

## **EVOLVING SUPPLY CHAIN MANAGEMENT FROM INDUSTRY 4.0 TO INDUSTRY 5.0: A SYSTEMATIC REVIEW OF BLUE OCEAN STRATEGY IN SOUTH AFRICAN ENTERPRISES**

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### **ABSTRACT**

*This systematic review provides investigation into the evolution of Supply Chain Management (SCM) practices from Industry 4.0 to Industry 5.0 in South African enterprises, with a specific focus on the integration of Blue Ocean Strategy. Industry 5.0 marks a significant shift towards more personalised, sustainable, and human-centric industrial practices, leveraging advanced technologies to improve operational efficiency and address environmental concerns. The research aims to investigate how SCM practices in South African firms are transforming under the influence of Industry 5.0 paradigms and to assess how the Blue Ocean Strategy can bolster competitiveness, operational efficiency, and sustainable growth.*

*Adopting a comprehensive methodology, this study systematically reviewed peer-reviewed articles from 2019 to 2023. Employing the PRISMA framework for structured literature review, and thematic analysis using Atlas-ti 24 software, the research scrutinised the evolution of SCM practices, focusing on technological adoption, strategic innovation, and sustainability integration.*

*The findings reveal that South African firms are progressively adopting Industry 5.0 technologies, integrating them within SCM to improve flexibility, responsiveness, and sustainability. The application of Blue Ocean Strategy is identified as a catalyst for creating uncontested market spaces and driving innovation, which not only improves the firms' market position but also aligns with sustainable business practices. However, challenges such as technological integration complexity, high transition costs, and the need for skilled human resources are notable impediments.*

*This research significantly contributes to academic literature by providing a nuanced understanding of the SCM evolution in the context of Industry 5.0 within emerging markets, particularly focusing on South African enterprises. It also offers practical insights for industry practitioners on leveraging Blue Ocean Strategy alongside Industry 5.0 technologies to achieve competitive advantage and sustainable growth. The study underlines the need for policy interventions to support technological adaptation and capacity building in the SCM sector, suggesting avenues for future research on overcoming the barriers to Industry 5.0 adoption.*

**Keywords:** Blue Ocean Strategy; Digital Transformation; Industry 4.0; Industry 5.0; South African Enterprises; Supply Chain Management.

*JEL Classification: L21, D81, H83*

### **1. INTRODUCTION**

#### **1.1 Background: the evolution from industry 4.0 to industry 5.0**

##### **Objectives and Significance**

Research objective: The primary objective of this research is to systematically review and analyse the evolution of supply chain management (SCM) practices as South African enterprises transitions from Industry 4.0 to Industry 5.0, specifically focusing on the integration of Blue Ocean Strategy. This study aims to identify

how these practices improve competitiveness and operational efficiency, address new market demands, and contribute to sustainable business growth.

Research question: How do supply chain management (SCM) practices evolve in South African enterprises as they transition from Industry 4.0 to Industry 5.0, and how does the integration of Blue Ocean Strategy improve competitiveness, operational efficiency, address new market demands, and contribute to sustainable business growth?

## **2.LITERATURE REVIEW**

### ***Overview of industry 4.0 and 5.0***

Industry 4.0 and 5.0 signify significant advancements in the industrial sector, with each being defined by unique fundamental technology and business approaches. Industry 4.0, which was first proposed by Yang et al. (2022) centres around cyber-physical systems and advancements in services (Maresova et al., 2018). The fundamental technologies supporting Industry 4.0 encompass 3D printing, big data analytics, cloud computing, Internet of Things (IoT), and robotics (Ali & Xie, 2021). This phase focuses on the use of digital technologies into manufacturing processes to improve efficiency and productivity. Industry 5.0 centres around Human-centric smart manufacturing (HCSM), which provides the collaboration between humans and machines in the manufacturing setting (Yang et al., 2022). The shift from Industry 4.0 to Industry 5.0 is a transformation towards smart production that prioritises human-centered approaches. Technological capabilities are key in both Industry 4.0 and Industry 5.0. In Industry 4.0, these capabilities are used to gain a competitive advantage through technological differentiation. On the other hand, Industry 5.0 emphasises the interaction between humans and machines to improve manufacturing processes. The transition from Industry 4.0 to Industry 5.0 signifies a shift towards industrial practices that are more interconnected and focused on human needs. This emphasises the significance of fundamental technology and inventive approaches in influencing the future of manufacturing industries.

### ***Supply chain management practices***

The practices of Supply Chain Management (SCM) have seen substantial changes with the emergence of Industry 4.0. This period is defined by the incorporation of digital technologies into many facets of supply chain operations (Bienhaus & Haddud, 2018). Industry 4.0 has caused significant changes in supply chain management (SCM), with a focus on integrated planning and execution, logistical visibility, smart warehousing, and sophisticated analytics (Bienhaus et al., 2018). Through using Industry 4.0 technologies such as big data analytics and sustainable development, companies have been able to improve their abilities and competitiveness in global supply chains (Ngetich et al., 2022). The adoption of circular supply chain management (CSCM) has arisen as a solution to address the requirements of sustainability and resource efficiency in supply chain management (Zhang et al., 2021). Circular supply chain management (SCM) practices prioritise the establishment of closed-loop systems that minimise waste and encourage the reuse of resources (Zhang et al., 2023).

### ***Blue ocean strategy***

Through the incorporation of the Blue Ocean Strategy into Supply Chain Management (SCM) practices, it is possible to generate innovative value propositions. The Blue Ocean Strategy is centred around the creation of market spaces that have no rivalry, achieved by implementing value innovation. By integrating this strategy into supply chain management (SCM), companies can discern innovative market prospects and build inventive value propositions that distinguish them from rivals (Christodoulou & Langley, 2019). This approach entails the exploration of innovative methods to provide value to customers while concurrently decreasing expenses. By implementing the principles of Blue Ocean Strategy, companies can distinguish themselves in the market and get a competitive edge by providing distinctive value propositions that strongly appeal to customers (Christodoulou et al., 2019).

