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Transitioning from Industry 4.0 to 5.0: Sustainable supply chain management and talent management insights

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Orientation: A systematic literature review emphasises the importance of building a resilient and forward-looking industrial sector that can adapt to the evolving demands of Industry 5.0 as it transitions from Industry 4.0. The strategic recommendations from this review underscore the significance of sustainable supply chain management (SSCM) and effective talent management.

Research purpose: This study aims to investigate how the transition from Industry 4.0 to Industry 5.0 impacts SSCM and talent management, based on a systematic review and synthesis of existing literature.

Motivation for the study: The significance of the study lies in understanding the profound implications of Industry 5.0 on supply chain sustainability and workforce development, particularly in the context of integrating human-centric and sustainable practices with advanced digital technologies.

Research approach/design and method: The study employs the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology to conduct a comprehensive systematic review. It synthesises existing literature focussing on the technological advancements, human resource challenges and sustainable practices adopted by industries transitioning from Industry 4.0 to Industry 5.0.

Main findings: The study reveals that industries are increasingly integrating advanced technologies such as artificial intelligence (AI), big data analytics and blockchain to improve supply chain efficiency and sustainability. Significant emphasis is placed on reskilling and upskilling the workforce to align with the demands of new technologies and human-centric industrial processes.

Practical/managerial implications: The findings highlight the key role of policymakers, industry leaders, and educational institutions in driving the successful adaptation to Industry 5.0. Policymakers must prioritise funding and supportive regulations, while industry leaders need to embrace ongoing upskilling initiatives.

Contribution/value-add: The study proposes several strategic recommendations, including the development of inclusive digital infrastructure, encouraging industry collaborations to align educational curricula with market needs and promoting continuous professional development for employees. These recommendations aim to facilitate a resilient and forward-thinking industrial sector capable of meeting the evolving demands of Industry 5.0.

Keywords: artificial intelligence; industry 4.0; Industry 5.0; sustainable supply chain management; systematic literature review; talent management.

Introduction

Industry 4.0, or the Fourth Industrial Revolution, is a major transformation in manufacturing and production methods that involves automation, digitisation and the incorporation of technologies such as the Internet of things (IoT), cloud computing, big data, artificial intelligence (AI) and embedded systems (Xiao-xia & Zhou, 2022). This shift has resulted in improved efficiency, adaptability and personalisation in industrial processes. Industry 5.0 expands on the principles of Industry 4.0, placing significant emphasis on the collaboration between humans and machines. It specifically focusses on the management of sustainable supply chains and talent (Xiao-xia et al., 2022). The transition from Industry 4.0 to Industry 5.0 is a move towards a manufacturing method that prioritises human involvement and collaboration with machines to improve production processes and increase efficiency.

Talent management is equally key in the context of shifting to Industry 5.0. Organisations should prioritise training and increasing knowledge among employees on environmental and social sustainability in order to establish a sustainable supply chain (Jing et al., 2018). Talent management ensures that staff possess the necessary skills and expertise to effectively drive sustainability efforts inside the organisation. Organisations are able to establish a sustainable supply chain that adheres to the principles of Industry 5.0 by increasing employees' knowledge and understanding of environmental protection and sustainability (Jing et al., 2018).

Sustainable supply chain management (SSCM) not only increases environmental performance but also improves overall organisational performance (Aylak, 2022). Organisations are able to attain Sustainable Development Goals (SDGs) by effectively overseeing the movement of materials and information, taking into account economic, social and environmental aspects (Kot, 2022). Implementing sustainable supply chain strategies can confer a competitive advantage by exerting pressure on enterprises in a sector to embrace sustainable practices or face the danger of lagging behind (Wu et al., 2018).

Research objective

The primary objective of this research is to systematically review and synthesise existing literature to understand the transition from Industry 4.0 to Industry 5.0, with a specific focus on SSCM and talent management.

Research question

How does the transition from Industry 4.0 to Industry 5.0 impact SSCM and talent management, based on a systematic review and synthesis of existing literature?

The purpose of this study is to investigate the influence of the transition from Industry 4.0 to Industry 5.0 on SSCM and talent management. The study aims to identify critical trends, challenges and opportunities related to the integration of advanced digital technologies, human-centric approaches and sustainability principles by conducting a systematic review and synthesis of the existing literature. This will provide actionable insights to improve the resilience, efficiency and adaptability of organisations in the changing industrial landscape.

Significance of the study

The transition from Industry 4.0 to Industry 5.0 marks a significant evolution in the industrial and technological landscape, emphasising not only automation and digitalisation but also human-centric technologies and sustainability. This study's significance lies in its comprehensive examination of this transition, particularly focussing on SSCM and talent management.

Literature review

Evolving talent strategies for the industrial shift: Aligning talent management with Industry 4.0 and Industry 5.0 demands

The current body of literature offers useful insights into talent management practices that help aid this transformation. Research such as Whysall et al. (2019) provides the difficulties presented by Industry 4.0, underlining the need for innovative strategies in nurturing skills and abilities in response to the swift developments in technology. It is key to synchronise talent management strategies with the changing demands of Industry 5.0 in order to guarantee organisational success.

The influence of talent management on employee performance has been thoroughly examined in the study titled 'Impact of Talent Management on Employee Performance in the Banking Industry of Bangladesh' (Tazin & Hakim, 2022). The study repeatedly demonstrates that implementing good people management methods has a major impact on employee performance in many industries.

Therefore, organisations that are shifting to Industry 5.0 are able to utilise talent management practices to improve workforce efficiency and flexibility in response to technology progress. Talent management has been a central focus in the hospitality industry for improving organisational performance (Cho et al., 2006). Cho et al. (2006) highlight the significance of human resource management (HRM) strategies in improving business performance, underlining the key role of talent management in achieving success. This is consistent with the idea that attracting, keeping and nurturing talented individuals are key elements in identifying future leaders in various businesses (Jimoh & Kee, 2022).

The literature emphasises the key importance of efficiently cultivating and overseeing talent in the age of Industry 4.0 ('Industry 4.0 and effective talent management' (Anon, 2019). With the shift towards Industry 5.0, there is a heightened focus on talent management. Organisations must implement talent management strategies that not only attract and retain highly competent workers but also promote their ongoing growth to meet the requirements of the changing industrial landscape.

The triple bottom line approach: Advancing economic, environmental and social goals through sustainable supply chain management

Sustainable supply chain management is the practice of incorporating environmental, social and economic objectives into the everyday activities, operations, strategies and decision-making processes of a supply chain (Alves et al., 2019). Sustainable development in the supply chain involves taking steps that address the economic, social and environmental aspects (Kot, 2018). Sustainable supply chain management is founded upon three fundamental dimensions: economic sustainability, environmental sustainability and social sustainability (Wu et al., 2018). Studies suggest that

implementing sustainable supply chain practices can have a significant influence on key aspects of organisational operations, including procurement, manufacturing and logistics, which are key components of supply chain management (Aylak, 2022).

However, the practice of SSCM is linked to improved corporate financial performance. Specifically, when companies integrate social and environmental supply chain management, it has a beneficial impact on their return on assets and return on equity (Wang & Sarkis, 2013). Organisations striving for sustainability must take into account continuous modifications in the design and management of their supply chains. This involves integrating economic, environmental and social performance indicators at strategic, tactical and operational levels (Fahimnia et al., 2017).

To successfully implement SSCM, organisations need to cultivate cultural characteristics that encourage social sustainability practices in the supply chain. This goes beyond simply monitoring suppliers and involves promoting behavioural changes throughout the entire supply chain, including lower-tier suppliers and the surrounding community (Marshall et al., 2015). Consequently, the connection between strategic entrepreneurship and social capital has been shown in relation to organisational performance via SSCM. This highlights the significance of entrepreneurial methods in promoting sustainability initiatives (Wijaya, 2023).

Talent management in the context of Industry 4.0 and Industry 5.0

Industry 4.0, which involves integrating digital technology into manufacturing and supply chain management, has presented considerable difficulties in talent management (Whysall et al., 2019). The rapid technological breakthroughs linked to Industry 4.0 have resulted in a disparity between the abilities that employees currently have and the changing demands of their jobs. This calls for the implementation of new and improved techniques for developing talent. This shift emphasises the significance of synchronising talent management strategies with the evolving requirements of the digital age in order to sustain a competitive advantage. Effective talent management is key for cultivating employee engagement and dedication, both of which are imperative for retaining top talent (Pandita & Ray, 2018).

