



Review

A glimpse of the future sustainable digital omnichannel retailing emerges - A systematic literature review

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ABSTRACT

With an emphasis on digitalization, distribution, logistics, and transportation, omnichannel retailing is essential in supply chain management (SCM). With this retailing strategy, sustainability and profitability in e-commerce may be addressed in a creative and cooperative manner. This article examines the relationship between digitization and Omnichannel retail and highlights sustainability concerns. The articles from WoS and Scopus between 2017 and October 2023 are included in the study. After excluding conference papers, journals not listed by the ABDC, and non-English publications, the 400 articles first found via a keyword search were reduced to 99. Using a range of criteria, including publication year, journal, nation, ABDC category, citations, and research methods, the content analysis of the chosen articles is part of the systematic literature review. This classification makes it possible to compare things, which shows how digitization and omnichannel retailing can help with sustainability. The results show a few studies relating sustainability with omnichannel retailing. While statistical modelling is used in Omnichannel Retailing to address consumer satisfaction, game theory modelling is commonly used for price decisions. Nevertheless, a few literature address environmental issues with theory and coordinated strategy. To address sustainability concerns and further our understanding of the relationship between digitization, sustainability, and omnichannel retailing, this analysis proposes interesting directions for future research.

1. Introduction

The Internet's introduction in the 1990s paved the way for online shopping to completely change the corporate environment. Direct client sales were made possible by pioneering internet marketplaces like Amazon (Risberg, 2023). Driven by digital technologies, e-commerce has become the foundation of online business operations, facilitating smooth transactions (Al Mashalah et al., 2022). Because of things like the growth of online channels and mobile apps that increase consumer convenience and value, the acceptability of the Internet has been gradually increasing (Chou and Shao, 2021). Online sales were predicted to reach USD 1034 billion in 2022, up 7.7% from 2021; this would make up 14.6% of total sales and demonstrate the significant impact of online shopping (US Census Bureau News, 2023). Traditional

brick-and-mortar stores continue to have special qualities that allow customers to interact physically with products for instant pleasure, even in the face of the increasing rise of online shopping (Ozbilge et al., 2022).

These days, customers have various options for completing their product and information demands, including in-store orders, mail-order returns, internet purchases, home shipments, showrooms, web rooms, and auctions (Hossain et al., 2020). Over the last ten years, store-based enterprises have evolved into dual-channel, cross-channel, multi-channel, and omnichannel (Raza and Govindaluri, 2021). A truly effective system depends on the degree of channel integration, which can be categorized as dual-channel, multichannel, cross-channel, or omnichannel (Saghiri et al., 2017). An effective omnichannel strategy requires complete integration and visibility across all channels,

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including order fulfilment, promotions, transactions, product/pricing information, reverse logistics, and customer service (Saghiri et al., 2018). Retailers use digitization to improve customer satisfaction, visibility, channel integration, and a seamless consumer experience (Soleim et al., 2023). Hagberg et al. (2016) state that this entails digitizing consumer contacts and logistical tasks to reconfigure supply networks. To improve customer service and operational productivity, many retail supply chains are integrating technology and data (Warner and Wäger, 2019). The goal is to create a cohesive and effective omnichannel strategy that meets modern customer expectations.

Innovations in technology are credited with the rise in popularity of omnichannel shopping (Cai and Lo, 2020). The use of digital tools such as Radio Frequency Identification (RFID) and Electronic Data Interchange (EDI) is essential for integration (Kurnia et al., 2015). It is important to concentrate on three areas to improve digital omnichannel commerce: awareness, transformation, and ecosystem (Ishfaq et al., 2022). In omnichannel retailing, Jena and Singhal (2023) discovered that supply chain profit and sustainability are increased by combining digitization, sustainability, and corporate social responsibility. Hafezi et al. (2023) highlights cooperative methods that involve sharing innovations and investment in the production of green commodities. According to Wang et al. (2021a), timing integrated production and transportation can reduce carbon emissions. Circular economy concepts are now incorporated into retail return systems for sustainability (Frei et al., 2020). Big Data Analytics (BDA) greatly improves the Sustainable Manufacturing Supply Chain (SMSC), according to Raj et al. (2023). The relationship between environmental cooperation and business performance is covered by Mishra et al. (2023). Table 1 provides an overview of these previous review articles, focusing on the interplay between omnichannel retailing, digitalization, and sustainability.

Numerous papers, like those by Ozbilge et al. (2022), Al Mashalah et al. (2022), Akbari et al. (2022), and de Borja et al. (2020), frequently address the relationship between digitalization and omnichannel retailing. However, they frequently ignore sustainability-related issues. It is difficult to compare the long-term sustainability of traditional and online retail because the environmental impact of packaging waste and vehicle emissions from online purchases outweigh the automobile emissions from in-store visits (Frei et al., 2020). In the Shippo e-commerce benchmarking report 2020, the average online shopping rate of return ranges from 20% to 30%. Returns have a high environmental cost, involving extensive energy consumption in transportation, re-manufacturing, and packaging (Pålsson et al., 2017). Through their online presence, Omnichannel retailers possess the power to influence consumer shopping habits (Lynch and Barnes, 2020). Various strategies have attracted customers, including timing, product selection, pricing, delivery, pick-up options, and customer assistance (Tueanrat et al., 2021). In recent years, many physical shops have transformed retail storefronts into a hybrid combination of updated physical layouts, digitalized warehouses, and low-emission delivery vehicles, all essential components of omnichannel commerce (Ozbilge et al., 2022). This innovative approach may provide solutions to the challenges of profitability and sustainability in omnichannel retailing. Therefore, to address the research mentioned above gaps, we propose the following research questions (RQs).

RQ1. How many articles have been published in years, journals, countries, ABDC categories, and citations in omnichannel retailing, digitalization, and sustainability?

RQ2. What research methods and theories are employed in omnichannel retailing?

RQ3. What strategies, policies, contracts and sustainability are considered in omnichannel retailing?

RQ4. What is the future direction for omnichannel retailing, digitalization, and sustainability?

This review provides detailed data and content analysis of articles

related to omnichannel retailing and how omnichannel retailing could be a sustainability hero. We used a data and content analysis of articles from reputable journals to address the abovementioned research. Content Analysis is one kind of qualitative research where subjective analysis of text data content uses a methodical coding and pattern-finding approach to uncover themes and patterns (Moldavska and Welo, 2017). Content analysis can be fragmented into quantitative and qualitative (Bengtsson, 2016). To address the above four RQs, Firstly, we present a complete quantitative content analysis that addresses how many research articles were published in a year in which journal, country, what category (ABDC) journal, and how many citations focus on the trend of omnichannel retailing growth to address RQ1. Secondly, we provide the word cloud analysis of the articles' keywords using Python (LitStudy) software. After word cloud analysis, we introduce qualitative content analysis which addresses articles' classifications based on research method, theory, strategy, policy, contract and sustainability to address RQ2 and RQ3. Lastly, we provide the future research direction to link omnichannel retailing to sustainability using digital technologies to address RQ4.

2. Methodology

This paper aims to identify significant work that combines omnichannel retailing, digital technologies, and sustainability. It seeks to categorize and identify considerable research in this area while uncovering research gaps that can inspire future studies. The method of content analysis encompasses both qualitative and quantitative research approaches. When using quantitative analysis, the answer to the query "how many" is usually provided in the form of frequency. Using categories, qualitative analysis provides data that facilitates text understanding (Bengtsson, 2016). Fig. 1 shows a methodology for article selection, which is carried out in 4 phases: Search criteria, Screening, Eligibility and Included.

2.1. Search criteria

To conduct our research, we utilized two major bibliographic databases, Scopus and WoS. Our study focuses on sustainable digital omnichannel retailing; we concentrate on the articles related to omnichannel retailing, digital transformation, and sustainability. To start the search, we incorporated the keyword "supply chain" with various like "reverse supply chain," "sustainable supply chain," etc., using the Boolean "OR" operator. Next, to explore digital shifts in the supply chain, we used the "AND" Boolean operator to search within and again, we used keywords like "E-Commerce", "Emerging Technology", "Industry 4.0", etc. To add the sustainability context to this, we again used the "AND" Boolean operator to search within and used keywords like "Digital Ecosystem", "Sustainability", "Sustainability Development Goals", etc. To gain insights into various supply chain drivers, we introduced additional keywords such as "Logistics", "Transportation", "Distribution", "Order fulfilment", etc. Additionally, we introduced the concept of Omnichannel using the "AND" operator with keywords like "Omnichannel Retailing", "O2O mode", "Channel Cooperation", etc. Given our focus on the fashion industry, we added specific keywords like "Fashion Retailing", "Fashion", and "Fashion supply chain". Lastly, we used the keywords "Optimization", "Modelling", and "Simulation", and we denoted this set as keyword 1.

Initially, the keyword 1 search in Scopus search yielded 335 articles; however, we did not find any matching articles with the exact keywords in WoS. Reviewing these 335 articles, we noticed that the statistical research methodology needed to be adequately represented. To address this, we conducted an additional search using the keywords "Omnichannel *" and "SEM" (keyword 2) to capture the structural equation modelling research methodology, which initially resulted in 55 articles in Scopus and 10 articles in WoS. We get 400 articles from 2 keywords (keywords 1 and 2) and databases (Scopus and WoS), as shown in

Table 1

Previous review articles in omnichannel retailing, digitalization, and sustainability.