When incorporating Blue Ocean Strategy into supply chain management (SCM), it entails expanding the limits of the industry, researching uncontested market sectors, and establishing innovative value chains that are in line with customer requirements and preferences (Christodoulou et al., 2019). This strategy requires that companies prioritise the generation of value instead of engaging in rivalry, so prompting them to explore innovative ideas beyond the conventional confines of their respective sectors. Companies able to discover uncontested avenues for expansion and create value propositions that cater to unfulfilled customer needs by embracing a Blue Ocean approach (Geissdoerfer et al., 2018).

### 3. METHODOLOGY

#### 3.1 Systematic review process

This study systematically reviews and analyse the evolution of supply chain management (SCM) practices as South African enterprises transitions from Industry 4.0 to Industry 5.0, specifically focusing on the integration of Blue Ocean Strategy. This study aims to identify how these practices improve competitiveness and operational efficiency, address new market demands, and contribute to sustainable business growth.

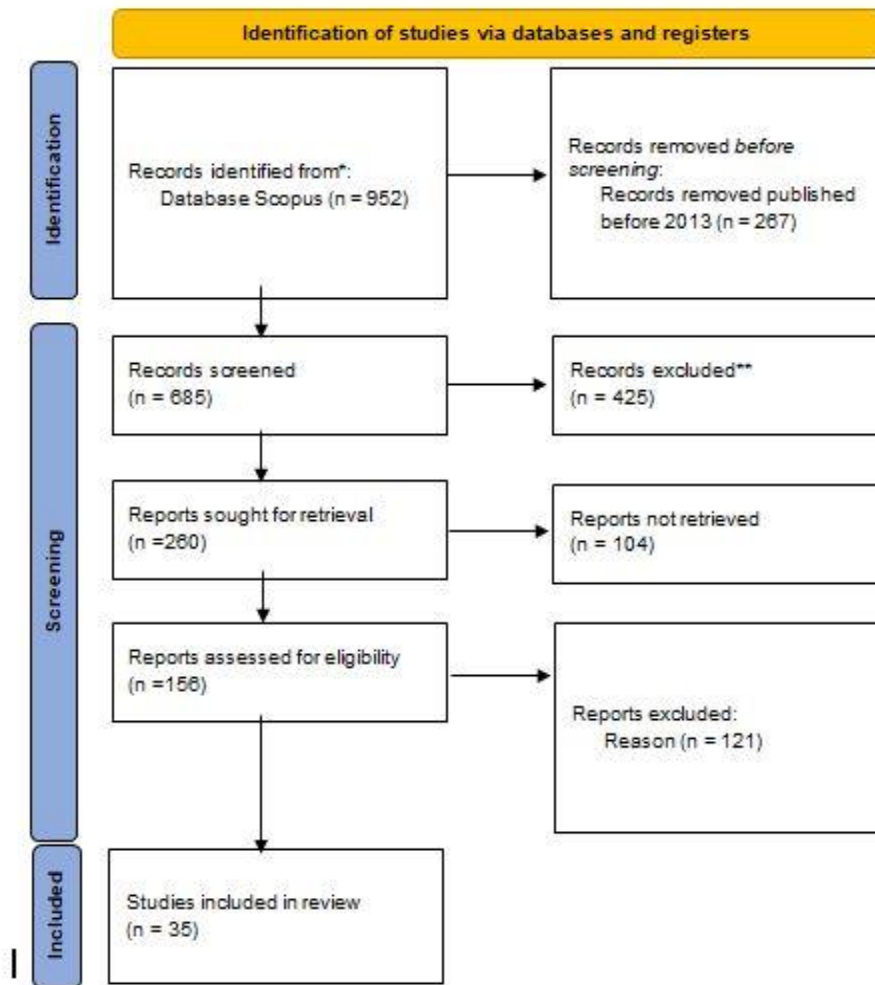
**1. Identification:** Comprehensive search of the Scopus database for articles published from 2019 to 2023 that analyses the evolution of supply chain management practices as South African enterprises transition from Industry 4.0 to Industry 5.0, focusing on the integration of Blue Ocean Strategy.

**2. Screening:** The articles were initially screened by assessing the relevance of their titles and abstracts to the topics of Industry 4.0, Industry 5.0, supply chain management, and blue ocean strategy. The eligibility of full texts is subsequently evaluated based on inclusion criteria that prioritise high-impact and peer-reviewed journals.

**3. Eligibility:** The study should primarily examine enterprises located in South Africa, while allowing for comparisons with other locations if they provide insights that are relevant to South Africa. The relevant literature comprises publications that pertain to the transition from Industry 4.0 to Industry 5.0 in the field of supply chain management. Studies must specifically address the implementation, problems, or effects of Blue Ocean Strategy. Superficial mentions without thorough analysis will be disregarded. The review will examine articles within the last five years to ensure their current relevance. Acceptable document categories comprise peer-reviewed scholarly articles, however editorials and non-peer-reviewed works are not considered.

**4. Inclusion:** Articles should specifically address the transition from Industry 4.0 to 5.0 in South African supply chains and provide a detailed analysis of the implementation or effects of Blue Ocean Strategy. The review includes scholarly articles that have undertaken peer review and were published in the past five years. These sources are written in English and can be accessed through open access. This practice guarantees that the findings are pertinent and applicable to the strategic development of supply chain management in South Africa.

**5. Synthesis:** The data obtained from the chosen research were analysed and synthesised to emphasise emergent themes, trends, and patterns. This synthesis facilitates the detection of deficiencies in the existing literature and aids in the development of suggestions for future research directions.