Organisations must develop talent management programmes that not only attract high-calibre individuals but also guarantee that employees maintain their commitment and enthusiasm in their positions. Talent management techniques that effectively contribute to the growth of an organisation align the staff with the company's goal, vision and corporate culture (Ijeoma, 2022). Talent management is gaining recognition as a strategic need that has a direct influence on organisational performance and achievement (Ijeoma, 2022). With the development of the industrial environment towards Industry 5.0, which prioritises collaboration between humans and machines and a comprehensive approach to integrating technology, people management techniques will have to adapt accordingly. Industry 5.0 prioritises creativity, innovation and the collaboration between personnel and modern technologies ('Industry 4.0 and effective talent management' (Anon, 2019). Hence, in the era of Industry 5.0, it is imperative for people management strategies to prioritise the cultivation of creativity, the promotion of an innovative culture and the improvement of skills that align with the capabilities of emerging technologies.

Integrating Industry 4.0 and Industry 5.0 with sustainable supply chains and talent management for organisational resilience

The transition from Industry 4.0 to Industry 5.0 is a significant change in manufacturing paradigms, with a focus on human-centric approaches and sustainability. Organisations that are focussed on improving their supply chain management and talent management strategies must make this transition. The primary research question that underpins this investigation is: 'How does the transition from Industry 4.0 to Industry 5.0 impact SSCM and talent management, based on a systematic review and synthesis of existing literature?'

The integration of advanced technologies, including the IoT, big data and AI, into manufacturing processes is the defining characteristic of Industry 4.0. This integration improves operational efficiency and responsiveness to market demands (He et al., 2023). However, as industries progress towards Industry 5.0, there is an increasing emphasis on sustainability and the role of human workers, which is a shift from a solely technological approach to a more comprehensive approach that encompasses social and environmental factors (Henriksen & Thomassen, 2023). This transition requires a reassessment of supply chain management practices to integrate sustainability as a fundamental principle. For example, SSCM practices are becoming more widely acknowledged as essential for encouraging long-term business growth and achieving competitive advantages (Paul et al., 2022; Xing, 2023). Organisations are obligated to interpret sustainability indices throughout their entire supply chain to address economic, environmental and social dimensions when implementing SSCM, which is a complex process (Haddach, 2020; Mukhsin & Suryanto, 2022).

In addition, the cultivation of innovation and adaptability within organisations is contingent upon talent management in the context of Industry 4.0 and Industry 5.0. There is an urgent requirement for a workforce that is proficient in these technologies and capable of promoting sustainable practices as industries adopt new technologies (Reynolds, 2024). Kadir and Broberg (2021) advocated for human-centred design approaches in work systems to guarantee that employees are prepared to thrive in environments that are becoming increasingly automated. Employee engagement and retention can be improved by incorporating sustainable practices into talent management strategies, as organisations that prioritise sustainability are more likely to motivate their workforce (Mukhsin et al., 2022). Furthermore, the promotion

of sustainability across supply chains is significantly influenced by governance mechanisms, including regulatory frameworks and collaborative initiatives, which in turn affect talent management practices (Reynolds, 2024).

Methodology

Preferred reporting items for systematic reviews and meta-analyses methodology

The preferred reporting items for systematic reviews and meta-analyses (PRISMA) framework is widely recognised and provides guidance for conducting systematic reviews and meta-analyses. It ensures that research synthesis is conducted with clarity, transparency and thoroughness. This methodology is highly suitable for conducting a systematic review of the transition from Industry 4.0 to Industry 5.0, with a specific focus on SSCM and talent management. It offers a well-organised approach for gathering, assessing and summarising the available evidence pertaining to this subject.

By following the PRISMA guidelines, researchers can systematically analyse the effects of Industry 5.0 on supply chain sustainability and talent management. This approach ensures a thorough review process and reliable conclusions. The method's focus on a systematic search, selection criteria and data extraction is in line with the research objective of synthesising literature on the influence of Industry 5.0 on sustainable supply chain practices and talent management strategies. This approach ensures that the review can be replicated and the findings are trustworthy.

The utilisation of the PRISMA approach improves the article's objective to thoroughly evaluate the consequences of Industry 5.0 on the sustainability of supply chains and the management of talent. This system guarantees a transparent and straightforward reporting process, from identifying research to final inclusion, by employing a standardised checklist and flowchart. An exhaustive methodology is key for fully understanding the scope and complexity of present-day research, identifying shortcomings and establishing sound conclusions that can inform future strategies and legislations within the framework of Industry 5.0. The PRISMA framework's systematic approach facilitates the meticulous assessment and integration of literature, rendering it an optimal selection for this research. It enables a methodical method of comprehending the shift from Industry 4.0 to Industry 5.0, offering useful perspectives on the impact of these developments on SSCM and talent management.

Inclusion and exclusion criteria

The criteria for selecting literature in this systematic review were carefully crafted to guarantee a thorough and pertinent synthesis of current research on the transition from Industry 4.0 to Industry 5.0, with a specific emphasis on SSCM and talent management. The inclusion criteria requires that studies explicitly focus on the concepts, technologies or frameworks associated with Industry 4.0 and Industry 5.0, which represent the progression of industrial practices and the adoption of sophisticated technology. The literature examined SSCM in these settings, addressing the integration of sustainable practices, environmental and social consequences, and strategies for attaining sustainability objectives. The literature also analysed talent management concerns that are relevant to Industry 4.0 and Industry 5.0, including skill prerequisites, workforce improvement and the influence of technological improvement on human resources. Only studies that utilise rigorous methodological approaches, such as empirical research, theoretical analysis, case studies or systematic reviews, and that have been published from 2010 onwards and in English, were considered. This is to assure the reliability, validity and relevance of the findings.

On the other hand, the exclusion criteria are also important in order to ensure that the review remains focussed and of high-quality. Any studies that do not specifically concentrate on Industry 4.0 or Industry 5.0, or do not include SSCM or talent management in relation to these concepts, were excluded. Any debates on industrial practices that do not have a clear connection to these issues are not pertinent to our review. To prioritise recent and original research, articles published before 2010 or studies that do not provide new insights but rather duplicate already thoroughly covered findings were eliminated. Unverified sources, such as opinion pieces, editorials and non-scholarly publications, were omitted to maintain the academic thoroughness and legitimacy of the synthesised findings.

To improve the trustworthiness of the review, studies that do not include enough methodological information, making it impossible to evaluate their reliability and validity, were eliminated. The inclusion criteria are essential for the selection of high-quality studies, as they establish a structured approach to ensuring the reliability, validity and relevance of the findings. The criteria guarantee that the studies included are directly aligned with the research objectives by emphasising research that explicitly explores SSCM, talent management, and Industry 4.0 and Industry 5.0. The reliability of the results is improved by minimising the risk of irrelevant or indirect studies influencing them through this targeted selection. In addition, the validity of the findings is improved by restricting the scope of studies to those published in peer-reviewed journals, which guarantees methodological rigour. The relevance of the criteria is further improved by its emphasis on recent publications (2010 onwards), which capture the most recent trends and advancements. The inclusion of studies that employ strong methodological approaches, such as systematic reviews and empirical research, guarantees credibility and comprehensive insights. These inclusion parameters, which have been meticulously defined, establish a strong foundation for the development of conclusions that are both relevant and

applicable in this systematic review. Any studies published in languages other than English were removed because of practical constraints in understanding and appropriately combining findings from non-English publications.

This systematic literature review aims to compile a comprehensive and high-quality body of research by following specific inclusion and exclusion criteria. It pursues to provide valuable insights into the impact of the transition from Industry 4.0 to Industry 5.0 on SSCM and talent management.

Search strategy

The search strategy for this systematic literature review was carefully crafted to locate and gather pertinent studies that examine the influence of the transition from Industry 4.0 to Industry 5.0 on SSCM and talent management. The practice involved conducting a thorough and organised search across many academic databases to guarantee the incorporation of a wide range of reliable and high-quality sources.

The databases chosen for this review were Web of Science, Scopus, IEEE Xplore, Google Scholar and ScienceDirect. The selection of these databases was based on their comprehensive inclusion of peer-reviewed journals, conference papers and industry reports in the domains of industrial engineering, supply chain management and HRM. The extensive range and interdisciplinary character of these databases guaranteed access to a diverse selection of pertinent material.

The keywords were carefully chosen and improved through initial searches and consultations with field specialists. The search mostly focussed on the following keywords: 'Industry 4.0', 'Industry 5.0', 'sustainable supply chain management', 'supply chain sustainability', 'talent management', 'human-centric technology', 'digital transformation' and 'systematic literature review'. The utilisation of Boolean operators, including AND, OR and NOT, facilitated the effective combination of these terms and the refinement of the search results. For example, searches are conducted using combined phrases such as 'Industry 4.0 AND sustainable supply chain' and 'Industry 5.0 AND talent management'. To further improve the search, the following search string was used ('Industry 4.0' OR 'Fourth Industrial Revolution' OR '4IR') AND ('Industry 5.0' OR 'Fifth Industrial Revolution') AND ('sustainable supply chain management' OR 'supply chain sustainability' OR 'green supply chain' OR 'sustainable logistics') AND ('talent management' OR 'human resource management' OR 'HRM' OR 'workforce management' OR 'employee development' OR 'skills management').

