factor, as leadership support often catalyzes the implementation of GSCM strategies across all organizational levels (Chacón Vargas *et al.*, 2018). Internal motivators may include reducing operational costs through energy efficiency and waste minimization (Wang *et al.*, 2018), and employee involvement (Dubey *et al.*, 2017).

External pressure arises from the expectations and demands placed on organizations by stakeholders beyond the company's boundaries, including governments, non-governmental organizations, customers, suppliers, competitors, and the broader community. These stakeholders can significantly influence the adoption of GSCM practices (Marrucci *et al.*, 2021; Tay *et al.*, 2015; Zhu *et al.*, 2010).

2.3. *GSCM performance*

Research in GSCM has primarily focused on examining how environmental sustainability practices impact environmental and economic performance (Maditati *et al.*, 2018). Economic performance is linked to a company's ability to reduce costs associated with material purchases, energy consumption, waste treatment, waste disposal, and fines for environmental incidents (Zhu *et al.*, 2008); or financial and marketing improvements (profitability, return on investment, growth in sales revenue) from implementing GSCM practices (Younis *et al.*, 2016), serving as a critical benchmark for evaluating organizational competitiveness and sustainability (Alkandi *et al.*, 2025).

Environmental performance is the extent to which an organization minimizes its negative impact on the natural environment through its operations and practices (Al Lawati *et al.*, 2024): reduction of effluents, solid waste, hazardous and toxic materials (Zhu *et al.*, 2008), and environmental accidents (Fang & Zhang, 2018). It is a critical indicator for evaluating the effectiveness of environmental practices (Zhu *et al.*, 2012).

3. RESEARCH FRAMEWORK AND HYPOTHESIS DEVELOPMENT

3.1. *GSCM drivers and internal GSCM practices*

The relationship between drivers and the adoption of GSCM practices has been discussed in the literature (Hebaz & Oulfarsi, 2021; Huang & Huang, 2021). Internal environmental awareness has been identified as crucial for companies implementing environmental practices (Kalpande & Toke, 2020). Social and environmental responsibility pressures companies into implementing GSCM practices (Xu *et al.*, 2022). Companies increasingly undertake strategic environmental initiatives to maintain corporate reputation through new product development and green practices (Habib *et al.*, 2020). Mojumder and Singh (2021) consider corporate social responsibility the main driver of GSCM practices within the Indian construction sector. Green production practices have been linked to environmental awareness fostered through green entrepreneurial behavior (de Guimarães *et al.*, 2018). Despite prior research focused on manufacturing sectors, the European Commission (2022) reports that the textile sector is one of the most polluting. These factors underscore the sector's vulnerability to environmental pressures and its alignment with the challenges addressed in GSCM research. Supply chain structures and stakeholder configurations support the applicability of findings from other industries to textile-fashion contexts (Mousa *et al.*, 2025). Based on this reasoning, we formulate the following hypotheses:

H1a. Environmental awareness positively influences the adoption of internal process GSCM practices.

H2a. Environmental awareness positively influences the adoption of internal product GSCM practices.

Legislative pressure through policies and regulations is a critical factor driving GSCM practices (Sabat, 2022). Ososanmi *et al.* (2022), based on research with Nigerian companies, conclude that government environmental regulations are the main driver of GSCM. Zhu *et al.* (2013), studying Chinese manufacturers, show that environmental regulations encourage manufacturers

to imitate successful competitors in adopting GSCM practices of eco-design and internal environmental management. In a study by Zhu and Sarkis (2006) with Chinese companies in automotive, thermal power, and electronics industries, legal regulations are the most important pressure for GSCM implementation. Luthra *et al.* (2016) reached similar conclusions, considering regulatory pressure the most critical factor in implementing process practices (green production, green logistics, and internal environmental management) and eco-design. Eltalhi *et al.* (2025) provide empirical evidence that government regulations significantly enhance GSCM practices, especially in developing economies. Likewise, Xu *et al.* (2022) demonstrate how carbon taxes and recycling subsidies reshape operational decisions in closed-loop supply chains, pushing manufacturers to modify internal processes to reduce emissions and comply with environmental regulations. Based on this, we propose:

H1b. Regulatory requirements positively influence the adoption of internal process GSCM practices.

H2b. Regulatory requirements positively influence the adoption of internal product GSCM practices.

Previous studies have identified top management commitment as a decisive factor in successful GSCM adoption. Mauricio and Lopes de Sousa Jabbour (2017) concluded that top management commitment is the most critical factor in adopting GSCM practices, while workers' participation is least influential. Internal motivators (organizational environmental commitment, green culture, and proactive leadership) have been identified as key predecessors for implementing internal environmental management and cleaner production processes. Ali (2022) emphasizes that green production must be embedded in organizational culture and actively promoted by top management for effective implementation. According to Panpatil and Kant (2022), internal enablers (especially strategic managerial commitment and green policy formulation) are among the highest-ranked factors promoting GSCM practices. Eltalhi *et al.* (2025) demonstrate that employee environmental commitment significantly enhances internal green supply chain initiatives. Cost is an internal motivator that significantly influences green practices implementation (Abbasi & Nilsson, 2012). Wang *et al.* (2018) found that cost drives internal GSCM practices: there are great opportunities for cost savings when green practices are incorporated early in procurement. Based on this reasoning, we can formulate the following hypotheses:

H1c. Internal motivators positively influence the adoption of internal process GSCM practices.

H2c. Internal motivators positively influence the adoption of internal product GSCM practices.

External pressures have a positive influence on the adoption of internal GSCM practices (Ahmed *et al.* 2020): stakeholders help promote internal environmental management and eco-design practices (Huang *et al.*, 2021) and cooperation in the textile-fashion sector (Habib *et al.*, 2022). Engaging suppliers and customers in GSCM initiatives further strengthens the effective adoption of green practices (Liu *et al.*, 2020). These findings justify extending the analysis of external pressures to the textile-fashion sector, where growing environmental scrutiny and regulatory pressures make stakeholder engagement even more crucial (Paluš *et al.*, 2024). Based on the above arguments, we propose the following hypotheses:

H1d. External pressure positively influences the adoption of internal process GSCM practices.

H2d. External pressure positively influences the adoption of internal product GSCM practices.

3.2. Internal GSCM practices and GSCM performance

The positive relationship between internal GSCM practices and economic performance has been widely supported by existing literature (Baumers *et al.*, 2016) although implementation costs can be a critical factor reducing financial returns in early adoption stages. The positive association suggests that adopting GSCM practices can generate net profit gains (Zhu & Sarkis, 2004). Environmentally friendly production, logistics, and product design increase company competitiveness (Das, 2022). Sun *et al.* (2017) directly link economic performance to GSCM practices, arguing that waste reduction protects the environment while lowering costs, improving economic outcomes. However, some GSCM practices may increase company costs, especially at the beginning (Fang & Zhang, 2018). Bon *et al.* (2018), Habib *et al.* (2020), and Zaid *et al.* (2018) have verified how GSCM practices have significant relationship with economic performance. According to the above, we might propose the following hypotheses:

H3a. The adoption of internal process GSCM practices positively influences economic performance.

H4a. The adoption of internal product GSCM practices positively influences economic performance.

Evidence supports the positive link between internal practices and environmental performance (Habib *et al.*, 2021). Companies adopting internal green practices are likely to reduce potential environmental pollution through non-toxic materials, component recycling, and the appropriate management of outdated machinery. Al Karim *et al.* (2024) assess the effects of GSCM practices on environmental performance, indicating that green design and collaboration improve environmental outcomes. (Khan *et al.*, 2024) obtain similar results in Pakistan's construction sector, for green production and logistics, enhancing environmental outcomes. El-Garaihy *et al.* (2022) similarly demonstrate that GSCM practices of product and process significantly impact environmental performance. Based on the above arguments, we can postulate the following hypotheses.

H3b. The adoption of internal process GSCM practices positively influences environmental performance.

H4b. The adoption of internal product GSCM practices positively influences environmental performance.

Figure 1 presents the proposed research framework, which illustrates the direct effects of GSCM drivers on GSCM practices and establishes the influence of these practices on GSCM performance.

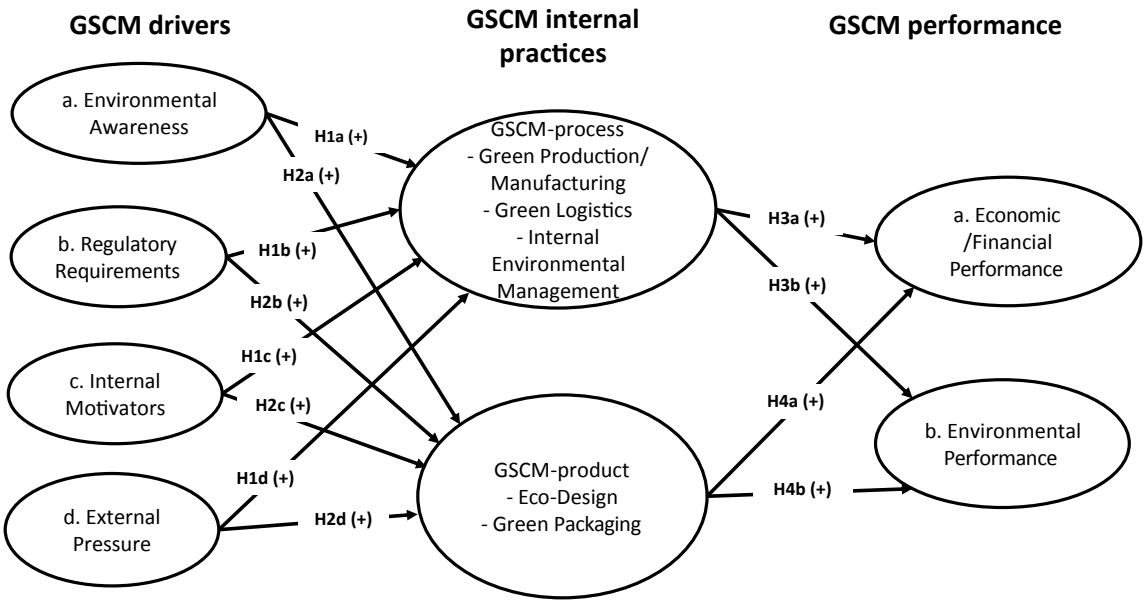


Figure 1
Research model
Source: Authors.