**FIGURE 1**  
**PRISMA FRAMEWORK**

**Article search**

Initially a search string was conducted on Supply Chain Management, Industry 4.0 and Industry 5.0 by use of keywords = “Industry 4.0” OR “fourth industrial revolution” OR “4IR” AND “Industry 5.0” OR “fifth industrial revolution” OR “5IR” AND “supply chain management” OR “SCM”, in indexed database of Scopus (restricted to title, abstracts and keywords of articles).

The recent five years (2019–2023) of peer-reviewed journal publications were considered for the search. The initially extracted articles were filtered by years (2013–2023), Subject area - Business, Management and Accounting, Document type – Articles, Source type – Journal, Language - English, Publication stage- Final stage, Open Access- All open access, and keywords- industry 4.0, industry 5.0, supply chain management, resulting in 35 articles.

**Article selection**

The extraction process focused exclusively on publications written in the English language, sourced from online sources such as Taylor & Francis, Emerald Insight, Springer, Wiley Online, and Science Direct, all of which are included in the Scopus database. Only scholarly literature with significant influence and relevance to the subject matter was taken into account. Out of the 952 papers that were initially extracted, 35 publications were chosen for further examination using the PRISMA approach of systematic review. The search was limited to empirical studies published from 2019 to 2023, specifically excluding reviews, conceptual pieces, conference papers, opinion articles, duplicate articles, and book chapters. Papers deemed irrelevant to this study were excluded by two academic experts following a thorough evaluation of the complete content of the chosen papers.

### ***Article classification***

The articles chosen for evaluation were further classified into the indicated themes by content analysis of the abstract and findings. The findings were subsequently discussed, synthesised, and evaluated within the identified themes.

## **4. DATA ANALYSIS**

In this study, Atlas-ti 24 software was utilised to conduct a thematic analysis by systematically reviewing and analysing the evolution of supply chain management (SCM) practices as South African enterprises transition from Industry 4.0 to Industry 5.0, specifically focusing on the integration of Blue Ocean Strategy. This study aims to identify how these practices improve competitiveness and operational efficiency, address new market demands, and contribute to sustainable business growth.

### ***Application to the research questions***

The thematic analysis using Atlas-ti 24 specifically aids in addressing the research questions about how supply chain management (SCM) practices evolve in South African enterprises as they transition from Industry 4.0 to Industry 5.0, and how the integration of Blue Ocean Strategy improves competitiveness, operational efficiency, addresses new market demands, and contributes to sustainable business growth, is pivotal in examining the transformative processes within SCM in the context of South African enterprises.

By employing a systematic review of existing literature and applying analytical frameworks such as the strategic conduct-performance paradigm, this study describes how strategic shifts towards Industry 5.0 technologies, coupled with the principles of the Blue Ocean Strategy, facilitate improved SCM practices. These evolved practices are expected to strengthen competitiveness, streamline operations, effectively meet emerging market demands, and encourage sustainable growth. This methodical approach not only underlines the practical applications of the research findings but also ensures that the insights collected are deeply rooted in empirical evidence, offering a substantive foundation for both academic exploration and practical implementation in improving the SCM capabilities of South African enterprises as they direct the complexities of Industry 5.0.

## **1. RESULTS AND FINDINGS**

### ***Study Selection***

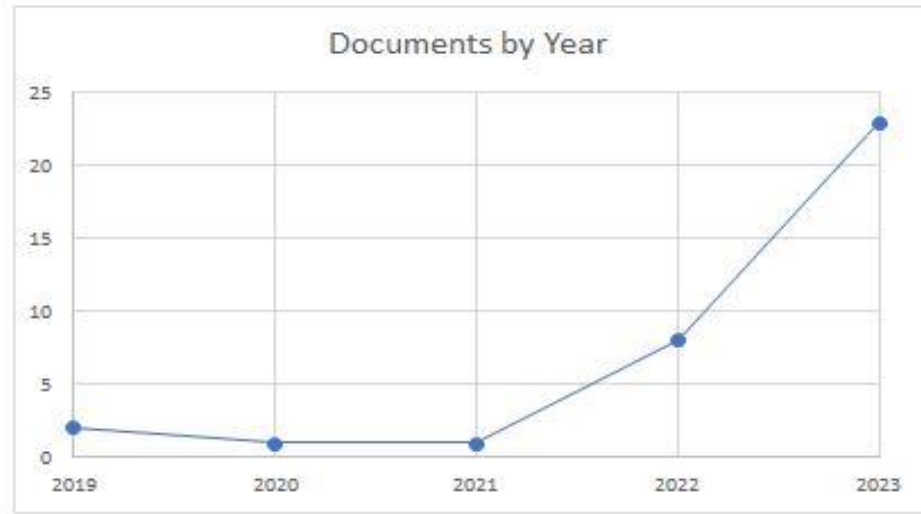
Figure 2 below, titled “Documents by Year”, illustrates the number of papers produced between 2019 and 2023 that pertain to Supply Chain Management (SCM) in the context of South African enterprises migrating from Industry 4.0 to Industry 5.0, while also embracing the Blue Ocean Strategy. The data demonstrates a steady rise in scholarly and industry documentation during the five-year period, indicating a growing academic and professional emphasis on SCM practices.

At first, there were only two papers in 2019. The number decreased to one in the following years of 2020 and 2021, but then increased to eight documents in 2022. This growth becomes much more noticeable in 2023, with a total of twenty-three documents. The inadequate documentation during the initial years indicates

that the incorporation of Industry 5.0 into supply chain management practices was at an early stage, with minimal involvement from academia and industry.