The search was conducted from January 2010 and December 2023. The chosen timeframe aims to encompass the latest and important breakthroughs in the shift from Industry 4.0 to Industry 5.0, with a specific emphasis on the past decade when prominent developments and discussions around these industrial paradigms have arisen. By restricting the search to this specific timeframe, it guaranteed that the review incorporated recent and relevant articles that accurately represented the current state of research and practice. Aside from conducting database searches, manual searches were performed by scanning the reference lists of important studies to find any more pertinent research that may have been missed in the initial database search. The utilisation of this snowballing technique was key in guaranteeing the thoroughness of the literature review

Data extraction and synthesis method

The methodology used for this systematic literature review was carefully planned and followed the PRISMA framework for data extraction and synthesis. This methodical approach guaranteed thorough and clear identification, selection and integration of pertinent literature that addresses the research question: What is the impact of the transition from Industry 4.0 to Industry 5.0 on sustainable supply chain management and talent management, based on a systematic review and synthesis of existing literature?.

A total of 119 publications published between 2020 and 2023 were found in the initial search. These studies specifically pertain to the subject areas of business management and accounting. In order to guarantee the pertinence and excellence of the incorporated research, a set of inclusion and exclusion criteria was methodically employed. The subject area filter narrowed the results to 32 studies specifically focussed on business management and accounting. These studies emphasise the key viewpoints of managers and operations in comprehending the transition to Industry 5.0.

Next, the document type filter was utilised to exclusively incorporate peer-reviewed studies, leading to the identification of 24 pertinent publications. This criterion guaranteed that only scientific work of superior quality was taken into account, excluding other forms of documents such as conference papers, book chapters and reports. Additional refinement was conducted by specifically targeting the publication stage, encompassing solely the ultimate, completely published works, leading to a total of 20 publications. This phase ensured that the review exclusively addressed research findings that were both thorough and validated.

The source type was limited to journal articles, thereafter, ensuring that the total number of publications remained at 20. This decision was made to guarantee that the evaluation was grounded on meticulously scrutinised and generally available research. The language filter was implemented to exclusively include items that were published in English, resulting in a total of 20 articles. This criterion was key to guaranteeing uniformity in the evaluation process and to assist the precise understanding and integration of the results.

Data extraction entailed the methodical gathering of pertinent information from each of the 20 chosen articles. The study provided key information such as the goals, approach, significant discoveries and the impact on SSCM and talent management during the transition from Industry 4.0 to Industry 5.0. To maintain consistency and comprehensiveness, a standardised data extraction form was employed. This form captured key information, including the types of Industry 4.0 and Industry 5.0 technologies discussed, the specific sustainability and talent management practices analysed, and any challenges or opportunities associated with these transitions that were identified.

A theme analysis approach was employed to synthesise the retrieved data. This approach entailed classifying the discoveries into significant topics pertaining to the influence of the transition from Industry 4.0 to Industry 5.0 on SSCM and talent management. Themes were determined by analysing the literature for repeated patterns and important ideas, including technological progress, sustainable practices, techniques for developing talent and ways that prioritise human needs. Thematic synthesis facilitated the incorporation of many discoveries into cohesive narratives that completely challenge the research subject.

Quality assessment of the selected studies

Conducting a quality assessment of the chosen studies was an important step in guaranteeing the dependability and accuracy of the findings given in this systematic literature review on the effects of transitioning from Industry 4.0 to Industry 5.0 on SSCM and talent management. This procedure entailed a meticulous assessment of the methodological soundness, pertinence and overall impact of each study on the research query.

At first, studies were evaluated and selected based on their direct connection to the study issue. Only the articles that specifically discussed topics related to Industry 4.0 and Industry 5.0, SSCM and talent management were considered. The chosen studies were subjected to a comprehensive evaluation of their quality using a predetermined set of criteria, which were derived from well-established guidelines for systematic reviews, such as the PRISMA framework.

The evaluation criteria centred on certain key aspects. Initially, the methodological rigour of each study was evaluated to ensure strong and dependable findings. Quantitative studies were assessed according to their utilisation of statistical analyses, sample sizes and control measures. The data collecting and analysis methods of qualitative research were evaluated, taking into account the clarity of their theoretical frameworks and the thoroughness of their theme analyses. The mixed-methods studies were examined to assess the extent to which they effectively incorporated both quantitative and qualitative data in order to offer comprehensive insights.

Also, a thorough assessment was conducted to determine the significance and extent of each study. The major factor considered was the degree to which each study addressed the fundamental components of Industry 4.0, Industry 5.0, SSCM and talent management. Research is required to gain a significant understanding of the effects of technology improvements on supply chain and talent management, particularly in terms of sustainability and human-centric features.

Consequently, an evaluation was conducted to determine the level of reporting quality in each study. This entailed assessing the clarity and comprehensiveness of the documentation of the research process, the results obtained and the circumstances under which the research was carried out. Studies that complied with reporting criteria, including the provision of explicit descriptions of their techniques, comprehensive discussions of their results and recognition of their limits, received higher ratings.

Ultimately, the impact of each study on the progress of knowledge in the fields of Industry 4.0, Industry 5.0, SSCM and talent management was taken into account. High-quality studies were defined as those that presented innovative perspectives, questioned established frameworks or conducted thorough analyses of existing literature that could guide future study and application.

Ethical considerations

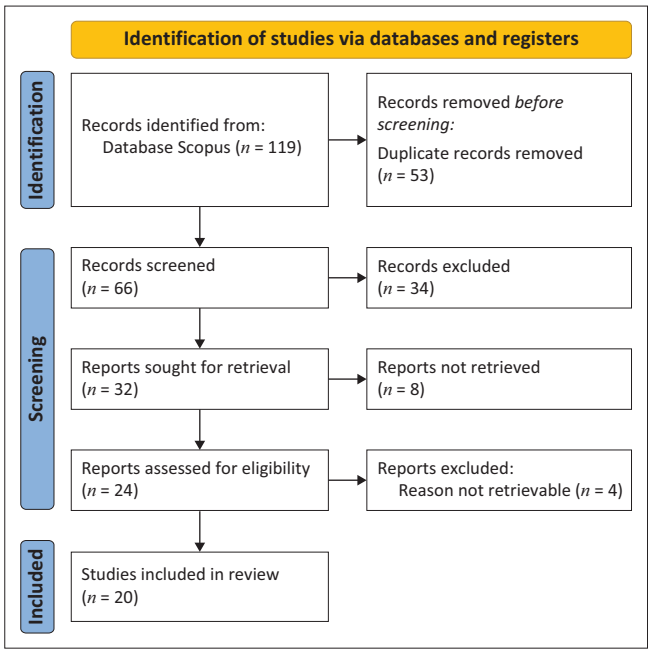
This article followed all ethical standards for research without direct contact with human or animal subjects.

Results

This systematic literature review examines the transition from Industry 4.0 to Industry 5.0, with a specific emphasis on SSCM and talent management. The PRISMA flow diagram was used to outline the meticulous approach used to find and choose relevant studies. The text provides information on the number of records identified through database searches, the number of records examined, the number of full-text articles evaluated for suitability and the number of studies included in the final synthesis. This comprehensive methodology guarantees that the review is conducted using a rigorous and systematic process of selecting high-quality studies, therefore yielding dependable insights into the research subject (Figure 1).

Figure 2, a pie chart, offers a detailed visual depiction of the distribution of scholarly articles which are related to SSCM and talent management from 2020 to 2023. The dataset classifies studies into distinct subject areas, showing the distribution of research results or academic documents across several fields. This classification exposes both the focal point of research interests and the possible deficiencies in documentation across many fields of study.

Based on the statistics, it is clear that 'Business Management and Accounting' is the most prevalent topic in the documentation landscape, with a total of 20 documents. This significant figure



Source: Rethlefsen, M.L., Kirtley, S., Waffenschmidt, S., Ayala, A.P., Moher, D., Page, M.J., & Koffel, J.B. (2021). PRISMA-S: An extension to the PRISMA statement for reporting literature searches in systematic reviews. *Systematic Reviews, 10*(1), 1–19. https://doi.org/10.1186/s13643-020-01542-z

FIGURE 1: Preferred reporting items for systematic reviews and meta-analyses framework.