4. METHODOLOGY

4.1. Sample and data collection

To conduct this study, data were collected using a survey-based research methodology, as described in (see Table S1 in the Supplementary Material). The Iberian Balance Sheet Analysis System (SABI), a financial analysis database of leading Spanish fashion and textile companies, was used to define the target population. As a result, a total of 2,805 companies with at least ten employees were identified. The survey was administered using a computer-assisted telephone interview (CATI) system operated by a specialized company, under the supervision of one of the authors, from September to October 2021. A stratified random sampling technique was applied within each stratum to select firms for participation. The population was stratified by two key variables, company size and industry classification code (CNAE), to ensure that the final sample reflected the diversity of firms operating in the Spanish textile-fashion sector. From the firms contacted, we obtained 166 complete responses, representing a response rate of approximately 5.9%. To reinforce the robustness of the analysis, we verified that our sample size meets Green's (1991) guideline for multiple regression, which is frequently referenced in structural equation modeling. Given that our structural model includes up to four predictors for some endogenous constructs, the minimum recommended sample size for detecting a medium effect size would be 84. Our final sample of 166 firms comfortably exceeds this threshold, ensuring the statistical adequacy of results. Regarding the sampling unit, since the analysis level in this study is the organization, only top managers within the areas of sustainability, quality, supply chain, and operations, and the managers of the sampled companies have participated in data collection. This decision was based on the assumption that only these individuals would have a comprehensive view of business processes and, consequently, would be able to assess the overall impact of GSCM practices.

4.2. Measurements

A two-part questionnaire was used for collecting data: one section contained questions regarding participants' demographic information, and the other measured items adapted from previously validated scales in the literature. Special attention was given to translating the original versions of the scales to accurately capture their linguistic nuances. All measures used in this study are included in the Supplementary Material (Appendices S1, S2, and S3).

Since the analysis uses pre-validated scales, efforts in this section focused on adapting the measures to the context and language in which the researchers were working. Respondents were requested to indicate the degree of agreement with statements related to key constructs of the study: GSCM drivers, internal GSCM practices, and GSCM performance (economic/financial and environmental). All variables in this study were measured using Likert-type scales (1 = strongly disagree to 7 = strongly agree) based on scales from previous studies in the literature. GSCM drivers consist of 20 items, classified into four categories (Govindan *et al.*, 2016): environmental awareness (2 items), regulatory requirements (4 items), internal motivators (6 items) and external pressure (8 items). GSCM drivers refer to variables that initiate and enhance the effectiveness of GSCM by motivating or compelling organizations to adopt and implement green practices.

Internal GSCM practices were measured using 21 items: green production practices (4 items), green logistics (4 items) (Wong *et al.*, 2021) and internal environmental management (7 items) (Zhu *et al.*, 2007b). These process practices reflect the organization's internal efforts to manage and optimize GSCM performance across key operational processes. In contrast, product practices emphasize environmental considerations during the product development stage. This includes eco-design (3 items) (Zhu *et al.*, 2007b) and green packaging (3 items) (Wong *et al.*, 2021).

GSCM performance measures were adopted from Çankaya and Sezen (2019), and comprise two key dimensions: economic/financial performance (7 items) and environmental performance (5 items). Economic/financial performance refers to a company's capacity to minimize various operational costs, including those related to raw material acquisition, energy usage, waste management, and environmental compliance penalties. It also encompasses broader financial outcomes such as increased profitability and sales growth. Environmental performance reflects the extent to which a company can reduce its ecological footprint by lowering emissions and waste, minimizing the use of toxic materials, and decreasing the frequency of environmentally harmful incidents.

To ensure the quality of the questionnaire, the authors validated its content through a pilot test with three experts in its different sections to find any problems with the questionnaire's wording, design, format, and suitability for the textile-fashion sector (Rashid Hashmi & Tawfiq Mohd, 2020). Their suggestions and contributions were incorporated into a revised version of the questionnaire.

4.3. Data analysis

In this study, we propose a research model and, because all measurements are operationalized as composites (Henseler, 2017; Rigdon, 2016), we have decided to use Partial Least Squares Structural Equation Modeling (PLS-SEM) in order to test the proposed hypotheses as well as the research model. There are two main reasons for this choice. Firstly, the study uses estimated Mode A and Mode B composites (Hair *et al.*, 2019; Rigdon *et al.*, 2017) and additionally, and secondly, the study adopts an explanatory approach (Henseler, 2018).

Accordingly, Mode A estimates were made for Environmental Awareness (EA), Regulatory Requirements (RR), External Pressure (EP), Economic Performance (ECP), and Environmental Performance (ENP); and Mode B estimates have been made for the rest, i.e., Internal Motivation (IM), Process GSCM practices, and Product GSCM practices.

This decision was based on the study's explanatory nature and the intrinsic characteristics of PLS-SEM when applied to component-based models (Henseler & Schuberth, 2020). Unlike reflective models, where indicators are considered, manifestations of an underlying latent construct, and formative models, where indicators define the construct, composites are understood as weighted combinations of their indicators. This conceptualization is appropriate in contexts where the main objective is prediction and the explanation of the variance of the dependent variables, which aligns with the objectives of our study. Furthermore, PLS-SEM is inherently a component-based method, where even constructs that could theoretically be latent are analyzed as composites formed by their indicators (Sabol *et al.*, 2023). This approach offers flexibility and is suitable when the normality assumptions required by covariance-based methods such as CB-SEM are not strictly met (Cepeda *et al.*, 2024).

Composites are estimated in Mode A when the indicators that constitute the latent variable are correlated. According to Hair *et al.* (2019), to evaluate explanatory modeling with PLS-SEM, a two-step process was developed: in the first step, the measurement model is evaluated, and, in the second step, the structural model is evaluated.

Mode B in PLS-SEM is used when the objective is to maximize the correlation of the construct with other constructs in the structural model (Schuberth *et al.*, 2023). In contrast to Mode A, which seeks to maximize the variance of the construct itself through its indicators, Mode B is more appropriate when the construct is conceived as a specific combination of its components, and its meaning and relationship with other variables in the model emanate from the unique contribution of each component.

To assess the significance of the parameters, we have used a bootstrap procedure (Chin, 1998). This resampling technique allows us to determine the significance of the coefficients, weights, and loadings of the indicators for each composite construct. In this study, the SmartPLS 3.2.6 software package was used for data analysis (Ringle *et al.*, 2015).

4.4. Common method bias analysis

To mitigate potential common method bias (CMB), procedural remedies were used during the research design phase following Podsakoff *et al.* (2012). Additionally, a statistical test based on variance inflation factors (VIFs) was conducted, as recommended by Kock and Lynn (2012). VIF values below the threshold of 3.3 indicate the absence of pathological collinearity and CMB (Kock, 2015). In this study, the maximum VIF was 1.975, suggesting that CMB is not a concern (see Table S2 in the Supplementary Material).

5. RESULTS

5.1. Measurement model assessment

Based on the results, one may conclude that the measurement model meets all necessary criteria for composites estimated in Mode A (see Table S3 in the Supplementary Material). First, individual items demonstrate reliability because all standardized loadings exceed 0.7. Second, all measures of internal consistency (i.e., Cronbach's alpha, composite reliability (ρ_c), and ρ_A) exceed 0.8, indicating that the model fulfills the requirement for construct reliability. Third, convergent validity is confirmed, since the average variance extracted (AVE) values exceed 0.5. Finally, all variables estimated in Mode A reach discriminant validity because the heterotrait-monotrait ratio (HTMT) values are below the strict 0.85 threshold (Table 2).

Table 2
Values of the Heterotrait-Monotrait Ratio (HTMT)

Constructs	EA	RR	EP	ECP	ENP
EA					
RR	0.447				
EP	0.807	0.706			
ECP	0.278	0.546	0.373		
ENP	0.662	0.449	0.471	0.516	

Notes: EA: Environmental Awareness; RR: Regulatory Requirements; EP: External Pressure; ECP: Economic Performance; ENP: Environmental Performance.

Source: Authors.

Regarding constructs estimated in mode B, all items and dimensions have variance inflation factor (VIF) values below 3.3, indicating no issues with potential multicollinearity (see Table S4 in the Supplementary Material). The weights and loadings are shown in Table S4. The most critical indicator for the internal motivators construct is im2, while internal environmental management and eco-design are the most significant dimensions of Process and Product GSCM practices, respectively.

5.2. *Structural model assessment*

As Henseler *et al.* (2009) discussed, using bootstrapping (5,000 resamples) generate standard errors and t-statistics to assess the statistical significance of the path coefficients. The percentile bootstraps at the 95% confidence interval are presented in Table 3, where the significance level of the proposed hypotheses is shown. As shown in Table 3, seven of the twelve proposed hypotheses are supported, while five are not. Regarding the VIF statistics for collinearity of the antecedent variables of the model, all values are less than three (Hair *et al.*, 2019).

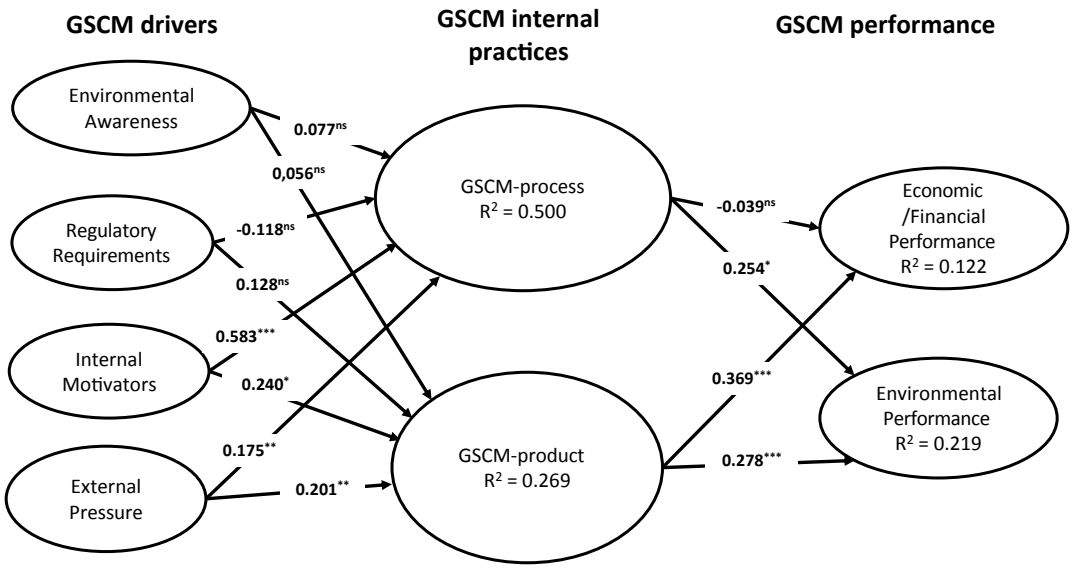
The results show that environmental awareness and regulatory requirements are not antecedents of internal GSCM practices, both process and product. Therefore, the proposed hypotheses H1a, H2a, H1b, and H2b are not supported. Figure 2 provides a graphical representation of the research model with the significance of the hypothesized relationships.

However, the hypothesized relationships between internal motivators and external pressure with the process GSCM practices and the product GSCM practices are significant (H1c, H2c, H1d, and H2d). These results indicate that internal motivator and external pressure are antecedents of process GSCM practices and product GSCM practices.

Regarding the relationship between process GSCM practices and product GSCM practices with economic performance and environmental performance, the results indicate that all GSCM practices are antecedents of both types of GSCM performance, except for process GSCM practices with economic performance (H3a). Table 3 shows the results supporting hypotheses H3b, H4a, and H4b, while hypothesis H3a is not fulfilled.