The significant surge in document production in 2022 and the substantial growth in 2023 suggest that supply chain management (SCM) practices in South African businesses have gained more attention, indicating a growing awareness of the significance of incorporating Industry 5.0 principles. This trend may suggest a wider acceptance of cutting-edge tactics and modern technologies in supply chain management (SCM), in line with the goals of Industry 5.0 to improve customisation, effectiveness, and sustainability in corporate operations.

The rising number of documents, especially in 2023, indicates that South African businesses are starting to acknowledge the benefits of implementing Blue Ocean Strategy in their supply chain management. By establishing novel market segments and avoiding excessive competition, these companies have the opportunity to gain competitive edges, improve operational effectiveness, and fulfil emerging market needs, all while promoting sustainable business expansion.



**FIGURE 2**  
**DOCUMENT BY YEAR**

*Source: Authors construction*

Figure 3 below, labelled “Documents by Country”, presents a visual representation of the world map distribution of documents about supply chain management (SCM) practices. It specifically focuses on the transition from Industry 4.0 to Industry 5.0 within South African businesses. The figure utilises a color-coded scheme to indicate the number of documents; for example, yellow represents a single document, whereas dark blue signifies a higher concentration, such as five papers. South Africa’s sole document submission is noteworthy, as it stands out among countries with a darker tint that have made more significant contributions to the SCM conversation. This visual representation provides the differences in how SCM practices are implemented and documented in various countries. These differences may indicate varying levels of acceptance and incorporation of Industry 5.0 principles.

Based on the diagram “Documents by Country”, South Africa is depicted with only one document, indicating limited involvement in documentation and potentially less adoption of advanced SCM practices compared to other countries. The United Kingdom, Brazil, India, and Italy have demonstrated a greater

adoption of Industry 4.0 and 5.0 principles in their supply chain management (SCM) systems. The United Kingdom has nine papers related to this, while Brazil, India, and Italy each have five.

The diagram illustrates an uneven distribution of documents, indicating a lack of balance in the research and reporting of advanced supply chain management strategies worldwide. This disparity may reflect that different region have varying levels of emphasis on integrating Industry 5.0. The significant difference in performance could be attributed to various factors, such as regional economic conditions, the level of technical development, and the presence or lack of government programmes that promote innovation in supply chain management.

Although Figure 1 displays the geographic spread of SCM documentation, it does not address the qualitative characteristics of these documents. An extensive investigation of the various sorts of documents, such as academic papers, industry reports, or detailed case studies, and their specialised content would provide a more nuanced comprehension of the nature of supply chain management (SCM) evolution in these countries. In South Africa, where there is currently very little representation, this draws attention to a possible gap in documented research and practice, emphasising an area that is ready for academic and industrial research.



**FIGURE 3**  
**DOCUMENTS BY COUNTRY**

**Source: Authors construction**

Table 1 below, labelled Article citation analysis Based on this analysis, we can conclude that the studies “Sustainable Supply Chain Management in Construction: An Exploratory Review for Future Research” by Cataldo et al., published in 2022 with 6 citations, and “Industry 5.0 Beyond Technology: An Analysis Through the Lens of Business and Operations Management Literature” by Borchardt et al., with 10 citations, have made significant contributions to the discussion on the development and future trajectory of supply chain management (SCM) in relation to sustainability and technological progress.

The number of citations varies from 0 for publications published in 2023 to 59 for Rad et al.'s 2022 paper on the effects of Industry 4.0 technologies on performance. The variation in citation counts is a

reflection of the differing influence and acknowledgement of these scholarly works among the academic community, with older publications naturally accumulating a higher number of citations as time goes on.

“The Impact of Industry 4.0 on Supply Chain Capability and Supply Chain Resilience” by Huang et al. and “Strategies to Overcome Barriers to Innovative Digitalisation Technologies for Supply Chain Logistics Resilience During Pandemic” by Gupta et al. have garnered 22 and 48 citations respectively. These articles emphasise the considerable research attention given to the resilience of supply chains amidst rapid technological advancements and global disruptions.

The mentioned journals encompass a wide spectrum, including “Industrial Management and Data Systems” and “Journal of Cleaner Production”. This demonstrates a multidisciplinary approach in analysing the effects of Industry 4.0 and 5.0 on supply chains, considering technological, managerial, and environmental aspects.

**Table 1. Article citation analysis**

Authors	Year	Title	Journal	Cited by
Cataldo I.; Banaitis A.; Samadhiya A.; Banaitienė N.; Kumar A.; Luthra S.	2022	SUSTAINABLE SUPPLY CHAIN MANAGEMENT IN CONSTRUCTION: AN EXPLORATORY REVIEW FOR FUTURE RESEARCH	Journal of Civil Engineering and Management	6
Atif S.	2023	The role of industry 4.0-enabled data-driven shared platform as an enabler of product-service system in the context of circular economy: A systematic literature review and future research directions	Business Strategy and Development	8
Brauner P.; Ziefle M.	2022	Beyond playful learning – Serious games for the human-centric digital transformation of production and a design process model	Technology in Society	14
Borchardt M.; Pereira G.M.; Milan G.S.; Scavarda A.R.; Nogueira E.O.; Poltosi L.C.	2022	Industry 5.0 Beyond Technology: An Analysis Through the Lens of Business and Operations Management Literature	Organizacija	10
Mihardjo L.W.W.; Sasmoko; Alamsyah F.; Elidjen	2019	Increaseing the firm transformation in industry 5.0: Experience-agility innovation model	International Journal of Recent Technology and Engineering	17
Ammirato S.; Felicetti A.M.; Linzalone R.; Corvello V.; Kumar	2023	Still our most important asset: A systematic review on human resource management in the midst of the fourth industrial revolution	Journal of Innovation and Knowledge	12