Author	Journal Name	Number of papers	Year	Methodology	Focus on	Key findings
Sharma and Dutta (2023)	International Journal of Retail and Distribution Management	258	2014–2022	Bibliometrics and content analysis	Current status of omnichannel retailing studies	<ul style="list-style-type: none"> The majority of this study, according to the findings, focuses on supply chain operations and strategy, digitization, channel integration, and consumer behaviour.
Both and Steinmann (2023)	International Review of Retail, Distribution, and Consumer Research	64	Till May 2022	Thematic literature Review	Experience of customers in omnichannel retail environments	<ul style="list-style-type: none"> Identified the eight omnichannel retail streams and emphasizes how efficiency and smooth channel integration may improve the customer-centric experience.
Risberg (2023)	International Review of Retail, Distribution, and Consumer Research	373	2021	Systematic Literature Review (SLR)	E-commerce logistics the transition via multiple channels to omnichannel logistics	<ul style="list-style-type: none"> Determine the importance within supply as well as internal shipment, the last-mile consumer guidance, plus reverse logistics in the retailing transformation.
Ozbilge et al. (2022)	Information Systems and Operational Research (INFOR)	263	1998–2019	SLR	Focus on converting bricks to mortar to bricks to clicks	<ul style="list-style-type: none"> Channel competition among a manufacturer/supplier against a conventional merchant. In an omnichannel world, inventory management and demand fulfilment systems must be altered.
Akbari et al. (2022)	Journal of Global Operations and Strategic Sourcing	164	1997–2021	Bibliometric review	AR/VR applications in SCM and operations	<ul style="list-style-type: none"> Customers can be influenced to consider sustainability when shopping via AR-RAs (augmented reality-based recommendation agents) in physical establishments. Because of its capacity to improve the purchase experience and enjoyment of consumers, AR/VR might be applied in retail businesses.
Sahoo et al. (2022)	Electronic Commerce Research	146	Nov 2021 to Oct 2021	Bibliometric and SLR	Blockchain Technology Penetration in SCM	<ul style="list-style-type: none"> Blockchain may be used to assist long-term economic activity, decision-making systems, and intelligent modes of transportation.
Agrawal et al. (2023a)	Benchmarking	151	2004–2021	Conceptual Framework	Channel coordination for reverse supply chain (RSC)	<ul style="list-style-type: none"> The most often utilized method for channel coordination in RSC is game-theoretical modelling. RSC makes no mention of corporate social responsibility.
Al Mashalah et al. (2022)	Transportation Research Part E: logistics and transportation review	153	1999–2019	SLR	Digital transformation in e-commerce	<ul style="list-style-type: none"> Digital technology has also permitted retailing tactics that have widened the conversion of retailing from mono store to multichannel and from multichannel to omnichannel. Because of the significant energy consumption required in transportation, remanufacturing, and packing, returns are environmentally expensive.
Hong et al. (2022)	International Journal of Production Research	268	1999–2020	SLR	Interaction of FRC in Terms of Sustainability	<ul style="list-style-type: none"> New business approaches (such as the collaborative economics and the application of social media) and technologies (blockchain technology, computing on the cloud, big data, and 5G) are key to ensuring sustainability.
de Borba et al. (2020)	International Journal of Retail and Distribution Management	32	2018–2020	SLR	Omnichannel Retailing Returns barriers	<ul style="list-style-type: none"> Identified 43 reverse logistics difficulties in omnichannel retail. Some of the most significant impediments include high investments, product replenishing, higher transportation expenses, and poor communication.
Raza and Govindaluri (2021)	Benchmarking	500	2009–19	Bibliometric and SLR	Omnichannel Management	<ul style="list-style-type: none"> Customized and management of sales forces are the future of commerce. Delivery management, return administration, distribution framework, and e-fulfilment for last-mile delivery.
Boysen et al. (2021)	European Journal of Operational Research	–	–	SLR	Warehouse serving brick and mortar in comparison to e-commerce	<ul style="list-style-type: none"> Warehouse systems will be impacted by omnichannel commerce.
Senyo and Osabutey (2023)	International Journal of Production Research	64	–	SLR	Supply networks with many levels of sustainability	<ul style="list-style-type: none"> Businesses may become more sustainable by using emerging digital advancements like IoT, a blockchain, big data, and AI.
Paula et al. (2020)	Supply Chain Management	165	2000 to 2017	Bibliometric and SLR	Collaboration and trust in the supply chain and reverse logistics	<ul style="list-style-type: none"> In reverse logistics, collaboration, trust, and integration are not handled properly. Because it has a beneficial influence on the environment, returns management may be a value creation.
Cai and Lo (2020)	International Journal of Production Economics	192	2005–2019	SLR	Omnichannel Strategy implementation	<ul style="list-style-type: none"> Limited research on how new technologies play in omnichannel management.

(continued on next page)

Table 1 (continued)

Author	Journal Name	Number of papers	Year	Methodology	Focus on	Key findings
Garay-Rondero et al. (2020)	Journal of Manufacturing Technology Management	170	1989 to 2019	Conceptual Framework	Digital SC in Industry 4.0	<ul style="list-style-type: none"> SCMs are being digitalized as a result of innovative research, imaginative transformation, and Industry 4.0 technologies. Internal, external, functional, geographical, network, and IT integration all have the potential to improve the performance of the SC.
Janjevic and Winkenbach (2020)	Transportation Research Part A: Policy and Practice	–	–	Conceptual Framework	Distribution strategies for the last mile	<ul style="list-style-type: none"> Describe urban last-mile online shopping distributing tactics.
Choi et al. (2020)	Transportation Research Part E: logistics and transportation review	39	2019	Conceptual Framework	Social Media Analytic (SMA) makes use of blockchain-based technology.	<ul style="list-style-type: none"> SMA is critical operations and supply chain management. The usage of SMA for operations and networking might be improved by blockchain technology.
Author	–	99	2017–Oct 2023	Content Analysis	Integrated approach for omnichannel retailing, digitalization, and sustainability	<ul style="list-style-type: none"> To determine the relevance of omnichannel retailing in digitization as well as sustainability. To comprehend the theory and approach of the omnichannel supply chain. To determine the relevance strategy, contract, and policy in omnichannel retailing. Provide the future direction to integrate omnichannel retailing, digitization, and sustainability

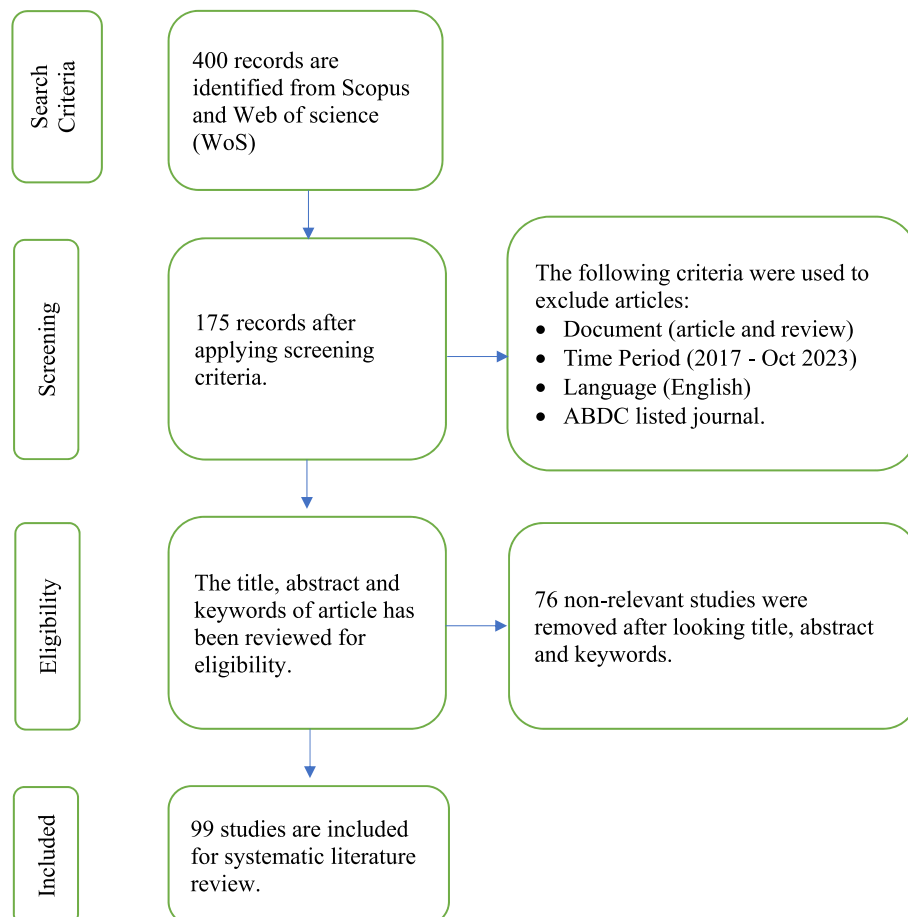


Fig. 1. Selection methodology.

Table 2

Keywords, databases, and their outputs.