In PLS-SEM, R^2 measures the proportion of variance explained in the dependent variables, while f^2 assesses the effect size by measuring the impact of removing exogenous variables on the explained variance in the structural model. Both statistics are essential for evaluating the model's goodness-of-fit and predictive relevance. According to (Hair *et al.*, 2019), dependent variables with an R^2 greater than 0.75 indicate substantial explained variance, around 0.50 indicate moderate, and around 0.25 indicate weak explained variance.

Regarding effect size, (Cohen, 2013) suggests that f^2 values of 0.02, 0.15, and 0.35 represent small, medium, and large effect sizes, respectively.



Notes: *** p < 0.001, ** p < 0.01, * p < 0.05, ns: non-significant (based on t(4999), one-tailed test)

Figure 2
Structural model
Source: Authors.

Table 3
Results of the structural model

Effects on endogenous variables	Path coeff.	Confidence intervals (95%)		Hypothesis support (p-value)	R^2 dependent construct	f^2 effect size	t-value
		5%CIlo	95%CIhi				
EA→ GSCM process (H1a)	0.077	–0.056	0.303	No (0.239)	0.500	0.005	0.692
RR→ GSCM process (H1b)	–0.118	–0.205	0.093	No (0.096)	0.500	0.019	0.102
IM→ GSCM process (H1c)	0.583	0.227	0.760	Yes (0.000)	0.500	0.250	3.502
EP→ GSCM process (H1d)	0.175	0.038	0.307	Yes (0.018)	0.500	0.033	2.081
EA→ GSCM product (H2a)	0.056	–0.160	0.256	No (0.330)	0.269	0.002	0.442
RR→ GSCM product (H2b)	0.128	–0.014	0.244	No (0.051)	0.269	0.015	1.624
IM→ GSCM product (H2c)	0.240	0.060	0.505	Yes (0.039)	0.269	0.029	1.744
EP→ GSCM product (H2d)	0.201	0.053	0.342	Yes (0.011)	0.269	0.030	2.284
GSCM process→ ECP (H3a)	–0.039	–0.171	0.141	No (0.341)	0.122	0.001	0.415
GSCM product→ ECP (H4a)	0.369	0.238	0.486	Yes (0.000)	0.122	0.108	4.907
GSCM process→ ENP (H3b)	0.254	0.080	0.465	Yes (0.015)	0.219	0.058	2.108
GSCM product→ ENP (H4b)	0.278	0.084	0.444	Yes (0.005)	0.219	0.069	2.497

Notes: EA: Environmental Awareness; RR: Regulatory Requirements; EP: External Pressure; IM: Internal; Motivators; ECP: Economic Performance; ENP: Environmental Performance.

Source: Authors.

5.3. Evaluation of the predictive power of the model

To evaluate the model's predictive power, the PLS predict procedure was applied following Shmueli *et al.* (2019), using GSCM performance as the target construct. The analysis, based on 5-fold cross-validation and repeated runs, showed Q^2predict > 0 for all indicators (see Table S5 in the Supplementary Material). Most indicators (regenerate, optimize, cycle, and virtualize) showed lower prediction errors in PLS-SEM than in linear models, indicating good predictive performance. However, exchange and share had slightly higher errors. Overall, the model demonstrates medium predictive power and potential generalizability.

6. DISCUSSION AND IMPLICATIONS

This study has examined the role of key drivers in the implementation of GSCM practices in the Spanish textile-fashion industry. The results indicate that the imposed regulatory requirements and environmental awareness do not influence the implementation of GSCM practices. In contrast, internal motivators have a significant impact on internal GSCM practices, being more influential in internal GSCM process practices. External pressures significantly influence internal GSCM practices, being more influential in internal GSCM product practices. Furthermore, this research demonstrates how GSCM process practices do not have a significant effect on economic performance but do positively influence environmental performance. GSCM product practices positively influence both economic and environmental performance. Therefore, both types of internal GSCM practices contribute equally to enhancing environmental performance.

6.1. Theoretical implications

A first contribution of this study suggests that legal and regulatory requirements such as government support and encouragement, regulations on the treatment of waste in dumping areas, and the environmental awareness of companies are not a direct predecessor of internal GSCM practices. This finding contrasts with prior assumptions highlighted in the literature. For instance, Zhu *et al.* (2005) argued that legal and regulatory requirements such as government support and encouragement, regulations on waste treatment in dumping areas, and the support and initiatives of institutions promoting environmental awareness in businesses are not direct precursors of internal GSCM practices. However, Zhu *et al.* (2007a) investigated the impact of regulatory pressures and internal awareness on GSCM practices and found no strong evidence of their role as drivers. In the Spanish context, regulatory requirements do not currently act as facilitators because there are still few binding regulations addressing the environmental impact of this sector. Although the European Commission published the EU Strategy on Sustainable and Circular Textile Products (European Commission, 2022) national regulations have not been implemented. This may influence this factor's weight when transposed in Spain. The strategy sets mandatory eco-design minimums, including recycled fibers use and extended producer responsibility. Although innovative companies have adopted these practices voluntarily, many firms are unlikely to change operations until new regulations require them.

The effects of environmental awareness have been measured through the protection from environmental, health, and safety risks, and corporate social responsibility commitment. Results suggest no clear association between environmental awareness and the implementation of internal GSCM practices. This may

depend on resource availability, as companies prioritize environmental initiatives when economically stable. As Habib *et al.* (2021) note, the company's size affects the implementation of GSCM practices and their sustainability, as large companies can easily obtain resources to apply these practices. Similarly, Mojumder and Singh (2021) found that effort to implement GSCM practices gradually decreases as we move from large to smaller companies. In our sample, we considered 83.7% small companies with less than 50 workers. Most environmental harm occurs upstream, while finished product companies have less direct impact. The type of company and/or type of products manufactured influences the adoption of GSCM practices. Our sample shows that 66% are manufacturers with fewer wet operations (e.g., clothing and apparel, luggage and bags, other textile products), whereas only 29% are involved in more resource-intensive activities (e.g. spinning fibers, manufacturing textiles, finishing, and leather tanning).

The second contribution to our study is to identify and explain that internal motivators and external pressure are key drivers of internal GSCM practices. This finding underscores that internal motivators related to economic benefits and cost savings, pressures related to the scarcity of resources, and the commitment of internal stakeholders such as senior management and employees, are significant in internal GSCM practices (Chakraborty *et al.*, 2023). For process-oriented GSCM practices, internal motivators have a direct effect. These practices involve operational improvements, and efficiency gains that organizations can internally control. Companies are naturally driven to optimize their processes towards reducing operational costs, energy consumption, and waste, all of which are objectives that closely align with internal economic and strategic incentives. In the case of product-oriented GSCM practices, internal motivators also play a significant role, although their influence may be slightly less direct. Companies motivated by cost-saving and innovative incentives may proactively design products that minimize resource use or are easier to recycle, anticipating future market demands and regulatory trends. Top management commitment and employee engagement often support innovation processes that lead to greener products and packaging solutions. The stronger influence of internal motivators on process practices compared to product practices may be better explained by the fact that measuring of internal motivators is more directly related to process-oriented activities such as auditing, controlling, and monitoring than to product-focused activities like eco-design and packaging. These elements are inherently connected to operational processes, whereas product-related practices, such as eco-design and green packaging, involve different capabilities and strategic priorities. The recently approved Eco-design Regulation (European Union, 2024) has set new rules affecting product design, which require all companies to adopt more GSCM product practices. On the other hand, external pressures (such as awareness of environmental issues and cooperation among supply chain partners, the competitive strategy followed by companies in the industry, and the ease of obtaining financing and making investments) are significant in internal GSCM practices and most influential in internal GSCM product practices. Prior research has emphasized the importance of stakeholder collaboration to apply GSCM practices effectively. Additionally, early engagement with buyers during the design and implementation of the GSCM internal product can prove highly beneficial in reducing the environmental impact on the lifecycle (Rehman Khan & Yu, 2020). Successful implementation of GSCM practices requires cooperation and coordination among supply chain stakeholders, including suppliers, manufacturers, and buyers (Zhu *et al.*, 2008).

Our third contribution highlights that GSCM process practices do not influence economic performance but environmental impact performance, while GSCM product practices positively influence economic and environmental performance. Previous studies have reported inconclusive results, showing no significant impact of internal environmental practices on economic results has been found (Laari *et al.*, 2016). Habib *et al.* (2021) confirmed the existence of a relationship between GSCM practices and economic and environmental performance occurs but noted that many companies lack well-defined economic and environmental performance measures, which limits their ability to evaluate outcomes and design future initiatives. Process practices significantly reduce the use of natural resources and mitigate the negative environmental impact of company operations by focusing on production control, CO_2 emissions reduction, transport optimization, and overall environmental management. However, the high cost of infrastructure required to implement these practices, to allow an efficient use of resources, could be the reason behind it not influencing economic performance. Internal process practices refer to internal processes for logistics, manufacturing, and environmental management. In the textile sector, significant investment in technology and machinery is required to change manufacturing processes (spinning, wet operations) and environmental management certifications also entail an economic cost. As a result, good process practices do not necessarily improve financial performance immediately and may even increase costs. Nevertheless, in the long term, they are expected to enhance financial competitiveness (Ahmed *et al.*, 2020). This situation might lessen if there were cooperation between different companies to invest in the necessary infrastructures so that both the investment and the economic benefits derived from the economies of scale were shared. By contrast, product practices focus on product design and packaging for reuse, recycling, and subsequent recovery. Product-oriented GSCM practices are more visible to consumers, investors, and other stakeholders. This visibility enhances environmental outcomes by reducing material consumption, promoting recyclability, and minimizing environmental impacts across the product life cycle. Simultaneously, it strengthens economic outcomes by improving brand reputation, increasing customer loyalty, opening access to green markets, and achieving cost savings through more efficient use of resources and packaging materials. Our study contributes to the literature by demonstrating, within the specific context of Spain's textile-fashion industry, that integrating environmental considerations into product design and packaging yields tangible benefits for both environmental and economic and financial performance. Thus, our findings extend previous research by providing empirical evidence that product-oriented GSCM practices can generate a dual positive impact, even in a sector where sustainability transitions are still developing.

6.2. Practical implications

Based on our results, managers within the textile-fashion industry should focus on strengthening internal motivators and external pressure as primary drivers for implementing GSCM practices linked to economic and environmental performance.

Regarding internal motivators, companies should create an ecosystem of understanding and shared values among senior management, employees, and trade unions, before adopting environmentally sustainable practices. Investment in cleaner technologies and Environmental Management Systems (EMS) like ISO 14001 facilitates systematic process improvements while optimizing resource use and reducing costs. Developing key performance indicators (KPIs) focused on cost-saving environmental metrics enables continuous operational improvement and performance-based employee rewards. Furthermore, supplier selection should comply with sustainability standards (Winkelmann *et al.*, 2024).