S.				
Dallasega P.; Woschank M.; Sarkis J.; Tippayawong K.Y.	2022	Logistics 4.0 measurement model: empirical validation based on an international survey	Industrial Management and Data Systems	9
Huang K.; Wang K.; Lee P.K.C.; Yeung A.C.L.	2023	The impact of industry 4.0 on supply chain capability and supply chain resilience: A dynamic resource-based view	International Journal of Production Economics	22
Rad F.F.; Oghazi P.; Palmié M.; Chirumalla K.; Pashkevich N.; Patel P.C.; Sattari S.	2022	Industry 4.0 and supply chain performance: A systematic literature review of the benefits, challenges, and critical success factors of 11 core technologies	Industrial Marketing Management	59
Michulek J.; Gajanova L.	2023	Is the Concept of Industry 4.0 Still Interesting for Scientists due to the Emergence of Industry 5.0? Bibliometric Analysis	Economics and Culture	1
Rita L.P.S.; Silva J.R.	2023	Competitiveness and R&D Subsidies: The Case of the Industry 4.0 Program in Portugal	BAR - Brazilian Administration Review	0
Thylén N.; Wänström C.; Hanson R.	2023	Challenges in introducing automated guided vehicles in a production facility– interactions between human, technology, and organisation	International Journal of Production Research	5
Lachvajderová L.; Kádárová J.	2022	Industry 4.0 Implementation and Industry 5.0 Readiness in Industrial Enterprises	Management and Production Engineering Review	12
Ghobakhloo M.; Iranmanesh M.; Morales M.E.; Nilashi M.; Amran A.	2023	Actions and approaches for enabling Industry 5.0-driven sustainable industrial transformation: A strategy roadmap	Corporate Social Responsibility and Environmental Management	33
Dornelles J.D.A.; Ayala N.F.; Frank A.G.	2023	Collaborative or substitutive robots? Effects on workers' skills in manufacturing activities	International Journal of Production Research	6
Madsen D.Ø.	2019	The emergence and rise of industry 4.0	Administrative	62

		viewed through the lens of management fashion theory	Sciences	
Gagliardi A.R.; Festa G.; Usai A.; Dell'Anno D.; Rossi M.	2023	The impact of knowledge management on the digital supply chain – a bibliometric literature review	International Journal of Physical Distribution and Logistics Management	7
Gupta H.; Yadav A.K.; Kusi-Sarpong S.; Khan S.A.; Sharma S.C.	2022	Strategies to overcome barriers to innovative digitalisation technologies for supply chain logistics resilience during pandemic	Technology in Society	48
Brzozowska M.; Kolasińska-Morawska K.; Sułkowski Ł.; Morawski P.	2023	Artificial-intelligence-powered customer service management in the logistics industry	Entrepreneurial Business and Economics Review	0
De Lombaert T.; Braekers K.; De Koster R.; Ramaekers K.	2023	In pursuit of humanised order picking planning: methodological review, literature classification and input from practice	International Journal of Production Research	17
Ghobakhloo M.; Iranmanesh M.; Foroughi B.; Babae Tirkolae E.; Asadi S.; Amran A.	2023	Industry 5.0 implications for inclusive sustainable manufacturing: An evidence-knowledge-based strategic roadmap	Journal of Cleaner Production	21
Dabo A.-A.A.; Hosseinian-Far A.	2023	An Integrated Methodology for Enhancing Reverse Logistics Flows and Networks in Industry 5.0	Logistics	0
León García O.A.; Madinabeitia D.	2023	Analysis of the use of industry 4.0 technologies as competitive advantage; [Análisis del uso de las tecnologías de la industria 4.0 como ventaja competitiva]	Revista de Metodos Cuantitativos para la Economia y la Empresa	2
Durmaz A.; Kitapçı H.	2021	Revisiting Customer Involved Value Chains Under The Conceptual Light Of Industry 5.0	Proceedings on Engineering Sciences	7
Rana J.; Daultani Y.	2023	Mapping the Role and Impact of	Operations	5

		Artificial Intelligence and Machine Learning Applications in Supply Chain Digital Transformation: A Bibliometric Analysis	Management Research	
Bouchard S.; Gamache S.; Abdulnour G.	2023	Strategy using modularity tools to operationalize mass customization in manufacturing small and medium-sized enterprises	Cleaner Logistics and Supply Chain	0
Cannavacciuolo L.; Ferraro G.; Ponsiglione C.; Primario S.; Quinto I.	2023	Technological innovation-enabling industry 4.0 paradigm: A systematic literature review	Technovation	19
Frederico G.F.	2023	ChatGPT in Supply Chains: Initial Evidence of Applications and Potential Research Agenda	Logistics	12
Dolgui A.; Ivanov D.	2023	Metaverse supply chain and operations management	International Journal of Production Research	18
Sharma V.P.; Prakash S.; Singh R.; Brar A.	2023	Decisive Drivers Contributing towards Modern Last Mile Delivery Operations: A Qualitative Analysis using ISM	International Journal of Mathematical, Engineering and Management Sciences	0
Fiorello M.; Gladysz B.; Corti D.; Wybraniak-Kujawa M.; Ejsmont K.; Sorlini M.	2023	Towards a smart lean green production paradigm to improve operational performance	Journal of Cleaner Production	6
Tsolakis N.; Goldsmith A.T.; Aivazidou E.; Kumar M.	2023	Microalgae-based circular supply chain configurations using Industry 4.0 technologies for pharmaceuticals	Journal of Cleaner Production	5
Ferrari A.; Mangano G.; Cagliano A.C.; De Marco A.	2023	4.0 technologies in city logistics: an empirical investigation of contextual factors	Operations Management Research	7
Nazarov D.; Klarin	2020	Taxonomy of Industry 4.0 research:	Systems Research	28

A.		Mapping scholarship and industry insights	and Behavioral Science	
Liu Q.; Trevisan A.H.; Yang M.; Mascarenhas J.	2022	A framework of digital technologies for the circular economy: Digital functions and mechanisms	Business Strategy and the Environment	91

Source: Authors construction

**Thematic Analysis outcomes**

In the context of this study, the thematic analysis outcome is provided in Table 2. This analysis categorises the research findings into three main themes, each supported by different codes that represent specific research focuses within these broader categories.