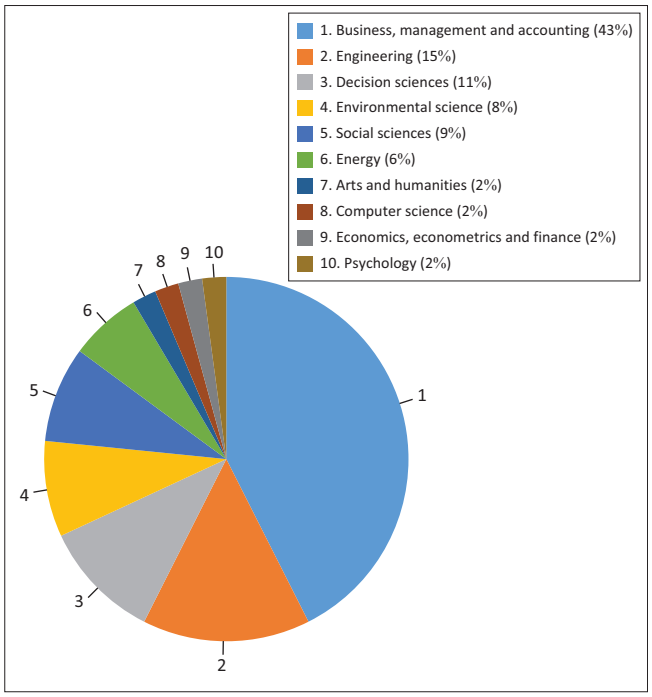


FIGURE 2: Documents by subject area.

indicates a distinguished emphasis on research and potentially a greater abundance of resources or interest in this particular field. The prevalence of this category can be traced to the widespread applicability of business management ideas and accounting practices across various industries, which motivates both academic and professional inquiries.

In addition, the field of 'Engineering' has a total of seven documents, which is the second-highest number among all fields. This demonstrates a strong enthusiasm for engineering subjects, which is probably a result of the continuous progress and breakthroughs in this specialised domain. The significant quantity of documents present here emphasises the key role that engineering plays in contemporary technological developments and the resolution of problems.

'Decision Sciences' is ranked third with five documents, indicating a significant involvement in this topic. This field encompasses key approaches and tools that are necessary for making well-informed decisions. The inclusion of this field emphasises its significance in improving strategies and results in diverse fields, such as business and engineering. The fields of 'Environmental Science' and 'Social Sciences' each have four documents, indicating a moderate level of research activity. The equitable presence of these disciplines indicates a harmonious focus on both the natural environment and social sciences. Environmental Science documents typically focus on key matters concerning sustainability and ecological equilibrium, while Social Sciences investigates the details of human behaviour and societal frameworks.

The 'Energy' category, containing three documents, implies a concentrated yet restricted investigation of subjects relating to energy. This could include research on renewable energy, energy efficiency and associated technologies, which demonstrates the increasing significance of energy sustainability. Particularly, there is just one document representing each of the subjects 'Arts and Humanities', 'Computer Science', 'Economics, Econometrics, and Finance' and 'Psychology'. This concise representation could suggest either specialised study interests or emergent topics within the scope of this dataset. The exclusive concentration on these categories may also emphasise prospective areas for additional investigation and improvement in order to achieve a more equitable distribution of academic output across all fields of study.

Thematic analysis

Figure 3 displays a word cloud that represents the most commonly appearing terms found in the titles of the publications in the given dataset. This visual depiction emphasises important themes and significant aspects of the research findings, providing valuable insights into the prevailing subjects and patterns. The most significant and conspicuous words in the cloud are 'innovation'. 'industry' and 'performance'. The focus on 'innovation' suggests a prominent scholarly interest in innovative and revolutionary concepts, methods and technology. This indicates that a significant number of the documents focus on investigating innovative methodologies and progress in diverse disciplines. The term 'industry' emphasises a concentration on pragmatic applications and the influence of research on industrial practices, demonstrating a strong correlation between academic research and real-world industrial difficulties. The significance of 'performance' indicates a focus on assessing and improving the efficiency, effectiveness and results of different processes and systems.

FIGURE 3: Word cloud.

Additional noteworthy terms encompass 'sustainable', 'administration', 'electronic', 'adaptability' and 'innovations'. The term 'green' implies a significant emphasis on sustainability and environmentally conscious behaviours, indicating that numerous research articles are dedicated to minimising environmental harm and advancing sustainable development. The term 'management' emphasises the significance of organisational and strategic elements, indicating that the study of effective management techniques is important. The inclusion of the terms 'digital' and 'technologies' suggests a strong focus on digital transformation and the integration of innovative technologies, highlighting the key role of technological progress in shaping contemporary research priorities. 'Resilience' pertains to the capacity of systems and organisations to endure and bounce back from disturbances, which is especially significant in light of recent global difficulties such as the coronavirus disease 2019 (COVID-19) epidemic.

The terms 'adoption', 'framework', 'implementation' and 'improve' indicate a concentration on the practical use and the process of incorporating innovative concepts and technology into current systems. This suggests that several documents focus on not just creating innovative ideas but also on how these ideas can be efficiently implemented and put into practice in real-life situations. However, the inclusion of terms such as 'sustainability', 'logistics', 'human', 'quality' and 'technologies' suggests a diverse array of study interests. The term 'sustainability' emphasises the continued significance of research focussed on achieving a balance between economic, environmental and social objectives.

The term 'logistics' implies a concentration on improving the efficiency of supply chain and distribution processes, whereas the terms 'human' and 'quality' indicate a keen interest in human elements and the overall excellence of outputs or products. The word cloud also displays several smaller yet noteworthy terms, including 'pandemic', 'digitalisation', 'challenges', 'framework' and 'effect'. These phrases signify particular areas of interest and concern, indicating that scholars are actively investigating current concerns and providing solutions to present challenges.

The thematic analysis outcome is provided in Table 1. This analysis categorises the research findings into three main themes, each supported by different sub-themes that represent specific research focusses within these broader categories.

The theme of Adoption of Modern Technology emphasises the key importance of incorporating sophisticated technology into industrial processes as a part of the road towards digital transformation. The inclusion of sub-themes such as 'digital transformation', 'AI applications' and 'technology advances in Industry 4.0' demonstrates a deliberate attempt to improve the precision and effectiveness of supply chain management using advanced digital tools and innovative methods. The theme emphasises the significance of digital transformation in improving and tailoring supply chain management to address the distinct requirements and situations of different industries.

The mentioned publications (Cannavacciuolo et al., 2023; Javaid et al., 2022; Wang & Esperança, 2023; Yin & Yu, 2022) offer a thorough comprehension of how these technical breakthroughs contribute to sustainable development and improve operational efficiency.

The theme of Human Resource Challenges highlights the importance of synchronising worker competencies and human

TABLE 1: Themes and sub-themes and supporting quotes.

Main themes	Sub-themes	Supporting quotes
Adoption of modern technologies	Digital transformation	An adoption-implementation framework of digital transformation for sustainable development (Yin and Yu, 2022).
		Can digital transformation improve market and operational performance? (Wang and Esperança, 2023).
		Digital transformation in Industry 4.0: opportunities and challenges (Dabo and Hosseinian-Far, 2023).
	AI applications	Artificial Intelligence Applications for Industry 4.0: A review (Javaid et al., 2022).
		Artificial Intelligence and its implications in Industry 4.0 (Javaid et al., 2022).
		Exploring AI in manufacturing: A comprehensive review (Das et al., 2023).
	Technological innovations in Industry 4.0	Technological innovation-enabling industry 4.0: A study … (Cannavacciuolo et al., 2023).
		Technological advancements driving industry 4.0 (Cannavacciuolo et al., 2023).
		Innovations in Industry 4.0: a pathway to sustainability (Siyal et al., 2023).
Human resource challenges	Reskilling and upskilling	Employees' reskilling and upskilling for industry 4.0 … (Leon, 2023).
		Reskilling in the age of Industry 4.0 (Leon, 2023).
		Upskilling workforce for technological advancements … (Javaid et al., 2023).
	Human factors in Industry 4.0	Reinforcing the significance of human factor in industry 4.0 (Mondal and Samaddar, 2023).
		Human factors and their impact on Industry 4.0 (Mondal and Samaddar, 2023).
		The role of human factors in digital transformation … (Ooi et al., 2023).
	HRM in technological change	Analysis of human resource management challenges in technological change ... (James et al., 2022).
		HR strategies for managing technological change … (James et al., 2022).
		Challenges in HR management during Industry 4.0 … (Gupta et al., 2022).
Sustainable practices	Corporate sustainability	Corporate sustainability entrepreneurship … The role of external factors … (Khan et al., 2023).
		Sustainability practices in corporate entrepreneurship … (Khan et al., 2023).
		Corporate sustainability in the digital age … (Siyal et al., 2023).
	Lean production and sustainability	The impact of lean production on sustainable operations … (Ooi et al., 2023).
		Lean production as a strategy for sustainability … (Ooi et al., 2023).
		Lean Industry 4.0: Past, present, and future … (Hines et al., 2023).
	Overcoming barriers to innovation	Strategies to overcome barriers to innovative practices … (Gupta et al., 2022).
		Innovative practices in overcoming sustainability challenges … (Gupta et al., 2022).
		Adoption of modern technologies for implementing Industry 4.0 … (Javaid et al., 2023).