The stronger influence of external pressure on production practices requires proactive stakeholder engagement and market responsiveness. Mandatory reporting requirements (European Commission, 2025), although only currently applicable to large companies, may increase transparency in communication with customers, local communities, and stakeholders. This collaborative approach should extend to creating networks of committed eco-design suppliers, representing a key aspect in achieving economic savings and improving the environmental impact. Companies should prioritize eco-design training for designers and agents involved in upstream and downstream supply chain operations. This presents opportunities for governments, universities, and training centers to offer updated training programs. Furthermore, seeking alternatives for green packaging represents a necessary improvement trend offering direct economic and environmental benefits. Textile and fashion companies must establish alliances with packaging companies to develop products that optimize materials and resources.

In scenarios where sustainability awareness is steadily growing, companies increasingly focus on the tactical role of eco-design as a means towards meet sustainability criteria and cultivating enduring competencies, ensuring organizational environmental sustainability (Hsu *et al.*, 2023). Embracing green product design practices offers vast benefits to businesses, including market differentiation, resource efficiency, longer product lifespans, circular economy opportunities, stronger stakeholder relationships, and compliance with evolving regulations (Chau *et al.*, 2023).

6.3. Limitations and future lines of research

This research presents certain limitations suggesting various future research avenues. Our study does not demonstrate specific relationships between the four driver categories and GSCM practices, nor individually analyze each GSCM practice's impact on performance measures. Future research could focus on discovering these relationships.

A second limitation concerns the positive relationship between practices and GSCM performance, as some practices may increase costs despite their environmental benefits. Future research could analyze whether this compensation relationship occurs and determine whether practices positively influence economic and environmental performance.

The third limitation relating to cooperative relationships between companies and their supply chains, was not analyzed. Future studies could examine how collaboration with suppliers and customers contributes to enhancing overall sustainability performance, building on internal practices. This would clarify how companies can align internal efforts with external partnerships to achieve comprehensive sustainability outcomes across supply chains.

Another limitation concerns company size, of which 97.5% are SMEs, this being consistent with the European average (European Commission, 2020). Additionally, sustainability performance was addressed in only two dimensions -economic and environmental- while future research could tackle the social dimension, according to the Triple Bottom Line (Elkington, 1998).

The geographical focus on Spain presents another limitation. Whilst many firms have international operations, findings primarily reflect Spanish regulatory, cultural, and economic conditions. Caution should be exercised when generalizing results to other contexts with different regulatory frameworks, market dynamics, or environmental pressures. Future studies could conduct cross-national comparative analyses examining whether observed relationships hold true in countries with more stringent environmental regulations or different industry structures. Researchers could explore how cultural factors, institutional capacity, and sustainability policy maturity influence the applicability of findings within diverse contexts.

The final limitation relates to temporal scope, capturing a snapshot of Spanish textile SMEs prior to the comprehensive European regulatory framework implementation on sustainability and circularity. Findings reveal significant gaps between current company practices and new regulation objectives (e.g., Eco-design, Waste, Due Diligence, Strategy for Circular Textiles, Corporate Reporting Directive). The situation appears similar across Europe, with the new Omnibus I simplification package proposal (European Commission, 2025), delaying the application of recently approved regulations and lowering the scope and requirements for all sectors, including textiles, having the EU considered these regulations to hinder European competitiveness. Longitudinal studies considering future implementation measures would be valuable, along with research focusing on larger firms operating downstream in supply chains.

7. AUTHORSHIP

Conceptualization, Juan C. Real, Silvia Pérez-Bou; Methodology, Juan C. Real, Ignacio Cepeda-Carrión; Formal analysis and investigation, Juan C. Real, Ignacio Cepeda-Carrión; Writing - original draft preparation, Juan C. Real, Silvia Pérez-Bou; Funding acquisition: Juan C. Real, Silvia Pérez-Bou.

8. ACKNOWLEDGEMENTS

This study has been funded through the research project US-1264451 "Green Supply Chain Management and Its Impact on

Environmental Performance Improvement in Andalusian Industrial Companies: A Capabilities Approach", Proyectos I+D+i FEDER Andalucía 2014-2020. Consejería de Economía y Conocimiento, Junta de Andalucía.

9. SUPPLEMENTARY FILE

A supplementary file containing additional methodological details and extended results is available at the following URL: https://ojs.ehu.eus/index.php/CG/libraryFiles/downloadPublic/207

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Management Letters / Cuadernos de Gestión 25/2 (2025) 89-101

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Management Letters / Cuadernos de Gestión

journal homepage: https://ojs.ehu.eus/index.php/CG
ISSN: 1131-6837 / e-ISSN: 1988-2157

Rethinking Business Valuation: A Bibliometric Review of Intangible Elements as Key Value Drivers. The Role of Managers in Value Creation

Repensando la Valoración Empresarial: Revisión Bibliométrica de los Intangibles como Impulsores Clave del Valor. El Rol Directivo en la Creación de Valor

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ARTICLE INFO

Received 21 September 2024,
Accepted 20 February 2025

Available online 31 October 2025

DOI: 10.5295/cdg.252305ab

JEL: M10, M15

ABSTRACT

Traditional business valuation methods do not consider most intangibles that affect the value of the company, although they are considered as key elements by both researchers and practitioners. Research in this field is not consolidated yet and although some authors have attempted to address this issue, there is no standardized list of intangible variables that can be systematically included in the valuation process. The objective of this study was to identify all intangibles studied regarding firm value, classify them into clusters and observe their relevance in the scientific literature over the years through a bibliometric approach. Using VOSviewer visualization tool, from the review of 843 published papers in the Web of Science (WOS) in the last two decades, we obtained 5 clusters of intangible variables related to firm value: Strategy and firm characteristics; External elements to the firm; Ownership structure; Management structure; and Stakeholders and CSR. "Strategy and firm characteristics" was the cluster with the highest scientific output, and "ownership structure" the most influential. We found that most of the intangible elements that affect the value of the company can be managed by the company's management. This makes managers the key element in value creation.

Keywords: Intangible elements, Clustering, Bibliometric analysis, Value creation, Managers decisions.

RESUMEN

Los métodos tradicionales de valoración de empresas no tienen en cuenta la mayoría de los intangibles que afectan al valor de la empresa, aunque tanto los investigadores como los profesionales los consideran elementos clave. La investigación en este campo aún no está consolidada y, aunque algunos autores han intentado abordar esta cuestión, no existe una lista estandarizada de variables intangibles que puedan incluirse sistemáticamente en el proceso de valoración. El objetivo de este estudio es identificar todos los intangibles estudiados en relación con el valor de las empresas, clasificarlos en clusters y observar su relevancia en la literatura científica a lo largo de los años mediante un enfoque bibliométrico. Utilizando la herramienta de visualización VOSviewer, a partir de la revisión de 843 artículos publicados en la Web of Science (WOS) en las dos últimas décadas, obtuvimos 5 clusters de variables intangibles relacionadas con el valor de la empresa: Estrategia y características de la empresa; Elementos externos a la empresa; Estructura de propiedad; Estructura de gestión; y RSC y los grupos de interés. «Estrategia y características de la empresa» fue el cluster con mayor producción científica, y "estructura de propiedad" el más influyente. Descubrimos que la mayoría de los elementos intangibles que afectan al valor de la empresa pueden ser gestionados por la dirección de la empresa. Esto convierte a los directivos en el elemento clave de la creación de valor.

Palabras clave: Elementos intangibles, Clustering, Análisis Bibliométrico, Creación de valor, Decisiones de los directivos.

1. INTRODUCTION

The determination of the value of a company is one of the most studied aspects in the academic literature referring to the business field. Estimating the value of the company is fundamental from the point of view of both shareholders and investors as well as of business management and the organization's managers (Triani & Tarmidi, 2019; Vayas-Ortega *et al.*, 2020a).

For investors, given the inefficiencies in the financial market, the possibility of obtaining positive returns is linked to the accuracy with which the intrinsic value of the company is determined and to the systematic errors in market expectations (Lu *et al.*, 2021).

From the point of view of corporate governance, determining the correct value of the company is fundamental from two different perspectives. First, management activity is evaluated by the ability of the managers to create value for the owners. Second, the firm's managers are the only ones who can create value by developing and sustaining competitive advantages that generate cash flows that provide a return exceeding the cost of capital (Koller *et al.*, 2010).

There are numerous tools that allow us to estimate the real value of a company. Traditional valuation methods, including Discounted Cash Flow method and valuation by multiples (Huang *et al.*, 2023), use quantitative variables such as cash flows or corporate profit to determine the value of the company. However, none of them include in the valuation process the economic value of key intangible elements for the company such as human capital (Vomberg *et al.*, 2015), brand reputation (Luo *et al.*, 2013) or innovation (Min & Smith, 2016) among others. An increasing number of authors defend that this type of elements has a fundamental role in the value of the companies (Belo *et al.*, 2022; Gyapong *et al.*, 2016; Kumar *et al.*, 2021). Research in this field, however, has been piecemeal and the intangibles considered in explaining entrepreneurial value have been many and varied in nature. Despite their importance in the value of the company, it is difficult to introduce intangibles in the valuation if we cannot even identify which qualitative aspects may be susceptible to be included in these processes. Although various authors have proposed different approaches for identifying, measuring, and incorporating certain intangible assets into the valuation process (Bueno *et al.*, 2011; García-Merino, 2015; Rodríguez-Castellanos *et al.*, 2007), as far as we know, not all of the intangible elements discussed in the literature have been fully identified in a way that establishes a widely accepted taxonomy of intangibles that contribute to a company's value.

Numerous authors have put forward models that attempt to explain the relationship between a single intangible, or a short list of intangibles, and firm value (Andriessen, 2004; Kumar *et al.*, 2021; Sorescu & Spanjol, 2008). The literature also includes holistic models that aim to integrate all the intangible drivers of enterprise value. Among these, the Intellectus Model (Bueno *et al.*, 2011) stands out for its rigor and global approach. These "integrative" models represent a significant advance in research on intangibles as drivers of business value. However, the intangibles they incorporate are not derived from a systematic review of prior literature on intangibles and the firm and may therefore be incomplete. In the words of Peters and Taylor (2017), much work remains to be done in the identification and measurement of intangibles. Thus, identifying the full set of intangibles studied is essential in order to develop new, more rigorous models. Moreover, these integrative models were developed more than a decade ago. The ongoing need to adapt intangible identification models to an ever-evolving social and economic context both guides and justifies continued efforts to improve upon earlier proposals (Bueno *et al.*, 2011). Analyzing this temporal evolution can allow us to determine which intangibles are currently regarded as most relevant by both academics and practitioners. In light of the identified gaps in the literature and the need to clarify the role of intangible assets in business valuation, the main objective of this study is to identify and structure the intangible elements addressed in the literature as explanatory factors of firm value, offering an updated and comprehensive view that reflects their thematic grouping, the attention they have received over time in the literature, and their academic relevance, with the aim of facilitating their future inclusion in business valuation models. To articulate this overarching aim, the study is organized around the following specific objectives: The first specific objective is to develop an updated list of those elements that could be included in the valuation process. Additionally, we will analyze whether the variables can be grouped into different clusters that define the structure of this field of knowledge. By grouping the variables obtained into clusters, a much more comprehensible list of intangibles can be generated (Corrado *et al.*, 2009). In addition, the creation of clusters provides a valuable framework for understanding the business environment. When studying a complex phenomenon such as intangibles that drive value it is necessary to examine not only each variable individually, but also the associations among them. This approach enables a comprehensive view of the phenomenon, facilitates a deeper understanding, and ultimately supports more informed practical decision-making (Maseda *et al.*, 2023). Due to the relevance that business value has on the work of managers (Koller *et al.*, 2010), it is interesting to know whether the intangible elements that can generate business value are internal to the company, so they can be managed by managers or, on the contrary, are external hence uncontrollable. The second specific objective is to analyze the evolution over time in the study of identified intangibles. This will allow us to determine which intangibles attracted greater interest from researchers in the past and which are more frequently studied today.