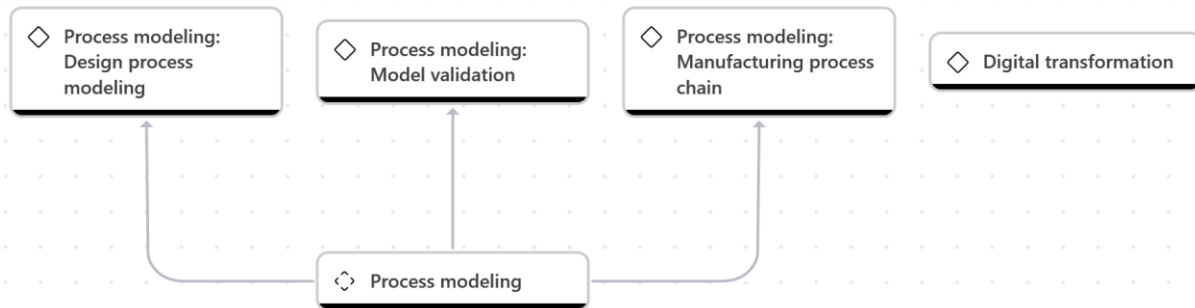
**Table 2. Major themes and codes identified**

Main Theme	Codes
Process Modelling	Design process modelling, model validation, manufacturing process chain, digital transformation
Production	Production system, sustainable supply chains, supply chains, Industry 4.0, lean production, quality management

Source: Author

**Thematic analysis results**

**Theme one: process modelling**



**FIGURE 4  
 CODES DERIVED FROM THEME 1**

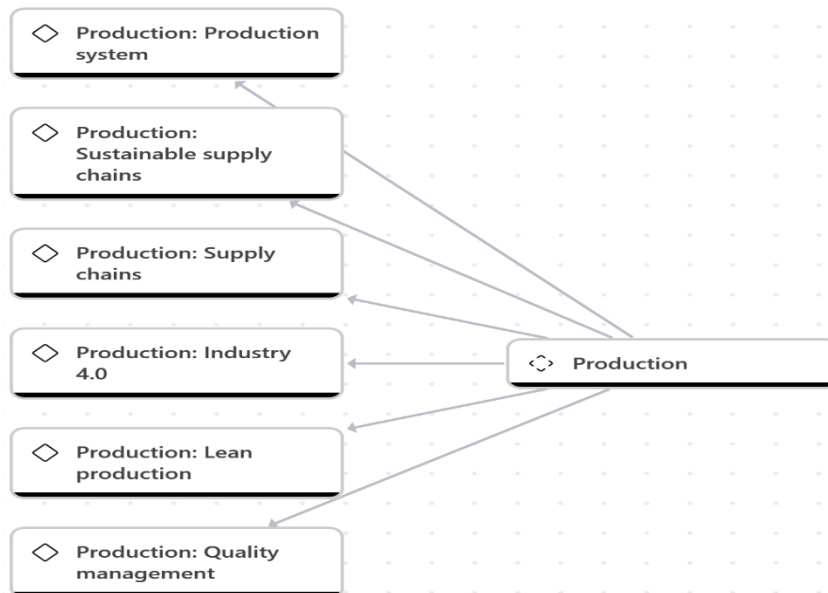
The diagram labelled Figure 5 provides the first theme and codes, “Process modelling” concisely represents the thematic analysis

Digital Transformation, a key facilitator that supports all other parts of process modelling. This refers to the overall trend of incorporating digital technologies into supply chain management (SCM) procedures results related to one of the main theme identified in this study. The theme is analysed into several codes that symbolise certain aspects within the wider field of process modelling.

The core of this theme is, indicating a change from traditional to advanced, digitised methods. The identification of design process modelling as a key element provides the importance of strategically

designing supply chain management processes to improve efficiency, accuracy, and adaptability. This code underlines the significance of designing supply chain procedures that are not only optimised for present operations but also adaptable to future Industry 5.0 requirements. Model validation is a key process that emphasises the importance of thorough testing and verification to ensure that the designed models function as intended. This guarantees that the SCM practices established are strong, dependable, and able to endure real-world obstacles, thus diminishing risk and improving performance. The third code, Manufacturing process chain, focuses on the utilisation of process modelling in the manufacturing environment. The diagram describes a development from the general concept of digital transformation to the specific aspects of design, validation, and application in manufacturing. It demonstrates a methodical approach to incorporating sophisticated process modelling methodologies, which is key for South African enterprises seeking to capitalise on the advantages of Industry 5.0.

**Theme two: production**



**FIGURE 5  
CODES DERIVED FROM THEME 2**

The diagram above Figure 6 presented illustrates the results of the thematic analysis pertaining to the “Production”. The subject is divided into multiple interconnected codes that together constitute a key component of the production side of supply chain management. The “Production” subject revolves around the Production system, which is a code that presumably symbolises the fundamental structures and procedures necessary for the production of goods and services. When referring to “supply chains as a standalone code”, it is likely indicating the larger practices of supply chain management (SCM) that go beyond only the manufacturing floor. This includes activities like as logistics, procurement, and distribution. This involves the comprehensive supervision and administration of supply chain operations, demonstrating a unified perspective on the movement of products and services from suppliers to customers.