Keywords	Scopus	Web of Science
Keywords 1	335	00
Keywords 2	55	10
Total	390	10
Grand Total	400	

Table 2. (Detailed keywords 1 and keywords 2 are mentioned in the supplementary material).

2.2. Screening

After applying various inclusion and exclusion criteria, we narrowed the selection to 175 articles. The first exclusion criterion is articles and review papers. Secondly, the period of the screen is from 2017 to Oct 2023. Thirdly, we restricted our study to the English language only. Lastly, focused on ABDC-listed journals, we filter based on the source excellence, with papers graded “A*”, “A,” “B,” and “C” by the Australian Business Deans Council included for review (Sahoo et al., 2022). So, after applying all these exclusion criteria, we got 175 articles, which were further refined in eligibility.

2.3. Eligibility

In the eligibility, we went through the title, abstract and keywords (TAK) analysis which includes, Article “titles” frequently offer a succinct synopsis of the content of the piece, “Abstracts” which provide a more thorough summary of the goals, procedures, findings, and conclusions of the study and lastly “keywords” which serve as crucial for determining the primary themes or subjects that an essay covers. To determine whether the content satisfies your research criteria, this stage is essential. We perform TAK analysis on all 175 articles we screened and found that 76 articles were non-relevant.

2.4. Included

There were 99 articles left in the final batch after the eligibility process, which would be included in the content analysis. This implies that these 99 articles satisfied the predetermined standards and were deemed the most appropriate for the research, which will be explained in the next section.

3. Content analysis

3.1. Quantitative content analysis

As mentioned in RQ1 we try to address quantitative content analysis by plotting a graph that demonstrates how many research articles were published in a year in which journal, country, what category (ABDC) journal, and how many citations, etc.

3.1.1. Data analysis based on year-wise distribution

Here, we show the graphs of reviewed literature as data analysis. Fig. 2 depicts the number of articles distributed from 2017 to Oct 2023. A graph demonstrating the total quantity of articles has increased over the past three years, indicating increased interest in this subject. After 2019, there has been exponential growth in the issue. The number of articles is expected to increase continuously as we notice 21 articles in ten months of 2023.

3.1.2. Data analysis based on ABDC category-wise

Fig. 3 shows the distribution based on the ABDC-listed journal. From the distribution graph, we found that there were 17 “A*” category journals, 59 “A” category journals, which is the highest, 17 “B” category, and 6 “C” category journals. (detailed ABDC categorization Table S1 attached in supplementary material).

3.1.3. Data analysis based on journal distribution

Fig. 4 depicts the journal distribution, which reveals that Transportation Research Part E: Logistics and Transportation Review have the most articles, which are 10. International Journal of Retail and Distribution Management and Journal of Retailing and Consumer Service have 9 articles, followed by other journals.

3.1.4. Data analysis based on research-wise distribution

A significant amount of quantitative research on omnichannel retailing has been identified in Fig. 5. Compared with quantitative analysis, the frequency of qualitative studies is less than half, and mixed-method studies are rare. For this reason, we believe that qualitative and mixed-method research needs specific extra attention.

3.1.5. Data analysis based on country-wise distribution

Fig. 6 depicts the study of research articles according to country contribution, which reveals that China has the most significant contribution in this sector with 30 articles, followed by India (15), the United States (8), Canada (5), the United Kingdom (4), Brazil, Malaysia, and South Korea (3).

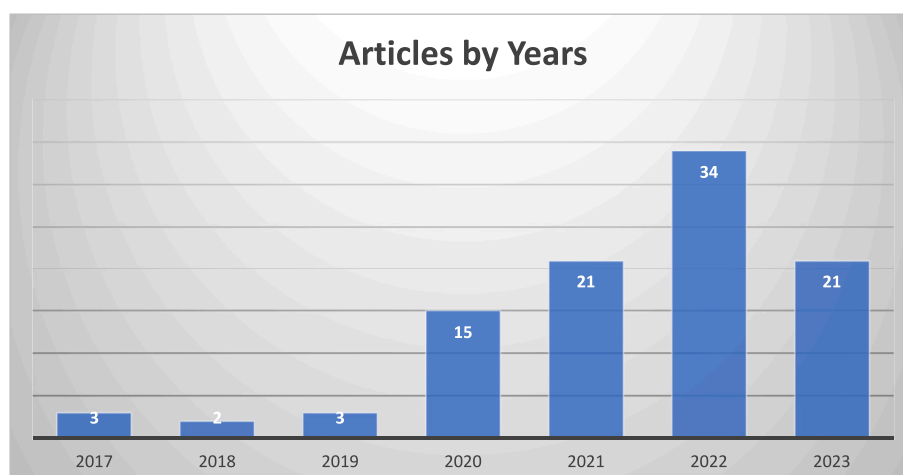


Fig. 2. Yearwise distribution of articles.

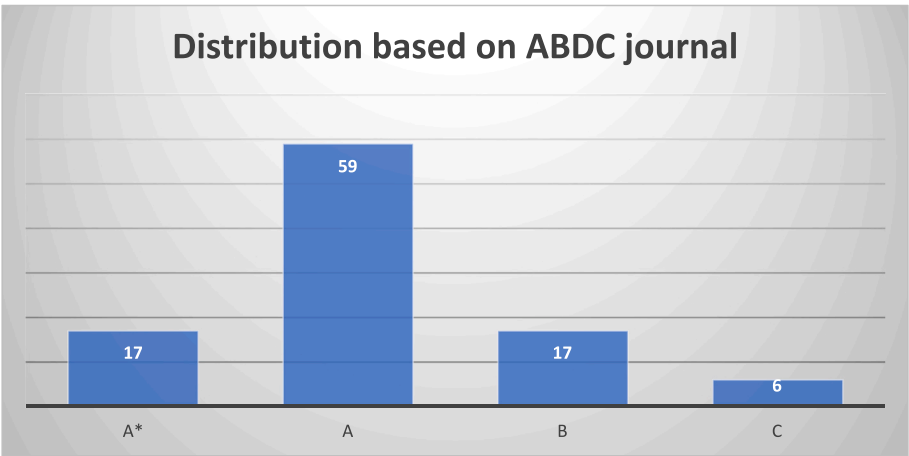


Fig. 3. Distribution based on ABDC journal.

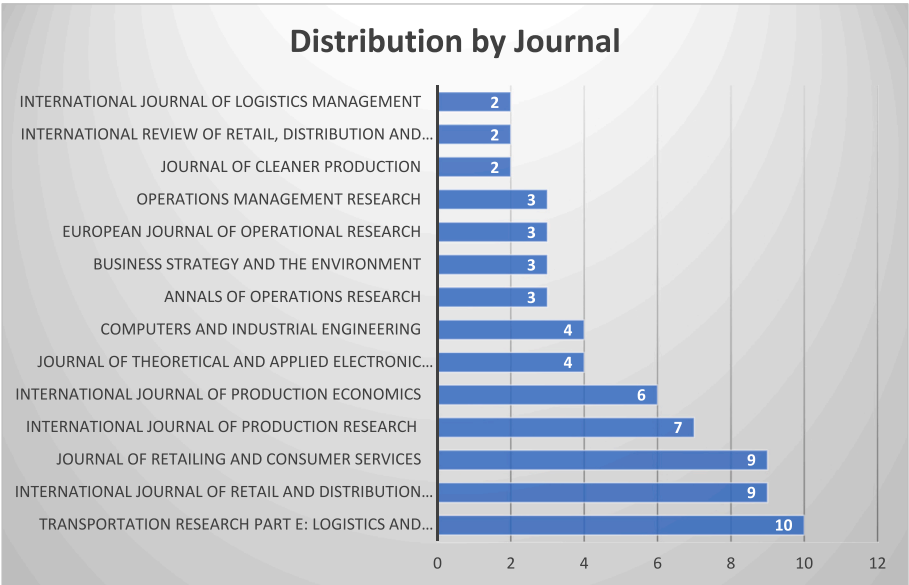


Fig. 4. Distribution by journals.

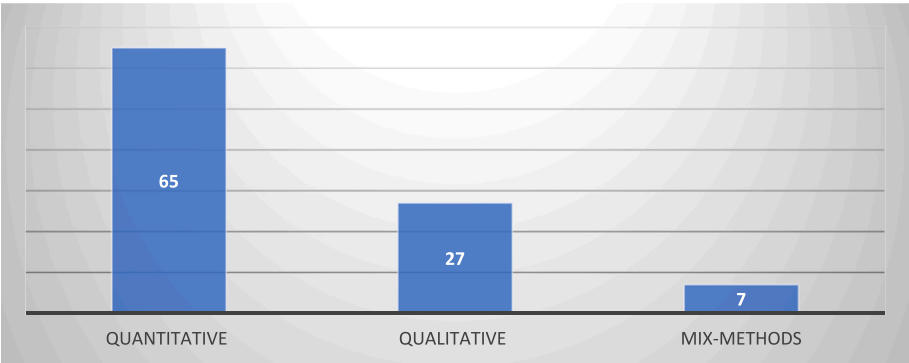


Fig. 5. Research method used in the articles.

3.1.6. Data analysis based on citationwise distribution

Fig. 7 shows the data analysis based on citations. We found 60 articles with citations between 0 and 10, 19 with citations between 11 and 30, 10 between 31 and 60, and only 2 articles have been cited above 150 times (detailed citations distribution Table S2 attached in supplementary

material).