The third specific objective is to analyze the importance given to each group of intangible elements in academic literature, both in terms of the number of articles published and their volume of citations.

Our work contributes to the existing literature by enabling structuration of the field of knowledge related to the impact of intangible elements on business value, complementing and expanding the previous proposals offered in the literature. The main contributions of our study are the following: firstly, based on a sample of 843 articles; by analyzing for the first time and systematically reviewing the most relevant literature on the studied phenomenon from 2000 to 2022, we obtain an updated list of all the intangibles studied in relation to value. Secondly, we grouped the identified variables into 5 clusters, in this way, we are able not only to obtain a more comprehensible list of intan-

gibles but also to understand the relationships among them. Thirdly we structure this field of knowledge by analyzing the temporal evolution in the study of these variables. This allows us to identify which intangibles are currently attracting the most interest from researchers and investors. Fourth, we determined the impact of each cluster in the literature over the last 25 years. The results of this study are a first, necessary step, which will allow us to open a line of research to determine which intangibles are really relevant in the company. This will facilitate the inclusion, by investors, of intangibles in the valuation process. Additionally, it will allow managers to know the most important qualitative variables to manage in order to enhance the value of their companies. Identifying the most highly valued intangibles today enables managers to focus their limited resources on the development of these intangibles.

Finally, our results contribute to the debate on whether company managers are the only agents that can generate value through the creation of sustainable competitive advantages, as suggested by authors such as Koller *et al.* (2010).

2. LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1. Value as a measure of business performance

The analysis of the existing literature revealed different points of view regarding the suitability of using firm value as a measure of business performance. He *et al.* (2020), among others, use variables such as profit, sales volume, stock returns or financial indicators such as financial or economic profitability, to approximate performance. Whereas the company's profit or economic profitability only takes into account the interests of one part of the organization, value creation considers the long-term interests of all stakeholders and not only those of shareholders (Koller *et al.*, 2010); which contributes to reducing agency problems (Triani & Tarmidi, 2019).

In line with authors such as Bardos *et al.* (2020) and Subagyo (2021), this study adopts a broad interpretation of firm value as a forward-looking estimate of a company's ability to generate sustainable performance, taking into account both its market valuation and financial indicators derived from its accounting situation.

The creation of value as an essential objective of the company is even more important in turbulent times such as the one we live in, due to the global geopolitical situation and the consequences of successive crises that have affected firm performance, such as the one triggered by COVID-19 (Hu & Zang, 2021) and the one resulting from the war in Ukraine (Ferriani & Gazzani, 2023). According to Koller *et al.* (2010) one of the keys to avoiding future financial crises, such as the one suffered in 2008, the 1998 Southeast Asian crisis or the "Internet Bubble" lies in reaffirming the basic economic rules by valuing any type of investment according to the guiding principle of value creation, always taking into account the underlying risk.

Considering some of the major current situations of economic turmoil, the crisis triggered by the pandemic once again translated into a shock to global financial markets, causing a drastic decline in firm value (Albuquerque *et al.*, 2020). Subsequently, the wars in Ukraine and the Middle East and the recent trade war triggered by the tariffs imposed by the United States have also significantly affected the value of companies in a wide range of industries. While the current environment does not strictly resemble traditional economic crises, it can be considered a context of accumulated instability. Unlike previous episodes, such as the 2008 financial crisis or the Southeast Asian crisis, the current challenges combine health emergencies, geopolitical tensions, supply chain disruptions, and an accelerated digital transformation. This convergence of systemic pressures creates a unique scenario that tests the adaptability of firms and the robustness of their strategic approaches. Therefore, in order to ensure the survival of a company and try to achieve the highest possible performance, it is key to propose business strategies that allow cushioning the impact of the crises on the value of the company including the management and valuation of intangible assets (Ding *et al.*, 2021). Given the distinctive nature of today's context, the intangibles that firms prioritize may also differ from those emphasized in past periods.

The current research trend, which gives greater importance to stakeholder value models than to shareholder value models (Bose *et al.*, 2022), is used as an additional discussion for prioritizing the preservation of company value over other performance indicators in times of crisis.

2.2. Business valuation

Business valuation has been studied extensively over the years. Numerous authors have sought to determine the correct method for calculating the true value of a firm. Williams (1938) laid the foundations of modern financial valuation by developing the Dividend Discount Model (DDM). In this model, Williams emphasized the difference between intrinsic value and market price, highlighting the importance of cash flow expectations and the use of a risk-adjusted discount rate. Modigliani and Miller (1958) demonstrated that, in a perfect market, the capital structure does not affect the value of the firm, as it depends solely on the cash flows generated by the assets. Reinforcing the idea proposed by Williams (1938), Sharpe (1964) developed the Capital Asset Pricing Model (CAPM), a model that integrates systematic risk into the discount rate used in valuation, thereby complementing previous models. Fama and French (1993) expanded the CAPM by introducing new variables to explain variations in asset returns. While the CAPM focuses on systematic risk (Beta), the Fama and French (1993) model adds size and value factors, providing a more comprehensive view of the various risk factors that affect the value of financial assets.

Currently, when determining the value of the company the Discounted Cash Flow model (DCF) is the valuation method that seems to have attracted the greatest consensus among academics (Huang *et al.*, 2023). This is due to the fact that this model determines the value of the company following the basic financial principles of valuation seen in early literature. However, the valuation by multiples through the price/earnings ratio is the most widely used method by financial analysts (Huang *et al.*, 2023). Both models include forecasts about future economic flows generated by the company and incorporate risk when discounting those flows and determining value (Huang *et al.*, 2023).

Both the discounted cash flow method and the price-earnings model include, for their valuation, only quantitative variables such as profit, sales, cash flows, and balance sheet items, among others, leaving aside the economic value of numerous intangible assets that are not reflected in the annual accounts and that may affect the value.

2.3. *Importance of intangibles in Firm Value*

Intangible assets have become the main driver of company's value and economic growth in recent years. However, despite their importance, many managers are reluctant to consider them as value drivers. Most of the economic disbursements in intangible elements (brand development, spending on innovation, etc.) are still considered as expenses by some managers, and not as investments (Gu & Lev, 2011). Another reason why most intangibles are excluded from a company's valuation is the inherent difficulty in quantifying them. Accounting information systems, which are grounded in traditional accounting practices, lack the capability to precisely measure intangibles and their economic impact in numerical terms. This challenge is particularly pronounced for intangibles that are not readily identifiable, separable, or do not arise from legal or contractual rights (García-Merino, 2015).

The non-inclusion of intangible elements in the value of the company is a major problem for both investors and managers. On the one hand, for investors seeking to acquire part of the ownership of a company, deficient information on the intangible elements developed by the company can be a major source of losses. On the other hand, managers are the primary drivers of value creation within the company (Koller *et al.*, 2010). However, if intangible assets are not accounted for in the company's valuation, managers may lack the necessary precision to determine whether their decisions are genuinely generating value for stakeholders.

In turn, when analyzing the market value of companies, it can be seen that very frequently the market itself systematically assigns a much higher value to companies than that reflected in their financial statements. The difference between the two values is so large that it cannot be attributed solely to elements inherent to the financial markets nor to aspects external to the companies themselves. Numerous authors highlight the absence of intangible elements in valuation as a key factor in explaining this gap, which can reach up to 50% of a company's total value (Belo *et al.*, 2022).

Many authors argue that a greater commitment to intangibles in the company is particularly relevant to the evolution of the company's price in crisis situations. On the one hand, investment in intangibles has been observed as a protection mechanism against the sharp fall in corporate value in crises such as the financial crisis suffered in 2008 (Albuquerque *et al.*, 2020) as well as in the crisis caused by COVID 19 (Demers *et al.*, 2021). On the other hand, investing in intangibles has been shown to reduce stock price volatility in situations of economic uncertainty (Bouslah *et al.*, 2018).

2.4. *Inclusion of intangibles in Firm Value.*

Different authors have attempted to include intangibles in firm valuation. (Corrado *et al.*, 2009) define three main categories of intangibles: R&D, computerized information, and economic competencies, using aggregate expense data and the perpetual inventory method to calculate them. Other authors such as Eisfeldt and Papanikolaou (2013) and Eisfeldt *et al.* (2022) define intangibles through selling, general and administrative expenses (hereinafter SG&A). Peters and Taylor (2017), following the previous trend, determine the company's intangibles taking into account the SG&A, to which they only give a value of 30%, adding R&D expenses, giving these the main role when valuing the company's intangibles. These studies highlight the strength of using a set of intangibles that can be clearly identified, fulfilling one of the requirements proposed by Andriessen (2004), and which can also be measured using as a proxy various types of expenses incurred by the firm. Furthermore, they categorize the intangibles with the aim of developing a comprehensible list of intangibles (Corrado *et al.*, 2009). However, likely due to the limited and disparate list of intangibles considered, these studies have yielded contradictory results. That is, depending on the study, different intangibles are deemed relevant. A major weakness observed in previous studies is that they lack a holistic view of the phenomenon. Previous studies only consider intangibles related to innovation, firm management expenses, product sales costs, etc. However, they overlook other types of intangibles that the literature has already shown to be powerful drivers of firm value, such as board of directors characteristics (Gyapong *et al.*, 2016), corporate social responsibility (Servaes & Tamayo, 2013), human capital (Vomberg *et al.*, 2015), brand reputation (Luo *et al.*, 2013), among others. On the other hand, one of the leading academic approaches aimed at identifying the intangibles that can be incorporated into a company's value is the intellectual capital framework. This concept encompasses a set of knowledge-based intangibles —such as applied experience, professional skills, and expertise— that can create value for the company (Edvinsson & Malone, 1997). Intellectual capital seeks to account for the non-monetary sources of an organization's wealth creation (Andriessen, 2004). Various models have been developed to further refine this concept, aiming to establish a structured approach to categorizing the types of intangibles that can be integrated into valuation processes. Among these, the "Intellectus Model" is particularly notable, as it classifies intellectual capital into four categories: "Human Capital," "Structural Capital," "Relational Capital," and "Entrepreneurship and Innovation Capital" (Bueno *et al.*, 2011). Models based on intellectual capital, such as the Intellectus model, seek, unlike previous models, to integrate all the intangibles that influence firm value. The underlying idea in these models, the need to integrate all possible intangible drivers of value into the analysis, forms the starting point of our research. However, when it comes to identifying intangibles, none of these models have systematically analyzed the intangibles previously studied in the literature. This fact, which can be considered a weakness of previous models, is addressed in our research. Furthermore, in the current context, there is a need to adapt the models to a constantly evolving social and economic reality (Bueno *et al.*, 2011). Over the years, intangibles that were once considered highly relevant may have lost importance, and other relevant intangibles may have emerged that were not included in previ-

ous models. All of this highlights the need to develop a methodology that allows for the identification of those intangibles that have been overlooked and, at the same time, enables the observation of the evolution of the importance that researchers and practitioners have attributed to them over time as drivers of value.