Note: Please see the full reference list of this article, Samuels, A.B., & Pelser, A.-M. (2025). Transitioning from Industry 4.0 to 5.0: Sustainable supply chain management and talent management insights. *SA Journal of Human Resource Management/SA Tydskrif vir Menslikehulpbronbestuur, 23*(0), a2874. https://doi.org/10.4102/sajhrm.v23i0.2874 for more information.
AI, artificial intelligence; HRM, human resource management.

elements with the technology progress of Industry 4.0 and Industry 5.0. The sub-themes of 'reskilling and upskilling', 'human aspects in Industry 4.0' and 'HRM in technological transition' emphasise the urgent requirement for ongoing education and strategic management of human resources. These endeavours are key for preserving a competitive advantage and guaranteeing that employees can adeptly adjust to and flourish in progressively automated and technologically sophisticated settings (James et al., 2022; Leon, 2023; Mondal & Samaddar, 2023). This theme demonstrates a dedication to cultivating a workforce that is capable of supporting SSCM through continuous learning and adjustment.

The sustainable practices theme integrates environmental, social and economic factors into industrial and supply chain activities. The inclusion of sub-themes such as 'corporate sustainability', 'lean production and sustainability' and 'overcoming hurdles to innovation' exemplify a thorough approach to incorporating sustainability into business operations. Studies suggest that incorporating sustainable practices in corporate entrepreneurship and adopting lean manufacturing methods are key to reducing environmental harm and improving operational efficiency (Hines et al., 2023; Khan et al., 2023; Ooi et al., 2023). This subject represents a forward-looking strategy that focusses on continuous improvement and the long-lasting nature of supply chain management solutions, guaranteeing that progress in the sector is both ecologically and economically sustainable.

Discussion

The transition from Industry 4.0 to Industry 5.0 signifies a fundamental change in the manufacturing and supply chain industries. This change involves the incorporation of modern digital technology and a renewed emphasis on practices that prioritise human well-being and sustainability. This systematic literature review pursues to clarify the effects of this change on SSCM and talent management. Through the process of classifying study outcomes into fundamental themes, we provide a thorough understanding of how the adoption of modern technology, human resource challenges and sustainable practices come together to drive industrial success. This discussion explores these themes, providing insights into the influence of the transition from Industry 4.0 to Industry 5.0 on SSCM and talent management. This is achieved by a thorough review of relevant literature. This thorough perspective will help businesses position themselves in the competitive and ever-changing landscape of Industry 5.0, eventually encouraging sustainable growth and improved competitiveness.

Theme 1: Adoption of modern technologies

Digital transformation refers to the ongoing and complex process of incorporating new digital tools and technology into different areas of an organisation's activities, as part of the adoption of modern technologies. It is a continuous

process that requires the use of innovative digital technologies to stimulate strategic revitalisation within an organisation. This renewal involves the restructuring of the business model, encouraging collaboration and shaping the organisational culture, emphasising the significance of adaptability in response to technological progress (Warner & Wäger, 2019). This implies that digital transformation is not a singular occurrence but an ongoing process that requires organisations to adopt change and innovation in order to remain competitive in the digital age.

The integration of contemporary digital technology is key in initiating digital transformation, specifically for small and medium-sized enterprises (SMEs). Vrontis et al. (2022) state that incorporating digital technology can accelerate the digital transformation of SMEs in their early stages. This adoption empowers these businesses to improve their ability to allocate resources with greater agility and flexibility (Vrontis et al., 2022). This emphasises the importance of integrating contemporary technologies as a key measure in attaining digital transformation, particularly for smaller enterprises aiming to remain pertinent and competitive in speedily changing marketplaces.

The incorporation of digital technology, such as data analytics and automation, into organisational routines can result in significant alterations in work processes, structures and cultures. According to Almatrodi and Skoumpopoulou (2023), digital transformation refers to the integration of digital tools that fundamentally change the way organisations function daily. This highlights the significant influence of digital technology on how organisations operate and emphasises the need for businesses to modify their procedures to fully utilise the advantages of digital transformation.

The integration of AI technology into several sectors has been steadily rising, demonstrating its potential to revolutionise operations and improve efficiency. Research conducted by Zhu et al. (2022) demonstrates the practicality of AI technology in achieving automation in contemporary logistics systems, with a particular focus on its ability to streamline operations and improve overall performance. This highlights the importance of AI in improving supply chain operations, in line with the objectives of Industry 5.0. The use of AI in talent management, as proposed by Hassan (2021), offers prospects for improving decision-making procedures and undertaking complex difficulties in diverse sectors. By integrating AI technologies into accounting operations, organisations are able to reap the advantages of improved solutions and equip workers with cutting-edge technological expertise.

The incorporation of AI not only simplifies talent management procedures but also improves the overall efficiency and efficacy of workforce management methods during the transition to Industry 5.0. Artificial intelligence applications play a key role in promoting innovation and efficiency in the construction of smart city development sector. Research conducted by scholars, including the study titled 'Research on the Application of Artificial Intelligence Technology in Intelligent Buildings' (Anon, 2022b) and the examination of AI's role in smart cities by Dash and Sharma (2022), highlights the significant impact of AI in improving urban infrastructure and promoting sustainability. Through the utilisation of AI technology, construction methods can undergo a significant transformation, resulting in the creation of more intelligent and productive urban areas that adhere to the principles of Industry 5.0.

The integration of AI in financial management, as examined by Dong (2018), demonstrates how AI technology can effectively analyse large amounts of data and improve financial planning and budgeting procedures. This not only improves the precision and effectiveness of financial operations but also adds to well-informed decision-making and strategic financial management practices. Artificial intelligence applications in financial management are key in the shift towards Industry 5.0, where data-driven analysis and automation are pivotal for promoting sustainable business practices.

In the field of engineering project management, the implementation of advanced AI technology, as explored by Gao et al. (2022), emphasises the significance of AI applications in improving project management methodologies. Organisations can improve project workflows, optimise resource allocation and improve project outcomes by raising awareness among project managers about the advantages of deep AI. This highlights the significance of AI in promoting innovation and effectiveness in project management methodologies, in line with the goals of Industry 5.0.

One of the primary risks associated with AI in supply chain management is the potential for algorithmic bias, which can result in unfair decision-making processes and exacerbate existing inequalities within supply chains. Kanti et al. (2022) have observed that the ethical implications of AI deployment require a balanced approach that considers both technological advancement and ethical governance. In addition, the integration of AI in supply chains raises concerns regarding data privacy and security, particularly as organisations collect and analyse voluminous sensitive information. Nevertheless, Jayaneththi et al.'s (2023) research has a primary focus on AI in medical devices and does not directly substantiate the assertions made regarding the privacy and security of supply chain data.

In addition, job displacement may result from the reliance on AI, as automation may replace human-held positions. This concern is echoed in the literature, which posits that

organisations must prioritise the upskilling of their workforce to accommodate new roles that necessitate a more profound comprehension of AI technologies (Glebova, 2024). Kanti et al. (2022) further substantiate the necessity of a human-centric approach, contending that, despite the potential benefits of AI in terms of operational efficiency, it is imperative to maintain human oversight in decision-making processes to guarantee the preservation of emotional intelligence and empathy in organisational dynamics.

Organisations should apply frameworks that prioritise stakeholder engagement and ethical considerations to encourage the responsible use of AI. For example, it is imperative that the integration of AI technologies be accompanied by strong governance structures that address ethical dilemmas and ensure adherence to regulatory standards. Sullivan and Wamba (2022) emphasise that the development of resilience through AI necessitates a strategic approach that integrates learning and adaptation to disruptions, thereby improving the overall performance of the firm. Davianto (2022) recommends that organisations establish a culture of continuous innovation and improvement, which emphasises the importance of data-driven decision-making in optimising operational efficiency. To achieve integrated supply chain management, this culture should encourage collaboration between human resources and AI systems, capitalising on the respective strengths of each.

The implementation of contemporary technologies, such as those related to Industry 5.0, requires a workforce that possesses extensive knowledge and skills in digitalisation (Ghobakhloo et al., 2022), Organisations must give priority to reskilling and upskilling programmes to guarantee that staff have the key skills to effectively use digital tools and contribute to technological breakthroughs in their sectors (Ghobakhloo et al., 2022). The disruptions caused by Industry 4.0 demand individuals to acquire new skills and update existing ones. This affects different areas of HRM, including recruiting and performance appraisal. It emphasises the importance of ongoing learning and skill development programmes (Agarwal et al., 2021).