3.2. Word cloud analysis

In this section, a word cloud topic modelling investigation was

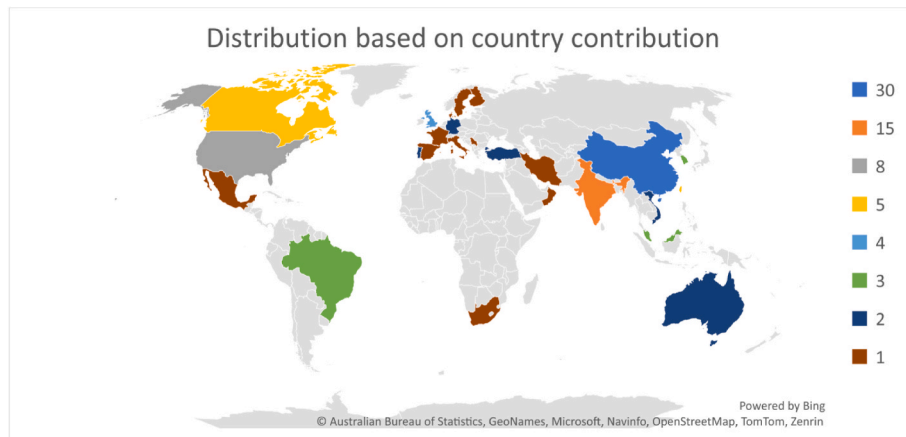


Fig. 6. Distribution based on country contribution.

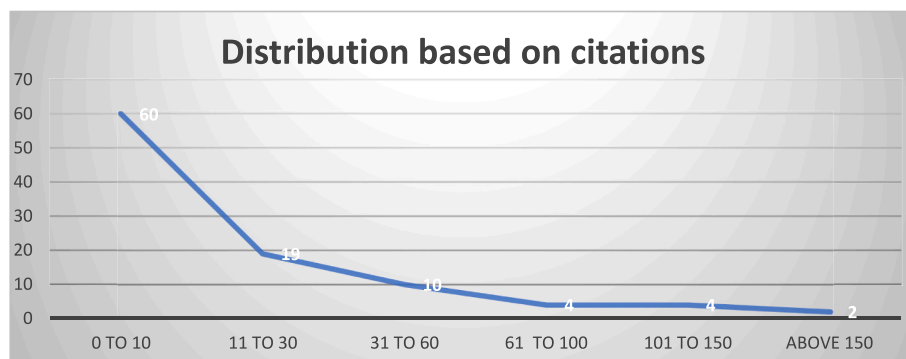


Fig. 7. Distribution based on country contribution.

carried out on the literature, and the resulting research clusters are presented. The initial step involved downloading the BibTeX file from Scopus and WoS, combining it using R software and converting it into CSV file format. The resulting CSV file of 99 articles was then utilized in three different software tools for conducting the network analysis, as detailed below. In our Python script or Jupyter Notebook, we employed the “LitStudy” Python package for literature study to extract the corpus of words used in the articles. This program makes it easier to choose scientific publications and evaluate their information using

visualizations and bibliography analysis of networks (Heldens et al., 2022). We use Non-Negative Matrix Factorization (NMF), an unsupervised approach for the corpus topic modelling. Unlike supervised methods, NMF does not require labelled subjects for model training. We have made clusters of author keywords to identify the keywords most commonly used in the literature. We successfully generated six distinct topic models visually represented in Fig. 8 by implementing this approach in Python.

Topic 1 consists of “omnichannel,” “engagement”, “collaboration”,



Fig. 8. Word cloud topic modelling in Python.

“loyalty” and “returns”.

Topic 2 consists of “customer”, “store”, “omnichannel”, “satisfaction”, “shopping”.

Topic 3 consists of “carbon”, “emission”, “manufacture”, “competition”, “remanufacturing”.

Topic 4 consists of “logistics”, “platform”, “ecommerce”, “strategies”, “green”.

Topic 5 consists of “blockchain”, “sustainability”, “review”, “literature”, “management”.

Topic 6 consists of “omnichannel”, “digital”, “framework”, “conceptual”, “review”.

One of the key findings from the word cloud analysis is the limited connections between author keywords related to omnichannel or omnichannel retailing and those related to sustainability or sustainability development. Most articles on omnichannel retailing focus on customer satisfaction, loyalty, and engagement, which leads us to contemplate whether omnichannel retailing could play a crucial role in sustainability efforts.

3.3. Qualitative content analysis

To address the RQ2 and RQ3, we analyze the articles in this part based on the research methodology, theory, strategy, contract policy and sustainability utilized to address the integration of omnichannel retailing, digitalization, and sustainability.

3.3.1. Analysis based on research method

The research method is classified into six major categories in Table 3. We categorized the numerous research papers according to the research methodologies they employed. Many of the studies used analytical, mathematical, and optimization models. Notably, the game theory model was mainly applied to pricing decisions in various contexts. Jena and Singhal (2023) used it for pricing decisions related to sustainability and digitalization, while Yamini and Gajanand (2023) applied it to access flexible return policies offered by manufacturers.

Similarly, Jena and Meena (2022) explored pricing decisions for the adoption of the CLSC, Xu et al. (2022) analyzed pricing decisions and sales-effort analysis of cross-channel returns, Liu et al. (2022) investigated free-riding behaviour, and Xia et al. (2023) studied financial decisions concerning the advocacy of low carbon supply chain. Furthermore, Qiu et al. (2022) probe pricing and quality strategies, and Liu et al. (2022) explored production choices for remanufacturing. Among optimization models, Wang et al. (2023) use genetic algorithms to minimize carbon emission and cost through integrated production and transportation, while Sarma et al. (2023) employed goal programming.

Statistical modelling, on the other hand, involves empirical survey analysis. For instance, Tran Xuan et al. (2023), Chen et al. (2022c), Pereira and Frazzon (2021), Son et al. (2021), Gao and Huang (2021), Zhang et al. (2022), Park and Kim (2022), Terblanche and Kidd (2021), Murfield et al. (2017), Song et al. (2019), Sorkun et al. (2020), Cotarelo et al. (2021), and Wang et al., 2022 investigated various aspects such as customer engagement, satisfaction, patronage intention, loyalty, channel integration quality, in-store service quality, logistics service quality, mobile shopping service quality, and omnichannel shopping value. Privacy concerns were addressed by Cheah et al. (2022) as moderating effects on patronage and trust in omnichannel retailing.

The use of AI/ML models was used in the following publications. Jauhar et al. (2023) used no-code intelligence to predict and minimize inventory distortions. Pereira and Frazzon (2021) suggested a data-driven strategy that blends machine learning techniques for predicting demand with simulation-based operational scheduling optimization. Gao and Fan (2021) used polynomial regression techniques to investigate the relationship between omnichannel customer involvement and support. Meanwhile, Li et al. (2021) used machine learning approaches such as decision forests, random forest models, and logistic

Table 3

Research methodology.

Research Method	Articles	Total
Analytical, Mathematical Model and Optimization model	Game Theory Models: He et al. (2023), Liu et al. (2023), Hafezi et al. (2023), Jena and Singhal (2023). Biswas et al. (2023), Yamini and Gajanand (2023), Sharma and Venkataraman (2022). Wan et al. (2022), Jena and Meena (2022), Wang et al., 2022, Xu et al. (2022), Liu et al. (2022), Wang and He, 2022, He et al. (2022), Hosseini-Motlagh et al. (2023), Agrawal et al. (2023), Zhao et al. (2022), Xia et al. (2023), Qiu et al. (2022), Niu et al. (2021), Liu et al. (2021a), Wu et al. (2021), Shen et al. (2021), Liu et al. (2021b), Xu et al. (2021), Li et al. (2021), He et al. (2020), Wu et al. (2020), Wang et al. (2020a), Jokar and Hosseini-Motlagh (2020). Wang et al. (2020b), Choi and Luo (2019), Yang et al. (2018)	33
Statistical Modelling	Goal Programming: Sarma et al. (2023)	1
	Genetic Algorithms: Wang et al. (2023)	1
Review	Nguyen et al. (2023), Wagner et al. (2023), Mukherjee et al. (2023), Tran Xuan et al. (2023), Chen et al. (2022c), Kumar et al. (2023), Upadhyay et al. (2022), Mishra et al. (2023), Aldrighetti et al. (2023), Cheah et al. (2022), Chen et al. (2022b), Lim et al. (2022), Zhang et al. (2022), Park and Kim (2022), Gao and Huang (2021), Yeh et al. (2022), Terblanche and Kidd (2021), Stojković et al. (2021), Son et al. (2021), Cotarelo et al. (2021), Ürgüplü and Yumurtacı Hüseyinoğlu (2021), Le and Nguyen-Le (2020), Omar et al. (2021), Lee (2020), Sorkun et al. (2020), Weber and Maier (2020), Aw (2019), Iyer et al. (2018), Huré et al. (2017), Murfield et al. (2017)	7
	SLR: Both and Steinmann (2023), Ozbilge et al. (2022), Chen et al. (2022a), Ayati et al. (2022), Hong et al. (2022), Boysen et al. (2021), Cai and Lo. (2020). SLR + Conceptual Framework: Sharma and Dutta (2023), Risberg (2023), Xu et al. (2023), Agrawal et al. (2023a,b), Al Mashalah et al. (2022), de Borja et al. (2020), Senyo and Osabutey (2023). Garay-Rondero et al. (2020), Janjevic and Winkenbach (2020), Choi et al. (2020)	10
AI-ML Methods	SLR + Bibliometric analysis: Gagliardi et al. (2023), Akbari et al. (2022), Sahoo et al. (2022), Raza and Govindaluri (2021), Paula et al. (2020)	5
	Jauhar et al. (2023), Pereira and Frazzon (2021), Gao and Fan (2021), Li et al. (2021).	4
Theoretical, Conceptual, and Hybrid methods	Ishfaq et al. (2022), Frei et al. (2020), Song et al. (2019), Saghir et al. (2017).	4
	Raj et al. (2023), Tsai and Hung (2021), Chowdhury et al. (2023), Luthra et al. (2022)	4

regression analysis to get insights into customers' online purchasing intentions. Other publications include reviews, hybrid research that combines qualitative and quantitative analysis, and multi-criteria decision-making (MCDM) methodologies. The current trend involves leveraging various digital technologies that collect big data, leading to the emergence of interdisciplinary models involving AI-ML, simulations, advanced data science tools, and more hybrid approaches.