In recent decades numerous authors have tried to find intangible elements capable of explaining the increase in corporate value in certain situations: Core competencies (Rodríguez-Castellanos *et al.*, 2007; García-Zambrano *et al.*, 2013, 2014), innovation (Sorescu & Spanjol, 2008), corporate social responsibility (Servaes & Tamayo, 2013), consumer satisfaction (García-Merino *et al.*, 2014), board characteristics (Gyapong *et al.*, 2016), training and advertising policies (García-Zambrano *et al.*, 2018), or marketing strategy (Kumar *et al.*, 2021), etc., are among these elements. However, there is no consensus on which elements should be included and which others should be excluded in the valuation process, so there is no standardized and universally accepted list in this regard. In addition, the importance given to different intangibles at different points in time has not been analysed.

3. METHODOLOGY

3.1. Sample

The analysis is based on scientific articles contained in the "Web of Science" database, the first international database created and currently the most influential and recognized one when performing bibliometric analysis (Li *et al.*, 2018).

The sample of articles was drawn as of November 29, 2022. In order to identify as many articles as possible, the main objective of which was to analyze firm value, we first selected all those whose title or keywords included the concept "firm value". We are aware that the selection of keywords may be subject to author bias; however, keywords are the most commonly used tool in the literature as a first approach that helps to reveal the knowledge structure of a research field (Maseda *et al.*, 2023). Secondly, we refined our search by taking into account those articles that belonged to the main collection of the WoS and that were included in the "business economics" research area. In terms of language and time reference, we have included in our sample all articles published in both English and Spanish from 2000 to November of 2022. Finally, we obtained a sample of 843 articles. These are articles already published and articles with early access, which are pending publication.

3.2. Data analysis

To identify the different variables collected in the literature that identify intangible elements that influence business value, we proceeded in two clearly differentiated steps. Firstly, we analyzed each scientific article individually in order to identify, upon reading each paper, the intangibles studied in them. Secondly, we performed a bibliometric analysis to complement the results obtained in the first step that allowed us to group the different variables into clusters.

Bibliometric techniques presents an important limitation: the algorithms and applications developed to determine the relevant terms that define our field of knowledge only take into account the number of times a word appears in the texts and the co-occurrence with the rest of the terms. Co-word analysis is used to map the strength of relationships between terms. If two concepts co-occur in an article, the two research topics are correlated (Maseda *et al.*, 2023). Although bibliometric applications, through this co-occurrence study, contribute to the systematization of the literature review, using replicable and objective protocols that minimize human bias (Maseda *et al.*, 2023), these applications are not able to identify the meaning of the words, as it is achieved through a manual review by experts. It is therefore interesting to combine both techniques (Demeter *et al.*, 2019). In the development of our study, we used text mining to be able to perform our bibliometric analysis.

In our case, prior to the bibliometric analysis and in order to avoid its limitations, a first analysis was made of each of the articles in order to eliminate all those whose main objective was not to study a causal relationship between the independent variables, whether tangible or intangible and business value, as well as those for which no published information was available. Thus, a total of 14 articles were excluded, the 1.66% of the total. Next, a second, separate analysis was carried out by each author to extract the tangible or intangible elements associated with enterprise value studied in each article. Thereafter, we discarded those articles that exclusively analyzed the influence of tangible elements on value. In undertaking this classification, we identified as intangibles those variables that do not appear on the company's financial statements due to the difficulty of being quantified in monetary value, yet can contribute to enhancing the company's competitive position by adding value to key stakeholders (Gamayuni, 2015). We adopt a broad interpretation of "intangible elements," consistent with how the literature often approaches the concept in the context of firm value. While some variables, such as firm age, size, diversification or debt policy, might not be classified as intangible assets in the strictest sense, they are frequently used in academic research as proxies or indicators of intangible capabilities. For instance, firm age can reflect accumulated knowledge or organizational maturity (Petruzzelli *et al.*, 2018); size may relate to structural complexity or the ability to mobilize intangible resources or the realization of economies of scale (Celli, 2013); and debt policy is often associated with a firm's capacity for financial flexibility and strategic diversification of funding sources (Tripathy & Uzma, 2022; Yousefi & Yung, 2022). This inclusive approach allows us to capture not only explicit intangible assets but also contextual factors that reflect or influence the firm's capacity to generate value through intangibles. Subsequently, and based on the results obtained, both authors re-evaluated their results in order to reach a consensus and extract a single list of those intangible elements that explain entrepreneurial value found in the literature. Discrepancies were resolved through a structured comparison of the authors' lists, jointly reviewing the corresponding articles based on the study's inclusion criteria to ensure consistent classification.

Once the relationship of intangible elements was obtained, the next step was to perform a bibliometric analysis of the same articles, in order to check whether the results obtained were equivalent and thus reinforce our initial results. Following authors such as Demeter *et al.* (2019) and Rodríguez-Rodríguez *et al.* (2021), to perform our text mining analysis, we used the VOSviewer 1.6.20 tool. Following the steps of text mining, first, defining the corpus of our research, we downloaded from WoS those articles that define our sample including their title and abstract. Once the downloaded file was entered into the application, VOSviewer developed an automatic functionality from which it created a list of terms (based on their occurrence in the texts) that potentially describe the research field. In a previous step, we identified all those words that appear 7 times minimum in the analyzed documents, as recommended by the application itself. In this way, we obtained a preliminary list of 519 words. In our case, following Demeter *et al.* (2019), we used the total count method instead of the binary count method. The total count indicates the total number of times a word appears in each paper, while the binary just indicates the presence or absence of the word in each paper. The total count technique has two advantages: first, it avoids the loss of information of the binary counting technique. Second, it offers a more detailed view of the cooccurrence of terms, since, if two terms appear four times, for example, in the abstract and title of an article, their union will be four times stronger than if we use the binary count where each term would only be counted once (Demeter *et al.*, 2019). Due to its greater simplicity, the binary method can be a good alternative to use when identifying the most relevant terms over a whole time period (Demeter *et al.*, 2019). Binary methods, in turn, can neutralize bias in long and repetitive documents, where a term may appear excessively repeated (Perianes-Rodriguez *et al.*, 2016). Therefore, while the binary method can be useful when studying general trends or conducting an exploratory analysis, when analyzing the co-occurrence of terms, we consider it more appropriate to use the total counting method. From this list, we performed an exhaustive analysis to obtain a new list of much more valuable words for our research. First, we identified those concepts related to intangible elements that explain value and grouped the synonyms into a single concept considering the variables identified in the manual identification carried out in the first step of the research. Each author conducted a separate analysis of the original concepts obtained to group synonyms into a single term (for example, family firm, family business, and family enterprise were grouped into "family firm"). Subsequently, the groupings made by each author were shared. Finally, both authors reevaluated their results to reach a consensus and extract a single list of variables. Minor discrepancies were resolved through a brief joint review of the proposed groupings. Then, we raised the model again taking into account, due to the grouping of words with the same meaning in a single concept, only those terms that appeared at least 20 times. After obtaining a new list of 191 words, the information was filtered. Firstly, we proceeded to eliminate all words without semantic meaning such as pronouns, connectors, or articles. Secondly, we eliminated all those words that appeared in many instances in the abstract of any article but that had nothing to do with the study of intangibles and the value of the company, since they were generic concepts or words typical of any research. Words such as "paper", "investigation", "significant", etc. Thirdly, in order to delimit our scope of study, we eliminated all words that had to do with the dependent variable (company value) or with quantitative variables such as "revenue", "profit", etc. Thus, we obtained a total of 32 constructs that included all the qualitative variables related to company value.

Finally, once the relationship of intangible variables had been identified, we used the VOSviewer tool to perform two types of analysis: the elaboration of a cluster of variables and the analysis of the evolution of the field of knowledge. VOSviewer uses a technique called "theme analysis" to create term maps based on distance, where the distance between concepts reflects the strength of their relationship. Thus, when analyzing our maps, the shorter the distance, the greater the co-occurrence of the terms analyzed in the articles that make up our object of analysis. For the formation of these clusters, the relationships between variables are determined by the number of times that these variables simultaneously appear in the articles studied. The clustering of terms was performed automatically by VOSviewer using the Leiden algorithm with a resolution parameter of 1.0, as recommended by the application itself. The minimum cluster size was set to 1, as indicated by default in the application, allowing the tool to detect even narrowly connected groups of terms.

In addition to identifying clusters, our purpose was to check the evolution of the field of knowledge, identifying what has been studied in the past, what is currently studied, and in which direction that field of study will possibly go in the future. Therefore, we performed a temporal analysis of the variables through the mapping offered by VOSviewer.

Finally, and thanks to the information obtained in relation to the journals of publication, number of citations, etc., we analyzed the productivity and influence of each of the clusters, these two variables being understood as the two main metrics for studying the output of scientific research. Productivity is generally measured by the number of published articles, while influence is measured by the number of citations. VOSviewer has an important limitation in that it does not identify the journal to which each article belongs nor the number of citations of each paper. Therefore, in the manual review of each article, carried out in the first step of this study, we also manually identified this information for each of the articles in our sample.

4. RESULTS

As can be seen in Figure 1, between 2000 and 2022, researchers have identified 32 constructs or variables representing intangible elements that could influence the explanation of company value.