As firms adapt to Industry 5.0, there is an increasing focus on developing competencies and improving digital skills to address the problems presented by the new digital manufacturing paradigm (Čirčová & Blštáková, 2023; Jurczuk & Florea, 2022). Upskilling for the future should prioritise developing skills that facilitate successful communication in digital settings while reskilling should concentrate on competencies linked to data processing and utilisation (Čirčová et al., 2023; Jurczuk et al., 2022). These skills are key for employees to adjust to the evolving technological environment and make significant contributions to the integration of contemporary technology in the workplace (Jurczuk et al., 2022).

Theme 2: Human resource challenges

Human factors in Industry 4.0 pertain to the influence of human behaviour, capacities, constraints and interactions within the context of this highly advanced technical industrial setting. Multiple studies underline the relevance of human capital in Industry 4.0, emphasising its significance across many industries and its impact on corporate success (Bontis et al., 2000). It is critical for organisations to acknowledge and utilise the talents, expertise and abilities of their employees in order to effectively navigate the complexity of Industry 4.0. The human element of Industry 4.0 is closely connected to the organisational and human performance within sophisticated systems.

Comprehending and controlling human variables within the framework of Industry 4.0 is key to improving operational effectiveness and safeguarding the welfare of workers (Brocal et al., 2019). Research has highlighted the significance of ergonomics and human factors in solving occupational health and safety issues throughout the Industry 4.0 era (Badri et al., 2018). This emphasises the key importance of human aspects in establishing a secure and favourable work environment amid the technology breakthroughs that define Industry 4.0. Human-centred design of work systems is an essential aspect that arises in relation to human factors in Industry 4.0. It is key to create work systems that give priority to the well-being of humans, their cognitive abilities and their relationships with technology to successfully transition to Industry 5.0 (Kadir et al., 2021).

Studies have recognised multiple aspects of the human element that influence the quality of performance in supply chain management. These findings highlight the importance of combining human elements with intelligent technologies to improve operational results (Mondal & Samaddar, 2021). This integration is key for synchronising human qualities with technical progress in the changing industrial environment. The literature emphasises the significance of taking into account human aspects while analysing accidents and errors in many businesses. Research has categorised the human variables that contribute to accidents into various groups, including human error, unsafe environments, individual factors and organisational factors. This highlights the importance of addressing these elements to reduce incidents and improve workplace safety (Reyes-Martínez et al., 2012). Comprehending the significance of human factors in accidents is fundamental to developing efficient risk management techniques and safeguarding the welfare of employees in Industry 4.0 environments.

Human resource management is crucial in undertaking the difficulties brought about by technological developments, not just in manufacturing but also in sectors such as tourism and hospitality, as emphasised by Hrou and Bahaj (2014). To effectively manage human resources, it is imperative to adopt a proactive approach that takes into account the ever-changing nature of technological breakthroughs. This approach examines external elements such as technological

change, as well as internal factors such as organisational strategy and past HRM practices. Organisations must implement effective HRM practices to utilise technological breakthroughs and improve their competitiveness in the changing business environment.

The preparedness of human resources is a key determinant of success for organisations as they transition from Industry 4.0 to Industry 5.0 in the digital age, as emphasised by Herawati et al. (2021). The potential benefits offered by the industrial ecosystem in the era of Industry 4.0 depend on the readiness of human resources to adjust to technological progress and changing job responsibilities. Organisations are required to prioritise strategic human resource development that is in line with their aims and promotes a culture of creativity and adaptation to succeed in the age of technological advancements.

In addition, the implementation of contemporary technologies, such as those related to Industry 5.0, requires a workforce that possesses extensive knowledge and skills in digitalisation (Ghobakhloo et al., 2022), Organisations must give priority to reskilling and upskilling programmes to guarantee that staff have the key skills to effectively use digital tools and contribute to technological breakthroughs in their sectors (Ghobakhloo et al., 2022). The disruptions caused by Industry 4.0 demand individuals to acquire new skills and update existing ones. This affects different areas of HRM, including recruiting and performance appraisal. It emphasises the importance of ongoing learning and skill development programmes (Agarwal et al., 2021).

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Theme 3: Sustainability practices

Corporate sustainability is a strategic approach that takes into account the economic, social and environmental elements of enterprises in order to ensure their long-term viability (Caldera et al., 2017). Lean production aims to minimise inefficiency and maximise productivity in manufacturing operations. By integrating these two methodologies, organisations are able to attain a more environmentally friendly operation by diminishing resource utilisation, emissions and improving overall efficiency (Ogunbiyi et al., 2014). Implementing lean production principles as part of corporate sustainability strategies can result in significant improvements across multiple dimensions of sustainability. Research has indicated that the use of lean practices leads to a decrease in waste, an improvement in energy efficiency and more effective management of resources. These outcomes are in line with the objectives of sustainable business practices (Ogunbiyi et al., 2014).

The combination of lean and green models is able to offer a systematic method for organisations to incorporate sustainability practices into several aspects of their operations, including waste management, energy conservation and emissions reduction (Ogunbiyi et al., 2014). In the age of Industry 4.0, the rapid progress in technology has given rise to fresh challenges in the field of talent management. The advent of Industry 4.0 has led to a transformation in work, which in turn requires a reassessment of talent development strategies. This is necessary to address the disparity between the current skills possessed by employees and the changing demands of jobs (Whysall et al., 2019). Organisations are required to embrace creative strategies for talent management to guarantee that staff possess the critical skills required to excel in a digital and automated work environment.

The involvement of Green Supply Chain Management (GSCM) in mediating the relationship between lean manufacturing practices and sustainable performance emphasises the interdependence of different sustainability initiatives within Industry 4.0 (Awan et al., 2022). By incorporating lean principles into supply chain management and prioritising environmental factors, organisations can improve their overall sustainability performance and contribute to a more environmentally aware corporate ecosystem.

Effective talent management becomes crucial when migrating from Industry 4.0 to Industry 5.0. Effective talent management practices that prioritise employee engagement, growth and retention are key for guaranteeing a highly qualified workforce that can drive innovation and sustainability in the upcoming industrial revolution (Pandita et al., 2018). By aligning personnel management strategies with the principles of corporate sustainability and lean production, a synergistic impact can be created that improves corporate performance and contributes to a more sustainable future.

Several studies have emphasised the need to recognise and overcome these challenges in order to promote innovation and sustainability inside organisations (Agolla & Lill, 2016; Gupta et al., 2020; Xavier et al., 2020). Companies that aim to implement sustainable supply chain strategies often face challenges such as a deficiency in technical proficiency, restricted research and development resources, significant initial investments and reluctance to embrace change (Gupta et al., 2020). To address these problems, scholars have suggested the use of eco-innovation maturity models as a strategy to assist organisations in incorporating eco-innovation and improving their sustainability efforts (Xavier et al., 2020).

The literature highlights the significance of comprehending the interconnectedness within the network of economic

sustainability innovations in order to efficiently tackle challenges to SSCM (Ahmadi et al., 2023). Organisations are able to establish comprehensive plans to overcome challenges and promote sustainable practices by acknowledging the intricate and interconnected nature of sustainability innovations. The importance of working together and exchanging information has been recognised as a key component in addressing challenges to the implementation of sustainable practices (Olde et al., 2016; Weissenberger-Eibl & Hampel, 2021). Utilising external knowledge from open innovation platforms and exchanging experiences can assist in closing gaps in comprehending sustainable practices and facilitating their execution.

In addition, it is imperative to recognise the significance of organisational change processes in higher education institutions for the improvement of sustainability practices (Hoover & Harder, 2015). Universities are able to promote creativity, innovation and sustainable development by recognising and resolving challenges that hinder progress in these areas. Agolla et al. (2016) emphasise that promoting risk-taking and providing space for experimentation are key elements in overcoming challenges to innovation in public sector organisations.

Adopting a culture that prioritises innovation and the ability to learn from failures can promote sustainable practices and support the shift towards Industry 5.0.

Theoretical and practical implications

The theme of the adoption of modern technologies emphasises the significance of digital transformation and technical innovation. The incorporation of AI and sophisticated digital tools into industrial processes not only improves operational efficiency but also requires a reassessment of current theoretical frameworks. The integration of AI into supply chain management disrupts conventional concepts of operational efficiency and decision-making processes, advocating for a transition towards data-centric and automated methodologies. This requires the development of new theoretical models that integrate the capabilities and constraints of AI in improving the ability of supply chains to withstand disruptions and maintain long-term environmental and social viability.