3.3.2. Analysis based on the theory used in articles

The numerous theories used in publications are included in Table 4.

Table 4

Theory used in articles.

Theory	Description	Articles
Game Theory (28)	Most used for the decision making between two player manufacturer and retailer for adoption of various techniques.	He et al. (2023), Liu et al. (2023), Hafezi et al. (2023), Jena and Singhal (2023), Biswas et al. (2023), Yamini and Gajanand (2023), Sharma and Venkataraman (2022), Wan et al. (2022), Jena and Meena (2022), Wang et al., 2022, Xu et al. (2022), Liu et al. (2022), Wang and He, 2022, He et al. (2022), Hosseini-Motlagh et al. (2023), Agrawal et al. (2023), Zhao et al. (2022), Xia et al. (2023), Wang et al. (2023), Niu et al. (2021), Qiu et al. (2022), Liu et al. (2021a), Wu et al. (2021), Shen et al. (2021), Liu et al. (2021b), Xu et al. (2021), Li et al. (2021), He et al. (2020), Wu et al. (2020), Wang et al. (2020a), Jokar and Hosseini-Motlagh (2020), Wang et al. (2020b), Choi and Luo (2019), Yang et al. (2018), Chen et al. (2022b), Lim et al. (2022), Cheah et al. (2022), Ürgüplü and Yumurtacı Hüseyinoğlu (2021)
SOR model (4)	In psychology, the SOR hypothesis helps us understand why people behave the way they do	Liu et al. (2022), Zhao et al. (2022), Liu et al. (2021a)
Utility theory (3)	Utility theory deals with individual choices or principles, and the beliefs concerning those values or preferences that enable them to be mathematically described. (Fishburn, 1968)	
Social exchange theory (2)	One of the most significant conceptual frameworks in organizational behaviour is social exchange theory (Cropanzano and Mitchell, 2005)	Tran Xuan et al. (2023), Chen et al. (2022c)
Stakeholder theory (2)	The theory of stakeholder relations is a business approach that focuses the interconnected relationships between a firm and its consumers, suppliers, workers, investors, communities, as well as other stakeholders.	Agrawal et al. (2023), Luthra et al. (2022)
Resource Based Theory (2)	The resource-based theory states that the resources that are most appropriate for a company's long-term success are those that are valuable, rare, hard to replicate, and non-replaceable.	Luthra et al. (2022), Song et al. (2019)
Unified theory of acceptance (1)	The unified acceptance theory is used to examine how technology adoption will improve employee performance.	Mukherjee et al. (2023)
Theory of planned behaviour (1)	The concept of planned behaviour is used to determine if employees desire to utilize technology.	Mukherjee et al. (2023)

Table 4 (continued)

Theory	Description	Articles
TAM theory (2)	The technological acceptability models (TAM) are an information systems theory that outlines how people embrace and employ innovation.	Kumar et al. (2023), Mukherjee et al. (2023)
Structural contingency theory (1)	The influence of organizational structure on organizational performance, according to structural theory of contingency, is decided by how well the architecture satisfies the contingencies, such as uncertainty, strategy, and scale.	Ishfaq et al. (2022),
Grounded theory methodology (1)	A grounded theory aims to discover or construct theory via the use of evidence that has been collected deliberately and evaluated through comparative analysis.	Zhang et al. (2022)
Brand extension theory (1)	The launch of a new product which takes advantage on the fame and standing of a current item is known as brand extension.	Park and Kim (2022)
Theory of constraint (1)	The theory of constraints is an approach for identifying and improving the factors that are restricting your project.	Sarma et al. (2023)
Expectation disconfirmation theory (1)	The expectancy-disconfirmation model is now the accepted method for elucidating public service customer satisfaction.	Gao and Huang (2021)
Cooperate social responsibility theory (CSR) (1)	CSR is a business philosophy in which companies make a concentrated effort to help society and the environment rather than damage them.	Frei et al. (2020)
Psychological reactance theory (1)	Individuals are generally driven to restore freedom of choice when they believe their options are being curtailed, according to PRT.	Cheah et al. (2022)
Triple bottom line (TBL) (1)	TBL includes financial, environmental, social parameter.	Aldrighetti et al. (2023)

Game theory is used by Hafezi et al. (2023) to examine how competition affects the prices and quality of sustainable items. The trade-offs between blockchain adoption for sustainability and traceability are examined by Biswas et al., in 2023. Using game theory, Sharma and Venkataraman (2022) examine carbon price and remanufacturing in a two-tier supply chain. To create alternative e-commerce supply chains for online customer feedback, Wan et al. (2022) use blockchain. He et al. (2020) studied buy-online-and-deliver-from-store (BODS) techniques and their effect on supply chain profit. Channel preference and free-riding are two topics covered by Liu et al. (2022). Xu et al. (2022) consider cross-channel return and trade credit financing variables to optimize sales efforts and price decisions. Competition is examined in return for product collecting channels by Hosseini-Motlagh et al. (2023). The impact of blockchain technology on supply chain profitability and societal welfare is examined by Choi and Luo (2019).

Businesses that practice CSR (Corporate Social Responsibility) work together to improve the lives of people and the environment. (Frei et al., 2020) use CSR theory to investigate how the retail returns system incorporates ideas from the circular economy and sustainable practices. Stakeholder Theory, Carroll, and the Triple Bottom Line (Aldrich et al. (2023)) are essential CSR frameworks (Brin and Nehme, 2019). Stakeholder theory intertwines a company's relationships with its customers, suppliers, employees, investors, communities, and other stakeholders.

Chen et al. (2022b) investigated the effect of marketing collaboration on new patronage using the SOR paradigm. The impact of shop kinds on consumer perceptions of empowerment, satisfaction, trust, and channel integration was investigated by Lim et al. (2022). Ürgüplü and Yumurtacı Hüseyinoğlu (2021) investigated the relationship between customer empowerment and omnichannel capabilities and satisfaction. Liu et al. (2022) emphasized the importance of services in influencing channel preferences and customer valuation. Zhao et al. (2022) concentrated on coordinating CLSC under quality control for remanufactured products, considering the loss-averse character of retailers and producers.

Decisions in the interactions between retailers and customers are influenced by social exchange theory, which directs interpersonal ties through personalized cost-benefit analyses. Using this idea, Chen et al. (2022c) investigated omnichannel commerce from the viewpoint of the customer. Social exchange theory was utilized by Tran Xuan et al. (2023) to investigate the effects of omnichannel characteristics on brand engagement, trust, and commitment. Song et al. (2019) used resource-based theory, which emphasizes valuable, scarce, and hard-to-replicate resources for long-term success, to examine the relationships between supply chain integration practices, efficiency in the omnichannel business, and logistics integration abilities.

Stakeholder and resource-based theories were utilized by Luthra et al. (2022) to investigate the influence of cooperation on circular supply chain management. Mukherjee et al. (2023) used TAM for blockchain adoption in retail supply chains using UTAUT and the Theory of Planned Behaviour to assess the impact of technology on employee performance and desire to use it. Kumar et al. (2023) used TAM for IoT-based blockchain warehouse management.

Numerous organizational theories have been utilized in contemporary research. Supply chains were digitalized by Ishfaq et al. (2022) by using Structural Contingency Theory. Grounded Theory was used by Zhang et al. (2022) to comprehend consumer expectations in physical stores. Gao and Huang (2021) investigated the Expectation Disconfirmation Theory in omnichannel consistency, whereas Park and Kim (2022) applied the Brand Extension Theory. Supply-chain planning was done by Sarma et al. (2023) using the Theory of Constraints, while privacy concerns in omnichannel shopping were investigated by Cheah et al. (2022) using the SOR model and Psychological Reactance Theory.

3.3.3. Analysis based on the strategy, contract and policies

In this part, we analyze the articles based on the strategy, contract, and policy (detailed analysis of articles based on strategy, contract, and policy in Table S3 attached in supplementary material).