The incorporation of Industry 4.0 into the production subject provides the significance of cutting-edge manufacturing technologies and intelligent systems in contemporary production processes. This indicates a specific interest in how South African enterprises are utilising the capabilities of the fourth industrial revolution to transform their production systems. Lean production is a concept that falls under the production theme, indicating a strategic emphasis on reducing waste and maximising efficiency. The application of lean

concepts is key in maximising customer value while minimising resource utilisation, especially in an era where resource limitations are becoming more prevalent. “Quality management” is a key component of the study, emphasising the importance of upholding strictness quality standards throughout the production process. This code implies that quality plays a key role in the production plan, impacting both competitiveness and consumer satisfaction.

Together, these codes within the “Production” category offer a detailed comprehension of the complex relationship between effectiveness, environmental consciousness, technology, and excellence in the production aspect of supply chain management. The thematic analysis of this themes indicates a deliberate endeavour by South African businesses to include these elements into their production methods, so positioning themselves favourably to capitalise on the opportunities offered by Industry 5.0. The emphasis on sustainability and efficient production within this framework is in line with the ideas of the Blue Ocean Strategy, which promotes innovation in creating value and establishing new market areas that can offer competitive advantages in a fast-changing industrial environment.

**Table 3. Main themes, the codes, and short quotes**

Main Theme	Codes	Short Quotes
Process Modelling	Design process modelling, model validation, manufacturing process chain, digital transformation	“The digital transformation of production (“Industry 4.0”) has the potential to enormously accelerate and improve the efficiency...”
		“Assess the concept of experience-agility innovation model to support transformation in the context of digital transformation to face Industry 5.0”
		“In addition, we assess the relevance and adequacy of human factors modelling in academic literature...”
		“Chains that can sync and support the rapid evolution of advanced industrial practices via supply chain digital transformation”.
		“Presents a conceptual model developed through expert discussion and Interpretive Structural Modelling (ISM), for formulating the proposed model of modern logistics in the era of Industry 4.0 (I4.0)”.
		“Technologies could stimulate the reconfiguration of medicine supply networks. Second, supply network modelling and scenario analysis allowed to explore supply chain configuration options for breast cancer pharm...”
		“Potentials for improving the current situation in the

Production	Production system, sustainable supply chains, supply chains, Industry 4.0, lean production, quality management	construction sector by using various types of supply chains such as increasing investment in energy conservation and emission reduction technologies to drives...”
		“Understanding how operators of production systems and production networks can be supported by human-centric industrial user interfaces...”
		“The digital transformation of production (“Industry 4.0”) has the potential to enormously accelerate and improve the efficiency of manufacturing processes...”
		“Iterative process model for designing serious games and exemplify this model using a supply chain and quality management serious game”.

Source: Author

## 2. Discussion and Interpretations of key findings

### *Theme One: Process Modelling*

Lu et al. (2018) analyses sustainable supply chain management using a social network approach, emphasising the impact of guanxi networks on the movement of supply chain capital. Comprehending these concepts is key for modelling the design process in supply chain management, especially when transitioning between different industrial periods. Vaio et al. (2023) focus on utilising digitalisation and artificial intelligence to improve supply chain management accountability and achieve sustainable performance. This study provides the importance of including technology in the modelling of supply chain management (SCM) during the design phase, particularly as companies move towards Industry 5.0. However, Al-Shammari (2023) presents a strategic planning model that aims to attain sustained competitive advantage in supply chain management (SCM). This model has the potential to play the key role in incorporating Blue Ocean Strategy into the design process modelling of Supply Chain Management (SCM) in order to improve competitiveness and successfully meet changing market requirements. Mukhsin and Suryanto (2022) emphasise the influence of sustainable supply chain management (SCM) on firm performance by means of competitive advantage. This emphasises the significance of including sustainability into the design process of supply chain management (SCM) modelling. It aligns with the goal of achieving sustainable corporate growth during the transitions between industrial revolutions.

According to the literature, creating a conceptual framework by building on previous research and using methods like focus groups can provide useful insights for guaranteeing the resilience of supply chains (Pettit et al., 2010). This paradigm can facilitate comprehension of the necessary adaptations in supply chain management procedures to address the issues arising from the transition from Industry 4.0 to Industry 5.0. This study provides the importance of incorporating sustainability into supply chain management (SCM) practices. This is achieved by linking corporate sustainability with human resource management (HRM) through the use of Sustainable HRM frameworks (Ehnert et al., 2015). The connection provides the importance of integrating human resources with sustainable business practices, a key factor for companies undergoing transitions between industrial revolutions. The literature emphasises

the influence of strategic quality focus on the ability to innovate and achieve sustained corporate success (Khan & Naeem, 2018).

Research have confirmed that implementing digital transformation in supply chains can decrease the bullwhip effect, facilitate the exchange of information, and increase the resilience of the supply chain (Yin & Ran, 2022; Gao, 2023; Li et al., 2023). This transformation entails leveraging technologies such as big data, the Internet of Things, and artificial intelligence to improve supply chain processes (Jiang, 2019; Pflaum et al., 2021; Li et al., 2023). Digital transformation has a role in promoting sustainability through the facilitation of environmentally friendly activities and the improvement of operational effectiveness (Sharabati, 2021; Lerman et al., 2022; Minh et al., 2023).

### ***Theme two: production***

The development of SCM practices is complicatedly linked to the implementation of sustainable supply chain management principles, circular economy concepts, and demand chain integration. The transition to Industry 5.0 involves adopting more sustainable practices, including the implementation of circular production systems (Genovese et al., 2017). These systems prioritise the utilisation of materials, the creation of self-sustaining industrial processes, and the minimisation of environmental effect. Through the comparison of traditional and circular production processes, companies are able to improve their operational efficiency and fulfil emerging market requirements. Demand chain management is key for coordinating marketing and supply chain management functions (Jüttner et al., 2007). Through the alignment of marketing strategies with supply chain operations, companies are able to improve their ability to anticipate and react to market demands, resulting in increased competitiveness and operational efficiency. Sustainable service supply chain management frameworks offer valuable insights for improving sustainability in sectors that focus on providing services (Liu et al., 2017). Although there has been significant research on manufacturing supply chain management (SCM), there is now a greater focus on understanding and improving SCM practices in service supply chains in order to achieve sustainable corporate growth.