The concept of sustainable practices combines corporate sustainability with lean production approaches, emphasising the theoretical overlap between environmental, social and economic sustainability. To successfully transition to Industry 5.0, it is crucial to adopt a comprehensive strategy for supply chain management that integrates SDGs. Theoretical models need to incorporate the complexities of applying sustainable practices throughout worldwide supply chains, while also tackling difficulties such as optimising resource utilisation, minimising waste and ensuring ethical sourcing. This requires an interdisciplinary methodology, incorporating knowledge from environmental science, economics and social responsibility.

The practical implications of moving from Industry 4.0 to Industry 5.0 are significant, especially in the areas of SSCM and talent management. The results of the systematic literature evaluation provide practical suggestions for practitioners seeking to negotiate this transition successfully. Regarding the adoption of modern technology, the practical implications entail the imperative for companies to allocate resources and embrace cutting-edge digital tools and AI technology. Companies should formulate comprehensive digital transformation strategies that utilise these technologies to improve the efficiency and sustainability of their supply chains. Practical measures involve using real-time data analytics to improve decision-making, utilising AI for predictive maintenance and demand forecasting, and adopting blockchain technology to provide transparent and secure supply chains.

The issue of human resource challenges has practical implications for the development of the workforce. Organisations should give high importance to reskilling and upskilling programmes to ensure that staff possess the key skills required to function and succeed in a technologically sophisticated setting. This entails establishing ongoing educational opportunities, cultivating a culture of creativity and formulating strategic human resources strategies that are in line with the objectives of Industry 5.0. It is imperative to revamp work structures in order to optimise human-machine cooperation, guaranteeing that technological progress does not undermine the well-being and efficiency of employees.

Regarding sustainable practices, firms must embrace and incorporate sustainable practices throughout their supply chains. This entails the implementation of lean production practices to minimise waste and optimise resource efficiency, the adoption of circular economy concepts to encourage recycling and reuse, and the assurance of ethical sourcing to increase social responsibility. Companies must formulate all-encompassing sustainability strategies that are in line with worldwide sustainability objectives, utilising technical developments to accomplish these aims.

Limitations

This study, while providing significant insights into the transition from Industry 4.0 to Industry 5.0, is subject to several limitations that must be acknowledged. Firstly, relying on existing literature may include biases that are inherent in the original studies, which could potentially restrict the comprehensiveness of our findings. Because of the fast rate of technical advancement and the changing nature of Industry 5.0 principles, some of the studies that have been evaluated may become outdated shortly. This can affect the significance of the conclusions that have been made. However, by excluding publications in languages other than English, there is a possibility that relevant studies, especially those conducted in non-Western contexts with distinct technology and management practices, were not considered. The study's emphasis on thematic analysis may have disregarded understated distinctions and industry-

specific circumstances that may have been caught by a more detailed method. Finally, the proposed practical applications are primarily theoretical and may encounter significant difficulties when put into practice in various real-life contexts. Therefore, additional empirical study is needed to confirm these findings and recommendations.

Conclusion and recommendations

This systematic literature review intended to clarify the effects of the transition from Industry 4.0 to Industry 5.0 on SSCM and talent management. The major findings suggest that incorporating modern digital technologies, such as AI and data analytics, is key to improving operational efficiency and sustainability in supply chain management. However, it is crucial to incorporate human-centred strategies and reskilling programmes to ensure that the skills of the workforce are in line with the technical progress of Industry 5.0. The focus on sustainable practices, which includes merging corporate sustainability and lean production processes, highlights the requirement for a comprehensive approach to supply chain management that considers economic, environmental and social goals.

Consequently, organisations should implement all-encompassing sustainability strategies that incorporate lean production practices in order to minimise waste and improve resource efficiency. Adopting circular economy ideas, advocating for recycling and reuse, and guaranteeing ethical sourcing are key measures for attaining SSCM. These plans should be in line with worldwide sustainability objectives, utilising technology progress to achieve these goals while also being competitive in the market.

The development of targeted upskilling and reskilling programmes that are specifically designed to meet the human-centric demands and technological advancements of Industry 5.0 is one of the most important practical recommendations. Organisations should collaborate with academic institutions to develop curricula that prioritise sustainability and integrate emerging technologies such as blockchain and AI, as indicated by the literature. For example, the integration of work-integrated learning opportunities can be facilitated by structured partnerships between universities and industries, which ensures that employees are equipped with practical, job-relevant skills. Furthermore, organisations may implement digital transformation strategies that capitalise on AI-driven predictive analytics to optimise their supply chains and make informed decisions.

Another practical recommendation is to implement lean manufacturing processes that incorporate circular economy principles, including recycling and waste minimisation, to attain economic efficiency and environmental sustainability. These initiatives can be piloted in specific supply chain segments by organisations to evaluate their effectiveness prior to their expansion.

Finally, in order to encourage sustainable behavioural change throughout the supply chain, it is imperative that firms implement supplier education programmes that align the sustainability objectives of lower-tier suppliers with those of the company.

Future research should prioritise doing empirical investigations to evaluate the theoretical conclusions of this review and investigate the practical deployment of Industry 5.0 technologies in various industrial environments. Conducting longitudinal research to analyse the lasting effects of digital transformation and sustainable practices on supply chain performance and talent management would yield more profound insights into the efficacy of these initiatives. It is important for research to incorporate non-Western contexts in order to gain a more thorough comprehension of worldwide practices and challenges in the shift towards Industry 5.0. Examining the interaction between technical progress and human-centred methods in diverse cultural and regulatory contexts can improve the current body of knowledge and provide practical recommendations for organisations globally.

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The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

A.B.S. and A.-M.P. significantly contributed to the conception, design, analysis and interpretation of the research article. A.B.S. and A.-M.P. confirm that the manuscript represents honest work and that no significant contributors have been omitted.

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Data availability

The data that support the findings of the study are available from the corresponding author, A.B.S., upon reasonable

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References

Agarwal, V., Mathiyazhagan, K., Malhotra, S., & Saikouk, T. (2021). Analysis of challenges in sustainable human resource management due to disruptions by industry 4.0: An emerging economy perspective. *International Journal of Manpower, 43*(2), 513–541. https://doi.org/10.1108/IJM-03-2021-0192

Agolla, J.E., & Lill, J.B.V. (2016). An empirical investigation into innovation drivers and barriers in public sector organisations. *International Journal of Innovation Science, 8*(4), 404–422. https://doi.org/10.1108/IJIS-06-2016-0006

Ahmadi, H., Pourhejazy, P., Moktadir, M.A., Dwivedi, A., & Liou, J.J.H. (2023). Delving into the interdependencies in the network of economic sustainability innovations. *IEEE Access, 11*, 29138–29148. https://doi.org/10.1109/ACCESS.2023.3260848

Almatrodi, I., & Skoumpopoulou, D. (2023). Organizational routines and digital transformation: An analysis of how organizational routines impact digital transformation transition in a Saudi University. *Systems, 11*(5), 239. https://doi.org/10.3390/systems11050239

Alves, A.P.F., Schultz, G., & Barcellos, M.D.D. (2019). Understanding sustainable supply chain coordination: A review of publications in Brazilian journals. *Revista Ciências Administrativas, 24*(3), 1–17. https://doi.org/10.5020/2318-0722.2018.6612

Anon. (2019). Industry 4.0 and effective talent management. *Human Resource Management International Digest, 27*(5), 13–15. https://doi.org/10.1108/HRMID-05-2019-0128

Awan, F.H., Liu, D., Jamil, K., Mustafa, S., Atif, M., Gul, R.F., & Guangyu, Q. (2022). Mediating role of green supply chain management between lean manufacturing practices and sustainable performance. *Frontiers in Psychology, 12*, 810504. https://doi.org/10.3389/fpsyg.2021.810504

Aylak, B.L. (2022). Impacts of sustainability on supply chain management. *European Journal of Science and Technology, 34*, 105–109. https://doi.org/10.31590/ejosat.1075779

Badri, A., Boudreau-Trudel, B., & Souissi, A.S. (2018). Occupational health and safety in the industry 4.0 era: A cause for major concern?. *Safety Science, 109*, 403–411. https://doi.org/10.1016/j.ssci.2018.06.012

Bontis, N., Keow, W.C.C., & Richardson, S. (2000). Intellectual capital and business performance in Malaysian industries. *Journal of Intellectual Capital, 1*(1), 85–100. https://doi.org/10.1108/14691930010324188

Brocal, F., González, C.M., Komljenović, D., Katina, P.F., & Pérez, M.Á.S. (2019). Emerging risk management in industry 4.0: An approach to improve organizational and human performance in the complex systems. *Complexity, 2019*(1), 1–13. https://doi.org/10.1155/2019/2089763

Caldera, S., Desha, C., & Dawes, L. (2017). Exploring the role of lean thinking in sustainable business practice: A systematic literature review. *Journal of Cleaner Production, 167*, 1546–1565. https://doi.org/10.1016/j.jclepro.2017.05.126