- a. **Omnichannel Retailing Strategy:** The TSBO strategy, as applied by Jena and Meena (2022), aids in making pricing decisions for a competitive and sustainable process in omnichannel CLSC. Ozbilge et al. (2022) discuss transitioning from physical to bricks-and-clicks retailers. For logistics services in online shopping, quality is determined by assessing the impact of four factors on customer loyalty (product timely delivery, availability, efficacy, and returns/exchanges). This evaluation employs tactics such as "Buy store and ship direct (BOSD)" and "Buy online pickup store" (BOPS), as investigated by Murfield et al. (2017) and Cotarelo et al. (2021). The buy-online-and-delivery-from-store (BODS) entails an organization selling items via the internet and in person and contracting an offline store to transport delivery from the store (He et al., 2020). Weber and
- Maier (2020) adopted the click-and-collect technique to eliminate comparison shopping.
- b. **Pricing Strategy:** Various contracts are employed to optimize pricing decisions for manufacturers and retailers while benefiting all participants and the broader networks. The two-part tariff contract involves dividing the price of a product or service into a bulk payment fee or a unit payment (Hosseini-Motlagh et al., 2023; Jena and Meena, 2022; Wang et al., 2020a). A wholesale pricing contract determines pricing based on the wholesale order quantity rather than per item (Zhao et al., 2022; Jokar and Hosseini-Motlagh, 2020). Revenue-sharing contracts require retailers to pay manufacturers a wholesale price for each unit ordered, as well as a percentage of sales produced by the retailer (Xu et al., 2022; Zhao et al., 2022; Wang et al., 2020b). A buyback contract involves an agreement between the retailer and (re)manufacturer on who will bear the cost of returning unsold merchandise (Jokar and Hosseini-Motlagh, 2020; Wu et al., 2021). These various contract strategies aim to achieve fairness and efficiency in pricing decisions throughout the supply chain.
- c. **Environmental impacts:** With a growing awareness of environmental deterioration, many companies are adopting environmentally friendly practices to minimize carbon emissions. Various schemes have been proposed to address this environmental concern, such as carbon taxation, which involves penalties imposed on businesses for excessive greenhouse gas emissions. Sharma and Venkataraman (2022) employed this policy to assess its impact on remanufacturing strategies and carbon emission reduction. The Clean Development Mechanism (CDM) is another approach to minimize pollution and achieve social responsibility objectives. Liu et al. (2021a) evaluated the pay-offs of logistics conflict on companies' CDM implementation techniques. Wang et al. (2023) address environmental regulation to study the economic motivations for merchants to collect old items under various legislation and channel authorities. Yang et al. (2018) reevaluated emission reduction decisions in setting cap-and-trade regulations by channel selection.
- d. **Return Policy:** Returns and order size are significant multipliers of e-commerce's environmental impact. Manufacturers offer flexible return policies to encourage shops to announce a forgiving return policy to their customers (Yamini and Gajanand, 2023). Wang and He, 2022 investigated the best modularity, price, channel strategies, and reimbursement policy in the supply chain's dual channels with mass customisation. Confente et al. (2021) explored how flexibility in return policies affects consumers' anxiety about risk and buy intent in two sales channels: offline and online (Wang et al., 2021b). In their work, Radhi and Zhang (2019) examined how the order quantities in each channel are impacted by resalable returns in a dual cross-channel return policy.
- e. **Resilience:** The ability of a system to recover after being deformed is referred to as resilience. The pandemic disrupted the apparel industry, exposing the vulnerabilities in textile supply. Chowdhury et al. (2023) used mitigation measures to address supply chain recovery in the garment sector.

Numerous strategies, contracts, and policies are discussed in the articles, such as TSBO, BOSD, BOPS, and BODS. Pricing contracts include two-part tariff contracts, wholesale price, buyback, and revenue-sharing agreements. Environmental impact regulations and policies encompass carbon taxation policies, clean development mechanisms, and cap-and-trade regulations. Additionally, specific articles explore various return policies and mitigation strategies. A combined approach can be utilized, which considers both environmental regulations and omnichannel retailing strategies. Furthermore, some articles investigate integrating omnichannel retailing strategies with specific pricing or return policies.

3.3.4. Analysis based on sustainability

Sustainability comprises three dimensions, namely economic, environmental and social. The main goal is to balance these three dimensions (Chen et al., 2022a). Integrating sustainable practices with business practices to establish an eco-conscious and responsible retail operation in omnichannel retailing entails taking a comprehensive strategy that considers environmental, social, and economic factors (Adivar et al., 2019). Returns are expensive for the environment since they need much energy for packing, remanufacturing, and shipping (Dutta et al., 2020). To address sustainability problems, several omnichannel retailers have embraced digital transformation solutions. To lessen the influence of returns on the environment and consumer anxiety (Frei et al., 2020), several shops have included AR/VR in their offerings by providing try-before-you-buy options (Akbari et al., 2022). Apart from utilizing modern technology (Biswas et al. (2023); Sahoo et al. (2022); Raj et al. (2023)), several e-commerce companies have also looked for methods to enhance their sustainability effects by boosting their operational effectiveness (Hong et al., 2022). Environmental imprints include energy use, CO2 emissions (Sharma and Venkataraman, 2022), and traffic delays (Upadhyay et al., 2022), all of which can worsen health. Table 5 shows the articles on sustainability's economic, environmental, and social impacts.

4. Discussion and research gaps

This methodology can subdivide into two fragments: the first is descriptive statistics and word cloud topic modelling, and the second is the content analysis, which is based on methodology, theories, strategies, policy, contracts, and sustainability considered in the articles.

We analyzed academic publications from 2017 to Oct 2023 using descriptive statistics. We discovered that articles related to Omnichannel Retailing have grown exponentially, and journals such as Transportation Research Part E (10) and the Journal of Retailing and Consumer Services published (9). Furthermore, we discovered that China has the most publications (30), followed by India (15). In the topic modelling analysis, we utilized author keywords and various software, such as Python, to analyze the word cloud and identify topic clusters. However, based on the word cloud, only a few of the author's keywords connected omnichannel, omnichannel retailing, sustainability, or sustainability development.

Through online platforms and digital technology, omnichannel retailers can offer extensive product information, including sustainable qualities like materials used, certifications, and production procedures (El Hilali et al., 2020). This transparency empowers consumers to make informed and sustainable purchase decisions while motivating retailers to prioritize environmentally friendly practices throughout their supply chains. Sustainable packaging practices, such as using recyclable or biodegradable materials, right-sizing packaging to reduce waste, and optimizing delivery routes for eco-friendly transportation, can also be

embraced by omnichannel retailers to further their sustainability efforts. However, after reviewing 99 articles, it was evident that most of the focus in omnichannel retailing research is on customer satisfaction, empowerment, engagement, patronage intentions, and pricing strategies related to technology adoption. The role of digitalization and e-commerce within omnichannel retailing has also been addressed to some extent.

Nonetheless, there is a need for more awareness and exploration of blockchain's potential impact in an omnichannel context. Additionally, a few articles touch only on sustainability and development in omnichannel retailing. Jena and Singhal (2023) note that the study of sustainable efforts in omnichannel retailing often neglects aspects such as product collection and reverse logistics, indicating opportunities for further investigation in these areas. According to Mishra et al. (2023), merchants can participate in environmental partnerships with their logistics suppliers to lessen the company's negative environmental effects. This emphasizes the possibility of better supply chain collaboration and ecologically conscientious retailing.

In the second section, we analyzed the articles based on methodology, theory, strategy, contract, policy, and sustainability. Most articles rely on the research methodology's analytical, mathematical, and optimization models. Game theory modelling is particularly prevalent for making pricing decisions between two key players: manufacturers and retailers. While some articles discuss sustainability issues like carbon emissions and the creation of green products, their main emphasis is still on supply chain profit maximization through price optimization. However, it is essential to recognize that in omnichannel commerce, few publications have addressed sustainability, green product creation, and carbon emissions. Jena and Meena's (2022) study, for example, looks at the payoffs of the TSBO omnichannel plan on the CLSC revenue while considering the retailer's and manufacturer's price rivalry. Mathematical modelling is a valuable technique for addressing sustainable omnichannel retail because it provides quantitative insights and allows a complete knowledge of the complex dynamics inside the system. Here are several approaches to overcoming the challenges of sustainable multichannel commerce using mathematical modelling.

- i. **Supply chain optimization:** Mathematical modelling can used to optimize SCM to reduce environmental consequences. These models may optimize transportation routes, inventory levels, and distribution strategies to minimize energy usage, emissions, and waste creation.
- ii. **Inventory management:** Mathematical modelling can be used to optimize inventory levels and ordering procedures to reduce waste and obsolescence. Models can assist retailers in determining appropriate order amounts, reorder points, and replenishment strategies by considering demand patterns, lead times, and product perishability.
- iii. **Resources allocation:** Mathematical models can efficiently distribute resources to suit client requests while minimizing waste and environmental damage. Based on demand estimates, capacity limits, and sustainability goals, models can optimize the distribution of employees, vehicles, and other resources across multiple channels and locations.
- iv. **Pricing and promotions:** Mathematical models can analyze pricing and promotional techniques to drive long-term customer behaviour. These models can investigate the influence of price incentives, discounts, and loyalty programs on customer decisions, considering aspects such as product environmental features and related costs.
- v. **Consumer behaviour:** Mathematical models can be addressed to analyze consumer behaviour and controlling processes about sustainable omnichannel retailing. To forecast adoption rates of sustainable practices, these models might combine customer preferences, perceived value of sustainability, and responsiveness to various marketing activities.