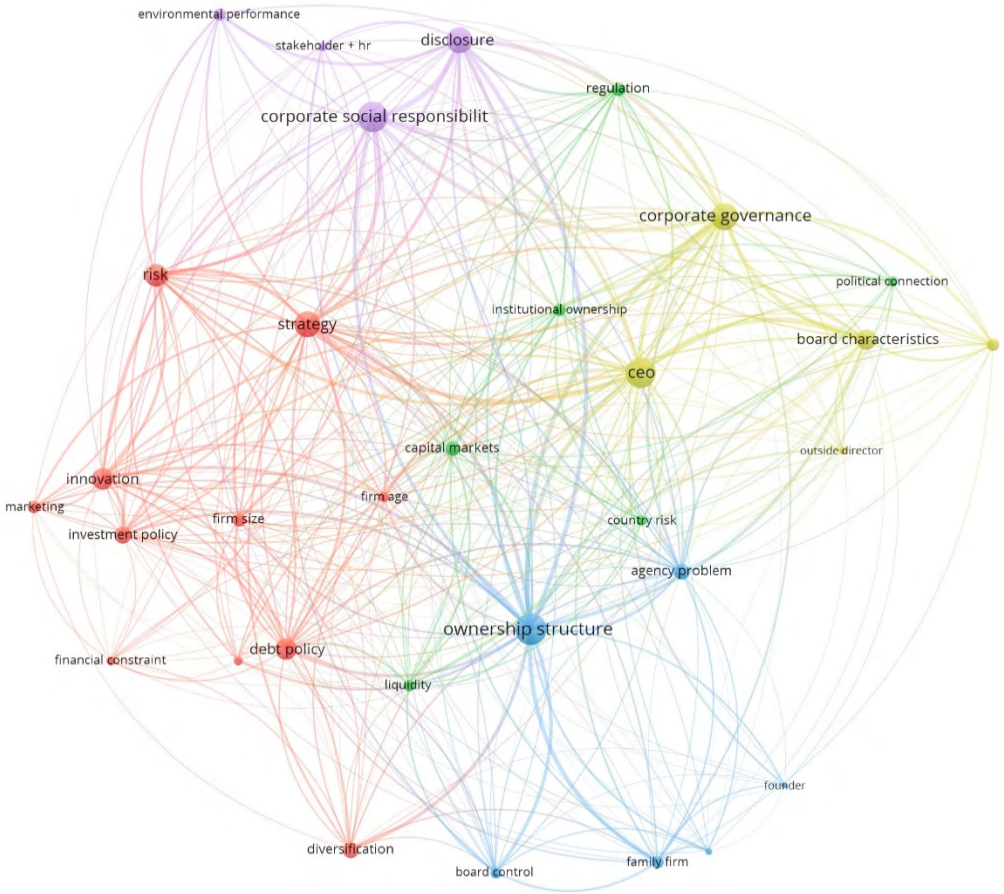

Figure 1
Clusters based on co-occurrence of terms
Source: Author's own elaboration.

These 32 variables are grouped into 5 clearly differentiated clusters. Each of the variables is identified as a dot on the map with the corresponding color of its cluster. The size of the representative point will be larger the greater the number of occurrences of this term in the analyzed literature. We can also observe the existing relationships between the different terms, according to the thickness of their connecting lines. The distance between the terms marks their correlation, with those terms that are more closely correlated being closer.

Based on the variables collected in the different clusters, we assigned interpretive labels to each group. In the first cluster we find two types of variables, firstly, those that refer to the company's own characteristics, among which are the age of the company, understood as the number of years it has been in operation, and the size of the organization. Secondly, those that describe business policy and strategy. Here we find from the determination of the level of indebtedness, sources of financing and investment alternatives (financial strategy), to other types of specific business strategies such as marketing strategy or innovation, to general concepts of competitive and corporate strategy. This cluster groups the variables that have traditionally been identified as those over which managers have direct control, which makes them the key element in creating value in the company (Koller *et al.*, 2010). This cluster was identified as "Strategy and company characteristics".

The second cluster includes variables related to the characteristics of the financing sources to which the company can have access, either primary or secondary markets. On the other hand, there is the country risk variable, which reflects all those elements uncontrollable by the company, related to the markets in which it operates, and which may affect its performance. Finally, we find another series of external elements such as regulation and the possibility for institutional bodies to participate as shareholders of the company. Although some of the variables included in this cluster might, a priori, seem unrelated, they all share a fundamental characteristic: They are all elements outside the company, beyond the control of management, but which nevertheless affect the organization's performance. However, despite not having direct control, managers can make decisions to adapt to them. This cluster was defined as "elements external to the company".

The third cluster is made up of the variables related to the ownership of the company. This cluster shows that in addition to management decisions, the number of shareholders, their characteristics, the presence of a family owner, the permanence of the founder in the company, or the commitment of the shareholders to the company, reflected through the control exercised by them, can influence the value of the company. Taking into account the variables that make it up, we will call this cluster "ownership structure"

The fourth cluster encompasses the variables related to the characteristics of the company's managers, as well as the practices they carry out, which is why we called it "managerial structure". The presence of this cluster corroborates the central importance of the management team in the value of the company, giving a new dimension to the importance of managers in business value. We can observe how the market not only values the decisions taken by the managers, but also the characteristics of the managers themselves, the way in which the management team is structured and the characteristics of the CEO have a direct effect on the value of the company.

The fifth and last cluster includes elements that define the company's relationship with all stakeholders, where elements such as personnel management stand out. On the other hand, we find the company's commitment to the environment and society as a whole, with particular attention to the company's transparency and dissemination of information on its business practices. The fact that there is a specific cluster for Corporate Social Responsibility and stakeholder management, especially for employees, highlights the importance of managing these variables. This cluster was labeled as "Corporate Social Responsibility and Stakeholders". All the variables identified, as well as the clusters they are grouped in, are shown in Table 1.

Table 1
Intangible variables explaining business value and clusters formed

Cluster	Variables	
Company strategy and characteristics	— Debt policy	— Investment policy
	— Diversification	— Ownership of directors
	— Financial restrictions	— Business strategy
	— Age	— Assumed risk
	— Size	— Marketing Policy
	— Innovation	
Elements external to the company	— Financial markets	— Market liquidity
	— Country risk	— Political connections
	— Institutional owners	— Regulation
Ownership structure	— Agency problems	— Family Firm
	— Proprietary control over management	— Minority owners
	— Founder	— Ownership structure
Management structure	— Characteristics of the Board of Directors	— Independent directors
		— Corporate Governance
	— CEO Characteristics	— External executives
CSR and stakeholders	— Corporate Social Responsibility	— Eco-efficiency
	— Stakeholders and employees	— Transparency and dissemination of information

Source: Author's own elaboration.

The size and density of the different clusters obtained provide relevant information both about the clusters themselves and about the phenomenon under study at a general level. The size of a cluster depends on the number and relevance of the elements it comprises. Larger clusters, such as the "Company strategy and characteristics" cluster, indicate more developed or better-represented thematic areas within the data. Smaller clusters, such as in this case the "CSR and stakeholders" cluster, represent more specific, emerging, or less-researched topics (Van Eck & Waltman, 2010). However, it is important to clarify that the lower size of this cluster does not necessarily reflect a lack of academic interest or relevance. On the contrary, our temporal and citation analysis shows that many of its elements, such as human capital, disclosure, or CSR, have gained significant traction in recent years. Therefore, the smaller size of this cluster is due to the limited attention these intangibles received in earlier periods, although they are now increasingly relevant in light of current research trends. Density refers to the intensity of the connections among the elements within each cluster. Clusters with higher density, such as in this case "Company strategy and characteristics" and "Ownership structure," are composed of highly interconnected concepts, representing consolidated lines of research. In contrast, low-density clusters, such as "Elements external to the company," are composed of more dispersed concepts (Van Eck & Waltman, 2010).

Finally, the positioning of the clusters on the map reveals information about the relationships between them, which allows us to better understand the importance of intangibles in today's business environment. More central clusters are more connected to other topics and represent interdisciplinary aspects (Van Eck & Waltman, 2010). Changes in the intangibles included in these clusters may affect a larger number of other intangibles. On the other hand, peripheral clusters represent more specialized and independent areas (Van Eck & Waltman, 2010). In our case, we can observe that aspects related to CSR are more independent from the rest of the clusters. However, the "External elements to the company" cluster represents aspects that may impact all areas of the firm.

Figure 2 shows the constructs that have been most analyzed over the years, showing in a color closer to blue the most studied terms in the initial years of our sample (year 2000) and in a color closer to yellow, the most studied concepts at present.

We can see how, while in the early 2000s the most studied intangible elements explaining value were those related to investment policies, marketing, the founder or the diversification strategy, nowadays elements such as CSR, transparency and disclosure of information, human resources or the company's political connections are studied to a greater extent. The intangibles represented in yellow are those currently attracting the most attention. This suggests stronger market reactions to these intangibles compared to more traditional ones that have lost prominence in recent years. From these results, it can be inferred that managers should focus their efforts and resources on developing CSR policies, establishing fruitful political connections, or implementing an efficient debt policy. Nevertheless, it is important to highlight the relevance of the interconnections among intangibles and the need to understand the model as a global phenomenon. Therefore, other intangibles, although perhaps to a lesser extent, should also be taken into account.

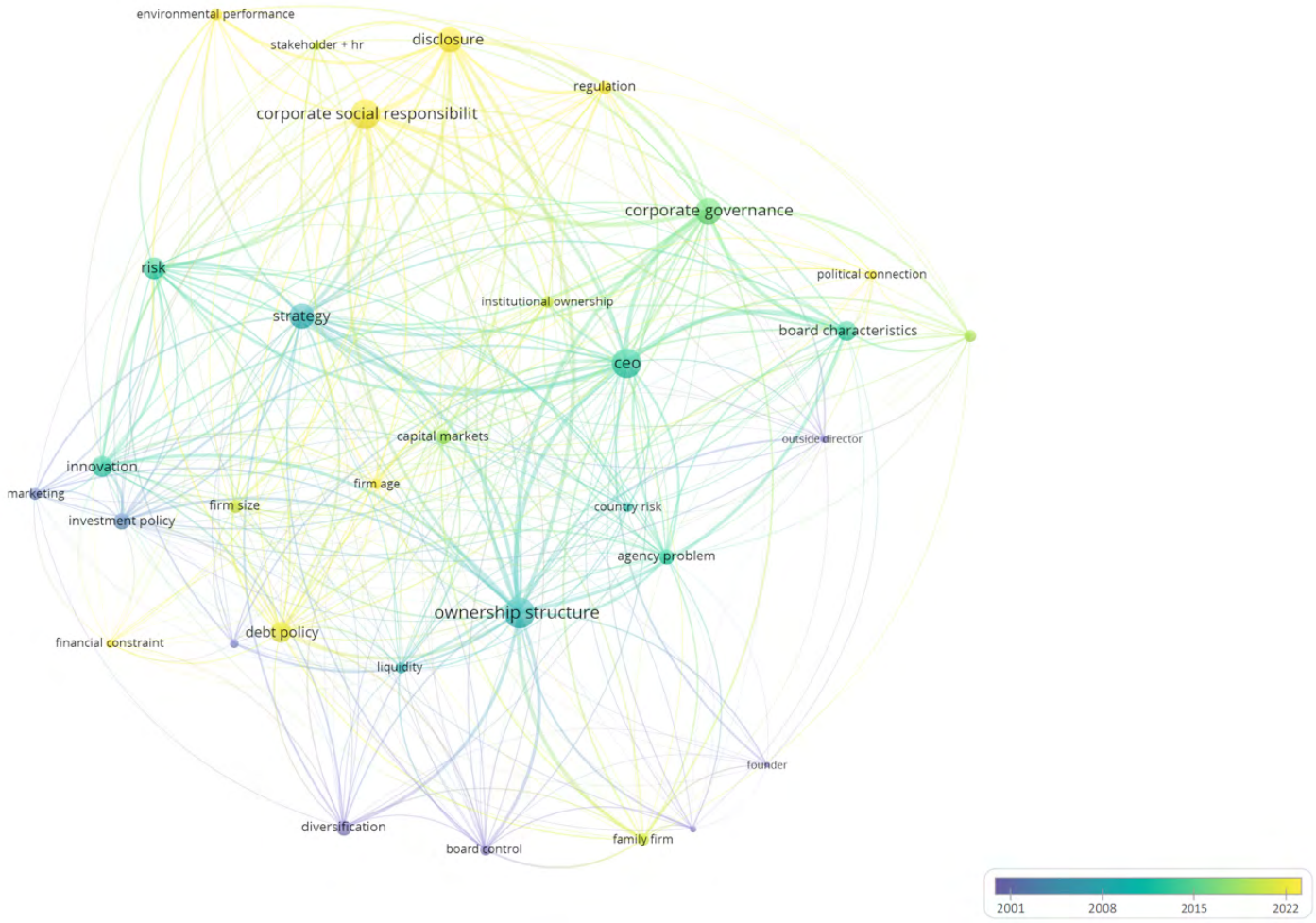

Figure 2
Time evolution in the study of the intangibles
Source: Author's own elaboration.