South African enterprises are adapting their supply chain management (SCM) strategies as they go from Industry 4.0 to Industry 5.0. The incorporation of the Blue Ocean Strategy is perceived as a means to augment competitiveness, optimise operational efficiency, cater to emerging market needs, and encourage sustainable business expansion. Sustainable supply chains have become key in facilitating this shift. Sustainable supply chains prioritise the triple bottom line, which encompasses the financial, social, and environmental dimensions (Markley & Davis, 2007).

Implementing Industry 4.0 technology in supply chain management (SCM) is able to result in improved operational effectiveness and a stronger competitive position. Blockchain technology provides novel opportunities for the digitalisation of supply chains, allowing for intelligent oversight and control of the supply chain (Feng & Song, 2019).

The application of blockchain technology has the capacity to revolutionise the process of integrating information into supply chains, establishing the foundation for intelligent management of supply chains (Feng et al., 2019). The relationship between effective supply chain management and company innovation has become key for long-term corporate expansion. The efficient implementation of supply chain procedures is acknowledged as a key factor in gaining a competitive edge by creating new and creative products (Modi & Mabert, 2010). Therefore, the significance of ongoing innovation and improvement in the supply chain to meet changing market needs and maintain corporate expansion is required.

## **3. CONCLUSION AND RECOMMENDATIONS**

### ***Implications for practioners and policymakers***



It is important to incorporate sustainable supply chain management (SSCM) principles. Research has indicated that Supply Chain and Supplier Relationship Management (SSCM) is becoming more significant as a result of variables such as societal influences, customer demands, and competitive forces (Esfahbodi et al., 2016). Implementing Sustainable Supply Chain Management (SSCM) can result in improved firm performance, strengthened financial performance, and optimised operational performance (Mukhsin et al., 2022). However, the adoption of sustainable supply chain orientation (SSCO) can assist in delineating strategies that lead to both sustainability and a competitive edge (Signori et al., 2015). The implementation of dynamic skills is key for attaining business sustainability and long-lasting competitive advantage (Bari et al., 2022). Dynamic skills, such as strategic routines, integrated value chains, and sustainability-oriented transformations, are key for gaining a competitive edge. This is especially significant when moving from one industrial revolution to another. In addition, the utilisation of technologies such as blockchain can facilitate the process of creating a visual representation of the supply chain for the purpose of implementing sustainable practices (Khan et al., 2022). Blockchain technologies have the potential to improve the integration of supply chains and support sustainability efforts, which are key throughout the shift to new industrial paradigms. It is key to comprehend the significance of supply chain risk management (SCRM). Implementing efficient Supply Chain Risk Management (SCRM) strategies can reduce the impact of vulnerabilities caused by events such as labour strikes and cyberattacks (Meyer et al., 2019).

#### ***Practical recommendations for South African enterprises***

Thakoor (2020) research emphasises the influence of market power on growth and inclusiveness, specifically focusing on how companies in South Africa may engage in practices that hinder competition. These findings indicate that South African companies should prioritise the cultivation of strong competition in order to stimulate growth and promote inclusiveness. Wesson (2021) study on audit market concentration in South Africa offers valuable insights into regulatory suggestions that can improve audit quality and address market concentration concerns, all of which are key considerations for enterprises directing shifts between industrial eras. By incorporating Blue Ocean Strategy into the supply chain management (SCM) processes of South African enterprises, they can improve their competitiveness, operational efficiency, and ability to meet new market demands. Implementing these practices can enable companies to distinguish themselves in market areas where there is less competition, resulting in long-term corporate expansion. By utilising the principles of Blue Ocean Strategy, companies can effectively innovate, decrease costs driven by competition, and establish new market prospects. This aligns with the research conducted by Kerr et al. (2014) on the impact of job creation and destruction in South Africa, which is key for achieving sustainable growth.

#### ***Future research***

The research conducted by Kato and Manchidi (2022) states the significance of using sustainable supply chain management methods to support companies, particularly in developing economies such as South Africa, in attaining sustainable growth and gaining a competitive edge. Additional investigation could explore specific strategies within the Blue Ocean Strategy framework that are in line with sustainable practices in order to improve competitiveness and operational efficiency throughout the shift to Industry 5.0. However, the research conducted by Kato et al. (2022) emphasises the need of maintaining supply chain sustainability and effectively managing risks. Future study could investigate the potential benefits of incorporating Blue Ocean Strategy ideas into supply chain management (SCM) risk management systems.

## CONCLUSION

This study aims to investigate the transition of supply chain management (SCM) in South African businesses as they shift from Industry 4.0 to Industry 5.0. Our focus is specifically on the incorporation of Blue Ocean Strategy. This transition signifies a pivotal move towards business strategies that prioritise human well-being, utilise sophisticated technology, and promote environmental sustainability. The results of our research emphasise that South African enterprises are actively restructuring their supply chain management practices to improve operational efficiency and competitiveness, as well as to meet new market requirements and promote sustainable corporate growth. This study provides valuable contributions to both academic knowledge and practical insights by presenting a thorough comprehension of how strategic improvements in supply chain management (SCM) might result in resilient and sustainable business models in the era of Industry 5.0. Our research offers a fundamental plan for other developing economies aiming to align their industrial practices with the requirements of the fifth industrial revolution.

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