Table 5
Sustainability impacts.

Sustainability Impact	Author	Total
Economical	Jena and Singhal (2023), Sahoo et al. (2022), Chen et al. (2022a), Jena and Meena (2022), Upadhyay et al. (2022), Mishra et al. (2023), Aldrighetti et al. (2023), Xu et al. (2022), Frei et al. (2020), Wu et al. (2020),	10
Environmental	Hafezi et al. (2023), Sahoo et al. (2022), Chen et al. (2022a), Sharma and Venkataraman (2022), Mishra et al. (2023), Aldrighetti et al. (2023), Xia et al. (2023), Wang et al., 2022, Liu et al. (2022), Frei et al. (2020), Wang et al. (2020b), Yang et al. (2018).	12
Social	Biswas et al. (2023), Raj et al. (2023), Sahoo et al. (2022), Hong et al. (2022), Aldrighetti et al. (2023), Senyo and Osabutey (2023)	7

- vi. **Simulation modelling:** Mathematical simulation models can replicate the behaviour of complex systems to assess the various tactics and interventions. Simulation models, for example, can assess the impact of installing sustainable packaging, modifying distribution networks, or introducing new technologies on sustainability performance.
- vii. **Lifecycle assessment:** Lifecycle assessments (LCAs) can be performed using mathematical models to measure the environmental implications of various retail operations and initiatives. LCAs consider the entire product lifespan, from raw material extraction to disposal, and can assist in identifying areas with the most significant environmental effects and informing decision-making for long-term changes.

Mathematical modelling should be created using appropriate data, assumptions, and stakeholder feedback. The models should be verified against real-world data and modified to increase accuracy and relevance.

We also find statistical modelling is used in many articles that address customer satisfaction, customer loyalty, customer engagement and patronage intentions with various parameters like logistics service quality, in-store service quality, type of retailer, and privacy concerns. However, we find only one article that addresses the concerns of environmental collaboration and supply chain performance, with responsible consumption and production acting as a buffer (Mishra et al., 2023). To address sustainable omnichannel retailing, surveys can be a valuable tool to collect quantitative information from many individuals. Valuable insights can be gained by designing a survey instrument that captures critical factors of sustainable omnichannel retailing, including customer behaviours, preferences, and attitudes towards sustainable practices. Additionally, conducting interviews with industry experts, store managers, and customers can provide further valuable perspectives on sustainable omnichannel retailing practices. Semi-structured interviews offer in-depth discussions and investigations into specific topics or concerns. Analyzing real-world case studies of sustainable omnichannel retailing efforts can be immensely beneficial to gain a comprehensive understanding. Selecting a few retail organizations that have successfully integrated sustainable practices across their omnichannel operations and studying their strategies, challenges, and outcomes can offer rich and thorough information. A more holistic understanding of sustainable omnichannel retailing can be achieved by combining research methodologies, such as surveys and interviews. Compiling results from qualitative and quantitative data sources enables a more thorough and complete understanding of the topic.

The current data sets linked to retail operations, customer behaviour, or sustainability can be analyzed to uncover patterns and linkages. Quantitative approaches such as regression analysis, clustering, or data mining may be used to uncover relevant features and patterns. The omnichannel business gives merchants a single picture of their inventory across several channels. This aids in optimizing stock levels, eliminating overstocking and stockouts, and lowering waste. Retailers may minimize wasteful production and reduce the environmental effects associated with excess manufacture and the disposal of unsold items by correctly managing inventories. In addition, simulation-based studies should be incorporated into research to investigate the consequences of omnichannel shopping on carbon dioxide emissions, establish metrics to measure these environmental effects, and discover novel techniques to reduce them. More mathematical and empirical research is required to fully comprehend the significance of technologies like IoT, AI, ML, data science, AR/VR, and SMA in omnichannel retailing, even if this field of study is constantly developing. For better customer involvement and fulfilment, a higher level of awareness is necessary (Al Mashalah et al., 2022).

The predominant theory employed in the articles is game theory, which addresses pricing and profit-making decisions related to adopting various technologies and conditions. Other theories utilized in the

articles include the SOR model, Utility theory, Resource-Based Theory, UTAT, TAM, etc. CSR is frequently used to address sustainability concerns. However, there is a need for more articles focusing on environmental issues such as sustainability, green product development, and carbon emissions. The review findings reveal that many empirical studies need a stronger theoretical foundation to support their conclusions. Future studies should evaluate omnichannel retailer sustainability performance by applying the TBL theory, considering profitability and responsibility towards social and environmental stewardship in omnichannel retailing. Retailers can embrace sustainable practices by adopting circular economy principles, encouraging repair and refurbishment services, implementing product take-back programs, and utilizing recycled or recyclable materials in packaging and products. Applying Cradle to Cradle concepts involves selecting recyclable materials and designing items for disassembly and recyclability. Working with suppliers in omnichannel retailing can achieve ethical sourcing practices, waste reduction, optimized transportation routes, and sustainability across the supply chain. Stakeholder theory also plays a vital role in omnichannel commerce sustainability initiatives, where engaging with stakeholders and incorporating their views can lead to long-term projects and progress towards sustainability goals. Future studies must establish theories specifically connected to omnichannel retail research to address diverse problems from retail, environmental, and customer perspectives using grounded theoretical techniques (Asmare and Zewdie, 2022).

Among various omnichannel retailing strategies, some notable ones mentioned in the articles are TSBO, BOSD, BOPS, BSSD, and BODS. Omnichannel retailers may leverage Internet platforms to improve their supply chains and reduce transportation-related emissions (El Hilali et al., 2020). Using strategies like ship-from-store or click-and-collect increases productivity and lowers emissions. Furthermore, encouraging practices such as BOPS can reduce reverse logistics emissions while increasing product lifespans. Furthermore, the relevant literature has studied several pricing agreements, including two-part tariff, wholesale price, buyback, and revenue-sharing agreements. Along with these contractual issues, studies have focused on environmental effect rules and policies such as carbon taxes, clean development methods, and cap-and-trade legislation. A combined approach, considering environmental regulations alongside omnichannel retailing strategies and pricing or return policies, is suggested for future use.

While omnichannel retailing may not be able to solve all sustainability problems, it can serve as a valuable tool in encouraging more sustainable practices in the retail business. Omnichannel shopping may be used to optimize processes, minimize waste, and equip consumers with knowledge; you may help to create a more sustainable and environmentally friendly purchasing experience.

5. Managerial implications

5.1. Theoretical implications

There needs to be more theoretical support for the findings of the empirical research already done in omnichannel retail. It is critical for academics to develop solid theoretical frameworks that support their work to progress our knowledge of multichannel retail's various difficulties—from the retail, environmental, and customer viewpoints. Establishing a solid theoretical foundation for empirical research improves the study's credibility and offers a thorough and organized framework for interpreting and analyzing the results. Through this approach, scholars may enhance the advancement and improvement of theoretical viewpoints unique to omnichannel retail, enhancing the scholarly conversation in this field.

Furthermore, it is becoming increasingly clear that modern SCM issues must be addressed. Scholars must investigate and incorporate contemporary issues into their work as the retail industry changes. This includes, among other things, understanding how online advertising

affects consumer behaviour, assessing the outcomes of environmental sustainability initiatives, and looking at CSR in omnichannel retailing. In order to fully understand the consequences of these emerging SCM concerns, which are essential parts of the omnichannel retail ecosystem, careful consideration must be given. In order to give a comprehensive knowledge of the dynamics in the contemporary retail environment, future research projects should not only close the theoretical gap but also take these contemporary features into account. By doing this, academics may provide insightful information that benefits academia and business, promoting advances in omnichannel retail theory and practice.

Addressing the need for more research on the connection between carbon emissions and an omnichannel retailing supply chain is essential for sustainable business practices. Subsequent research endeavours need to concentrate on comprehending how digitalization impacts carbon footprints, therefore requiring the establishment of resilient techniques to measure environmental impacts and the creation of creative policy approaches. Giving simulation-driven research and analysis of the environmental effects of product mobility priority is crucial. This entails assessing environmentally friendly transportation solutions in various urban and rural situations and providing merchants and customers with insightful information. Through investigating these facets, scholars might significantly add to the discourse around ecologically responsible retail methods and foster a more profound understanding of the complex connection between omnichannel activities and carbon footprints.

A comprehensive grasp of disruptive technologies such as the IoT, AI, ML, data extraction, AR/VR, text mining, and SMA is necessary, given the dynamic nature of omnichannel retail. Although this field's research has advanced significantly, there is an increasing awareness that a more thorough understanding requires a greater emphasis on data-driven and empirical studies. These technologies are essential for improving consumer satisfaction and engagement, emphasising the need for thorough empirical research to understand their ramifications properly. To maximize the advantages of digital transformations, integration in the omnichannel retail experience and to inform strategic decisions, a thorough empirical research investigation of these technical aspects is essential as the retail sector continues to change.