Additionally, we can observe a certain coherence between the identified clusters and their temporal evolution. With some exceptions, the clusters "Company strategy and characteristics" and "Ownership structure" encompass most of the intangibles studied at the beginning of the analysis period, whereas clusters such as "CSR and stakeholders" include the majority of the intangibles that are more extensively studied today.

The observed evolution in the study of intangibles within the literature is not arbitrary, but rather linked to the economic, social, and institutional transformations that have occurred over the past two decades. Among the most notable are the growing relevance of corporate sustainability and ESG standards (Barbosa *et al.*, 2023), the institutionalization of the Sustainable Development Goals (SDGs) (Galeazzo *et al.*, 2023), and increasing societal demands for ethical, transparent, and responsible business conduct (Adewole, 2024). These trends have led companies to prioritize value creation strategies grounded in CSR and stakeholder management over more traditional approaches, such as diversification policies. These shifts have progressively shaped the research agenda, which seeks to explain the elements most relevant in each specific period.

Once the results provided by the VOSviewer application were obtained, and in order to overcome the limitations it offers, we proceeded to analyze the productivity and influence of each of the clusters, including each article individually in its corresponding grouping. In this way and trying to study the impact on the academic literature of each group of intangible elements, our results show that the first cluster, "Strategy and characteristics of the company", concentrates 300 published articles, with a total of 7,286 citations, which means an average of 24.28 citations per article. The second cluster, "Elements external to the company", includes 112 articles with a total of 2,726 citations (24.34 citations per article). The third cluster, "Ownership structure" consists of a total of 75 articles with a total number of 5,105 citations (66.86 citations per article). The fourth cluster, called "Managerial structure", groups a total of 157 articles with a total of 3,221 citations (20.51 citations per article). The fifth and last cluster, "CSR and stakeholders" is made up of a total of 179 articles with 4,829 total citations (26.98 citations per article). It is worth noting that this fifth cluster, despite being the one that has been studied for the least number of years, has the second highest average number of citations per article, thus demonstrating the relative importance of the variables associated with CSR.

5. DISCUSSION AND CONCLUSSIONS

Our results support the thesis proposed by authors such as Belo *et al.* (2022) who defend the importance of including intangible elements in determining the value of a company. In the last 20 years, more than 800 publications have analyzed this relationship and the relevance of its implications in both the financial and business management fields. In line with our general objective to offer a structured and updated view of the intangible factors that explain firm value and support their inclusion in valuation models, our first specific objective was to identify all the intangible elements addressed in the literature and to group them into clusters that reflect the thematic structure of the field. As a result, we identified 32 intangible variables that have been studied over the last 20 years by researchers to explain firm value can be grouped into 5 clusters: Strategy and firm characteristics, Ownership structure, Management structure, Corporate Social Responsibility and stakeholders, and Elements external to the firm. As part of our second specific objective, we analyzed the temporal evolution in the study of the identified intangibles, observing a clear shift in academic focus over time. Whereas earlier research prioritized traditional elements, such as diversification strategies or investment policies, recent years have seen growing attention to contemporary concerns like Corporate Social Responsibility, stakeholder engagement, and disclosure. This shift reflects an underlying change in the priorities of both academia and the business world. Finally, in relation to our third specific objective, analyzing the impact on scientific literature of the intangible elements analyzed, it is worth noting that the cluster with the highest productivity is "Strategy and characteristics of the company" followed by "Corporate Social Responsibility and stakeholders". The variables included in the "Ownership structure" cluster, those that question the exclusivity of managers as value-creating agents in the company, despite having been studied in only 75 articles, present an average of 67 citations per article, well above the rest of the groupings, which show an average of between 20 and 27 citations per article. Based on the results of our research, several relevant contributions emerge for both business practice and academic inquiry. These contributions are particularly valuable for managers, investors, and emerging scholars interested in understanding and advancing the role of intangibles in firm valuation.

5.1. Research contributions for practice.

Our research concluded that enterprise value is affected by both internal and external intangible elements, which has important implications for business management. Company managers are obliged, if they want the market to value their work, not only to take into account aspects of business strategy, investment or marketing policies, but also to develop their relationship with the environment through transparency and corporate social responsibility. Our results showed that most of the intangible variables that explain value are company-specific and therefore manageable by management. This has major implications from the point of view of business management, making clear the responsibility of managers in value creation (Koller *et al.*, 2010). It is noted that the company's managers play a decisive role in company value creation. The decisions made by managers, as well as their characteristics, largely explain firm value. However, our results challenge the idea that managers are the only agents capable of creating value. The presence of the cluster "Ownership structure" shows that, in addition to the managers and their decisions, the market also assigns a greater or lesser value to the company depending on its owners. Therefore, aspects such as the atomized nature of the company's capital, the types of shareholders, or the presence of one or several families in the ownership structure can lead to greater value. On the other hand, with regard to the temporal evolution in the study of intangibles, the results of our study allowed us to identify the elements that currently attract the greatest attention from researchers. The higher volume of scientific production concerning the importance of certain intangibles in firm value suggests stronger market reactions to these intangibles, compared to other traditional ones that have lost relevance in recent years. Knowing which intangibles are most relevant today constitutes an important starting point for managerial decision-making. It is worth noting the increasing importance that the literature attaches to the relationship between the company and its environment, giving greater importance to CSR policies and stakeholder care as drivers of value (Bardos *et al.*, 2020). This is an important reference point, once again, for managers, who must focus their business policies on this type of variable if they want to promote the sustainable growth of their company. Decisions relating to Corporate Social Responsibility and stakeholder management, as well as human capital, are one of the decisions that managers must take the greatest care of. The presence of a differentiated cluster related to CSR, as well as the greater scientific production currently referring to this type of variable, shows that managers must focus their efforts in this direction if they want to ensure that the market values their company more highly. Another key intangible that is currently receiving significant attention in the academic literature is debt policy. Numerous authors have emphasized the importance of managing aspects such as the level of indebtedness (Subaygo, 2021), financial flexibility (Yousefi & Young, 2022), and debt diversification (Tripathy & Uzma, 2022), among others, in relation to firm value. Our results suggest that managers should pay special attention to this intangible in order to develop successful value-creation strategies. Thirdly, another intangible that should be actively managed due to its significant impact today is the creation of political connections. Managers who, in addition to effectively managing the organization, are able to build fruitful and lasting political ties will significantly enhance their firm's value (Brown & Huang, 2020). Finally, another intangible worth considering, particularly by investors, is the condition of being a family firm. Although this intangible is not directly manageable by managers, it is included in the "Ownership structure" cluster, which currently attracts the most attention in the literature. This result suggests that investors should take into account aspects such as family control over the company (Cid *et al.*, 2022) and the influence of non-family members (Ni *et al.*, 2020) when selecting companies for their portfolios with the aim of achieving high potential returns.

5.2. Avenues for future research.

The results of our study represent an important starting point for emerging scholars aiming to advance research in the

field of business valuation. Two key research avenues arise from our findings. First, there is a clear opportunity to develop new valuation models that more comprehensively incorporate intangible elements. Although previous proposals exist, such as the Intellectus Model, which integrate various intangibles into the analysis of their impact on value, our research has revealed the existence of intangible elements that had not been considered in prior approaches. The incorporation of these newly identified intangibles, alongside those already included in earlier studies, would allow for the construction of more accurate and rigorous valuation models. Among the main intangibles identified that have not yet been addressed in what might be considered integrative models, and which, given their significant impact today, would be strong candidates for inclusion in future models, are managerial political connections, the condition of being a family firm, and disclosure.

Second, future research could focus on prioritizing the identified intangible elements. Using a Delphi method involving a panel of experts, formed by academics, investors, and managers, scholars could determine which of the 32 intangibles are the most important intangible elements and therefore, which ones should be included in the valuation process. This would permit to establish a standardized list that could guide both academic research and practical decision-making. Additionally, it would be interesting to study the relationship between the 5 clusters identified. Studying the effect of each one of them on the decisions taken by managers with the aim of creating value in the company.

5.3. Limitations

This work, like all works, has limitations. Perhaps the most important one stems from the impossibility of bibliometric analysis applications, in our case VOSviewer, to identify the meaning of the words analyzed (Demeter *et al.*, 2019) in co-word analysis. Although bibliometric analysis facilitates the objective identification of thematic clusters (Aparicio *et al.*, 2023), it should be used as a complement to conventional literature reviews (Maseda *et al.*, 2023). This implies the need to perform a manual review of the literature, individually analyzing each of the articles, which may introduce author bias and also limits the sample size to be used. The second limitation lies in the use of WoS as the sole database employed as an information source, overlooking others such as Scopus or Google Scholar. The authors chose this criterion due to the need to manually review each article and with the aim of minimizing duplications with other databases. However, it might be interesting to broaden the scope of research in the future by including articles from other databases after a thorough analysis. Despite these limitations, our study presents a number of strengths worth highlighting: First, it makes an important contribution to the literature, structuring the field of knowledge referred to the influence of intangible elements on business value. For the first time, we conducted an exhaustive review of the literature, identifying all the intangibles studied and analyzing their evolution over time. Secondly, we combined two methodologies for a more accurate identification of intangible elements. We performed a manual literature review combined with a bibliometric analysis, which allows us to solve the different problems presented by both methodologies separately and to obtain higher quality results. Finally, we identified for the first time a list of all the intangible variables related to enterprise value, which constitutes a first step towards the development of the future research lines previously discussed.

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