5.2. Practical implications

Retailers are increasingly realizing how important it is to adopt omnichannel retailing methods, which combine online and physical channels seamlessly. This strategy necessitates significant technical investments for physical establishments to enhance the whole shopping experience for customers. To ensure that commodities are available when customers need them and to optimize inventory management, data-driven solutions for consumption scheduling and replenishment must be used. Employing novel digitization strategies, such as RFID technology, automated checkout processes, and smart shelves, enables merchants to maintain competitiveness in the quickly changing retail environment. Even with all of the attention that technology is receiving, merchants must continue to focus on customer happiness and ensure that technology adds to the shopping experience rather than takes away from it. Retailers should also consider how their digitization initiatives may affect the environment and work to include sustainable practices in their plans. Retailers may position businesses for longevity in the quickly changing retail sector by matching their technological investments with consumer preferences and environmental concerns.

The dynamic nature of contemporary trade makes it imperative for merchants to measure emissions meticulously during transportation and storage. Retailers are uniquely positioned to offer a better omnichannel consumer experience while supporting sustainability since they understand how crucial it is to support eco-friendly activities. Retailers need to make investments to create and maintain high standards for customer service in order to do this. By doing this, they support the broader objective of creating an ethical retail environment in addition to meeting the needs of a client base that is becoming more knowledgeable.

Retailers must expedite everyday shipment and return procedures since the omnichannel strategy becomes a strategic means of engaging environmentally conscious and well-informed customers. This entails implementing effective Supply Chain Management (SCM) practices that raise overall operational efficiency while lowering the carbon footprint. Motivating employees to continuously aim for the best possible customer experiences across the omnichannel retail journey is essential. It requires a culture that appreciates and places a high priority on customer satisfaction—from the time a product is dispatched to how simple returns are. A mutually beneficial partnership between consumers and retailers becomes critical in the last struggle for dominance inside the global retail ecosystem. They may work together to create a retail environment that is long-term lucrative, ethical, and sustainable by encouraging each other's expansion and sustainability initiatives.

6. Future research directions

Future research directions for sustainable omnichannel commerce can aid in identifying new difficulties and novel solutions. This section outlines significant areas where academics interested in omnichannel retailing, digitalization, and sustainability might conduct research.

1. **Technology and innovation in omnichannel retailing:** Examine the role of AI, blockchain, IoT, etc. In supporting sustainable omnichannel retailing. Investigate how these technologies may boost efficiency, traceability, transparency, and environmental performance throughout the retail value chain. Retailers require potent systems and technology to manage inventory levels across several channels and give customers up-to-date product availability information. RFID, barcodes, and inventory management systems can all help to improve visibility and enable successful order fulfilment.
2. **Data analytics in omnichannel retailing:** Investigate how modern data analytics approaches, such as ML, predictive modelling, and optimization algorithms, may be used to achieve long-term omnichannel commerce success. Provide decision-making instruments that leverage big data to estimate customer demand, and improve the management of stocks, all while keeping sustainability objectives in mind. Using data analytics and predictive analytics to optimize transportation, logistics, and warehousing in omnichannel commerce can give important information. Retailers may make more informed judgements, enhance forecasting accuracy, and optimize inventory levels and resource allocation by analyzing historical data, demand trends, and consumer behaviour.
3. **Transportation and reverse logistics:** Efficient transportation ensures timely product delivery across many channels. Retailers must optimize transportation routes, modes, and schedules to decrease costs, reduce emissions, and satisfy consumer expectations. Using a combination of carriers, route optimization algorithms, and contemplating alternate delivery techniques such as crowdsourced or micro-fulfilment centres are all possibilities. Reverse logistics, including product returns and swaps, is essential to omnichannel commerce. Efficient reverse logistics process management, such as product collection, inspection, refurbishing, and redistribution, is critical for reducing waste and optimizing resource utilization. Retailers could expedite operations and incorporate environmentally friendly disposal or recycling options for returned merchandise.
4. **Last-mile delivery in omnichannel retailing:** Last-mile delivery has the potential to become one of the costliest and environmentally harmful parts of the supply chain. Retailers are looking into different options, such as installing electric cars, utilizing local pickup points or lockers, and leveraging intelligent delivery technology and alternative delivery options (e.g., drones) to improve efficiency and minimize carbon emissions in the final leg of product delivery. Investigate various delivery options' environmental, social, and economic effects to reduce carbon emissions and enhance efficiency.

5. **Sustainable packaging and waste reduction in omnichannel retailing:** Research environmentally friendly packaging materials, designs, and waste reduction solutions. Investigate activities to encourage reusable packaging, minimum packaging, and environmentally friendly materials. Examine how customer attitudes, acceptance, and behaviour have changed in relation to sustainable packaging options. Also, consider how retailers may reduce their carbon footprint by utilizing environmentally friendly containers, streamlining shipping processes, and investing in energy-efficient warehouse layouts and systems. Furthermore, environmentally friendly practices such as consolidation centres, pooled transportation, and reverse logistics optimization can help to reduce environmental effects.
6. **Warehouse automation and robots in omnichannel retailing:** Automation technologies such as robots, automated guided vehicles (AGVs), and warehouse management systems (WMS) can improve warehousing efficiency, accuracy, and speed. These technologies can help with order picking, inventory management, and fulfilment procedures, reducing labour needs and improving overall operational performance.
7. **Circular economy in omnichannel retailing:** Investigate how circular economy ideas might be included in omnichannel commerce practices. Investigate resource conservation, waste reduction, and product lifecycle extension solutions for product design, reverse logistics, remanufacturing, and recycling. Also, investigate collaborative relationships and business strategies that support the circular economy concepts in omnichannel retailing. Investigate product take-back programs, recycling networks, and reverse logistics optimization tactics to reduce waste, stimulate product reuse, and support a more sustainable product lifetime.
8. **Customer engagement and experience with omnichannel retailing:** Investigate techniques for educating and engaging customers in sustainable consumption habits. Examine the efficacy of sustainability-focused marketing campaigns, personalized suggestions, and eco-feedback systems in raising awareness and encouraging sustainable choices across various retail channels. Investigate how to establish a consistent and long-lasting consumer experience across numerous media. Investigate new technologies and techniques for integrating physical stores, online platforms, and mobile apps, emphasising decreasing friction, increasing convenience, and providing consistent sustainability messaging.
9. **Stakeholder collaboration and channel integration in omnichannel retailing:** Analyze the responsibilities of various stakeholders in encouraging sustainable omnichannel retailing, such as retailers, suppliers, customers, policymakers, and so on. Investigate collaborative methods, incentive structures, and governance frameworks in the retail business that stimulate collective action and promote sustainability. Examine strategies and tactics for integrating e-commerce sites, mobile apps, physical shops, and other channels smoothly and sustainably. Investigate how merchants may use omnichannel capabilities to minimize carbon emissions, increase resource utilization, and boost customer satisfaction.

7. Conclusion

Omnichannel retailing is widely recognized as a cornerstone of SCM, playing a critical role in digitization, distribution, and logistical control. The significant increase in research publications highlights the critical necessity of omnichannel commerce. We rigorously evaluated 99 research publications in our analysis, methodically documenting various aspects of the digital revolution inside omnichannel shopping and its far-reaching implications for sustainability. Notably, we saw an exponential rise in the number of articles published in this sector and data analysis provides the proper distribution of these articles based on various factors.

We also discovered that most publications employed game theory

models for pricing decisions to maximize total supply chain profitability by adopting particular technologies, environmental standards, and contracts. After that, we find that statistical modelling is most frequently used to address consumer satisfaction, loyalty, engagement, and patronage intentions. We also found that most empirical investigations need more theory to support their findings. The articles lag using a combined method that considers sustainability while employing an omnichannel retailing strategy. So, we provide the possible future direction in the relevant area with research opportunities for academics interested in omnichannel retailing, digitalization and sustainability.

Our findings and recommendations will serve to develop the subject and motivate other researchers to address the gaps that have been identified. This study suggests intriguing future directions for scholars and practitioners interested in omnichannel retailing, digitalization, and sustainability. This review also offers value by summarizing contemporary innovations in omnichannel retailing, digitalization, and sustainability.

8. Limitations and future scope

This study has a few limitations, some of which could lead to intriguing future research. First, there are all-inclusion criteria of this paper, which insights this review as confined to those published in "A*" or "A" or "B" or "C" journals, which are only recently available. Data is gathered using the Scopus and WoS databases; some essential research papers may need to be included in this collection. Secondly, a number of noteworthy publications, such as books and papers from conferences, may have been neglected. We also exclude publications that focus on "government sponsors", "government subsidies", and "charity organizations, among other topics that may yield fascinating future studies.

CRedit authorship contribution statement

Manjunath S. Vhatkar: Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Rakesh D. Raut:** Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Ravindra Gokhale:** Writing – review & editing, Formal analysis, Data curation, Conceptualization. **Naoufel Cheikhrouhou:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization. **Milind Akarte:** Writing – review & editing, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

I am Manjunath S. Vhatkar, the corresponding author for the submitted manuscript titled "A Glimpse of the Future Sustainable Digital Omnichannel Retailing Emerges - A Systematic Literature Review."

On behalf of all the authors of this manuscript, I disclose that this paper has NO financial or personal relationship with people or organizations that could inappropriately influence or bias the contents of the paper and research.

Data availability

No data was used for the research described in the article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jclepro.2024.141111>.

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