Cannavacciuolo, L., Ferraro, G., Ponsiglione, C., Primario, S., & Quinto, I. (2023). Technological innovation-enabling industry 4.0 paradigm: A systematic literature review. *Technovation, 124*, 102733. https://doi.org/10.1016/j.technovation.2023.102733

Chen, X. (2022). Research on the application of AI artificial intelligence technology in intelligent buildings. *Academic Journal of Architecture and Geotechnical Engineering, 4*(3), 37–41. https://doi.org/10.25236/AJAGE.2022.040306

Cho, S., Woods, R.H., Jang, S., & Erdem, M. (2006). Measuring the impact of human resource management practices on hospitality firms' performances. *International Journal of Hospitality Management, 25*(2), 262–277. https://doi.org/10.1016/j.ijhm.2005.04.001

Čirčová, V., & Blštáková, J. (2023). Building competence of managers for companies in digital transformation. *Ekonomické Rozhľady – Economic Review, 52*(1), 48–66. https://doi.org/10.53465/ER.2644-7185.2023.1.48-66

Dash, B., & Sharma, P.K. (2022). Role of artificial intelligence in smart cities for information gathering and dissemination (A review). *Academic Journal of Research and Scientific Publishing, 4*(39), 58–75. https://doi.org/10.52132/Ajrsp.e.2022.39.4

Dabo, A.A.A., & Hosseinian-Far, A. (2023). An integrated methodology for enhancing reverse logistics flows and networks in Industry 5.0. *Logistics, 7*(4), 97. https://doi.org/10.3390/logistics7040097

Das, S., Mondal, S., Struck, F., Eissfeldt, J., Beernink, L., Sigouras, V., Hoose, S., & Kopac, L. (2023). What can we see inside the crystal ball? Exploring opportunities and challenges for metaverse and circular economy. *Academic Journal of Interdisciplinary Studies, 12*(6), 221–237. https://doi.org/10.36941/ajis-2023-0165

Davianto, H. (2022). The advantages of artificial intelligence in operational decision making. *Hasanuddin Economics and Business Review, 6*(1), 24. https://doi.org/10.26487/hebr.v6i1.5082

Dong, J. (2018). Application research of artificial intelligence technology in enterprise financial management. In *Proceedings of the 2018 International Conference on Economics, Finance and Business Development (ICEFBD)*.

Fahimnia, B., Sarkis, J., Gunasekaran, A., & Farahani, R.Z. (2017). Decision models for sustainable supply chain design and management. *Annals of Operations Research, 250*(2), 277–278. https://doi.org/10.1007/s10479-017-2428-0

Gao, A., Guillao, N.L., & Zhou, Y. (2022). Modern engineering project management based on deep artificial intelligence technology. In *Proceedings of the 2022 3rd International Conference on Modern Education and Information Management (ICMEIM 2022)* (pp. 225–233).

Ghobakhloo, M., Iranmanesh, M., Vilkas, M., Grybauskas, A., & Amran, A. (2022). Drivers and barriers of industry 4.0 technology adoption among manufacturing SMEs: A systematic review and transformation roadmap. *Journal of Manufacturing Technology Management, 33*(6), 1029–1058. https://doi.org/10.1108/JMTM-12-2021-0505

Glebova, E. (2024). Artificial intelligence development and dissemination impact on the sports industry labor market. *Frontiers in Sports and Active Living, 6*, 1363892. https://doi.org/10.3389/fspor.2024.1363892

Gupta, H.C., Kusi-Sarpong, S., & Rezaei, J. (2020). Barriers and overcoming strategies to supply chain sustainability innovation. *Resources Conservation and Recycling, 161*, 104819. https://doi.org/10.1016/j.resconrec.2020.104819

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*, *69*, 101970. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85127105101&doi=10.1016%2fj.techsoc.2022.101970&partnerID=40&md5=7a973b65e5eb3a99d00a86f1a0dde78f 10.1016/j.techsoc.2022.101970

Haddach, A. (2020). Specification of logistic chain sustainability: Environmental, social and economic issues. *International Archives of the Photogrammetry Remote Sensing and Spatial Information Sciences, XLIV-4/W3-2020*, 241–248. https://doi.org/10.5194/isprs-archives-XLIV-4-W3-2020-241-2020

Hassan, S.A.A. (2021). The impact of artificial intelligence on the accounting profession in the tourism sector in Egypt. *International Journal of Applied Research, 7*(6), 319–328. https://doi.org/10.22271/allresearch.2021.v7.i6e.8716

He, Y., Qu, T., Zhang, K., Li, M., Huang, G.Q., & Chen, Z. (2023). Production logistics in industry 3.X: Bibliometric analysis, frontier case study, and future directions. *Systems, 11*(7), 371. https://doi.org/10.3390/systems11070371

Henriksen, B., & Thomassen, M.K. (2023). Industry 5.0 and manufacturing paradigms: Craft manufacturing – A case from boat manufacturing. In *IFIP International Conference on Advances in Production Management Systems* (pp. 282–296). Springer.

Herawati, A., Suhermin, S., Anisah, H.U., & Sambung, R. (2021). Industrial revolution 4.0: What should be prepared for the next stage?. *Jurnal Inovasi Ekonomi, 6*(1), 25–32. https://doi.org/10.22219/jiko.v6i01.14899

Hines, P., Tortorella, G.L., Antony, J., & Romero, D. (2023). Lean industry 4.0: Past, present, and future. *Quality Management Journal, 30*(1), 64–88. https://doi.org/10.1080/10686967.2022.2144786

Hoover, E., & Harder, M.K. (2015). What lies beneath the surface? The hidden complexities of organizational change for sustainability in higher education. *Journal of Cleaner Production, 106*, 175–188. https://doi.org/10.1016/j.jclepro.2014.01.081

Hrou, S.A.A., & Bahaj, M. (2014). Human resource management practice tourism and hotel industry. *SHS Web of Conferences, 12*, 01076. https://doi.org/10.1051/shsconf/20141201076

Ijeoma, O.G. (2022). Talent management and employee commitment in federal institute of industrial research Oshodi, Lagos Nigeria. *Journal of Human Resource &Leadership, 6*(2), 72–88. https://doi.org/10.53819/81018102t4060

James, A.T., Kumar, G., Tayal, P., Chauhan, A., Wadhawa, C., & Panchal, J. (2022). Analysis of human resource management challenges in implementation of industry 4.0 in Indian automobile industry. *Technological Forecasting and Social Change, 176*, 121483. https://doi.org/10.1016/j.techfore.2022.121483

Javaid, M., Haleem, A., Singh, R.P., & Suman, R. (2022). Artificial intelligence applications for industry 4.0: A literature-based study. *Journal of Industrial Integration and Management, 7*(1), 83–111. https://doi.org/10.1142/S2424862221300040

Javaid, M., Khan, S., Haleem, A. & Rab, S. (2023). Adoption of modern technologies for implementing industry 4.0: an integrated MCDM approach. *Benchmarking*, *30*(10), 3753–3790. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85141422144&doi=10.1108%2fBIJ-01-2021-0017&partnerID=40&md5=802f91fcbf1d4056c3be7b7395afc9bc 10.1108/BIJ-01-2021-0017

Jayaneththi, B., McCaffery, F., & Regan, G. (2023). Data security challenges in AI-enabled medical device software. In *2023 31st Irish Conference on Artificial Intelligence and Cognitive Science (AICS)* (pp. 1–6). IEEE.

Jimoh, L.A., & Kee, D.M.H. (2022). Talent management: The way out of poor task performance. *Industrial and Commercial Training, 54*(4), 623–636. https://doi.org/10.1108/ICT-03-2022-0016

Jing, W., Zhang, Y., & Goh, M. (2018). Moderating the role of firm size in sustainable performance improvement through sustainable supply chain management. *Sustainability, 10*(5), 1654. https://doi.org/10.3390/su10051654

Jurczuk, A., & Florea, A. (2022). Future-Oriented Digital Skills for Process Design and Automation. *Human Technology*, *18*(2), 122–142. https://doi.org/10.14254/1795-6889.2022.18-2.3

Kadir, B.A., & Broberg, O. (2021). Human-Centered Design of Work Systems in the Transition to Industry 4.0. *Applied Ergonomics*, *92*, 103334. https://doi.org/10.1016/j.apergo.2020.103334

Kanti, P.S., Sadia, R., & Das, S. (2022). Artificial intelligence adoption in supply chain risk management: Scale development and validation. *Ho Chi Minh City Open University Journal of Science – Economics and Business Administration, 12*(2), 15–32. https://doi.org/10.46223/HCMCOUJS.econ.en.12.2.2142.2022

Khan, N.R., Ameer, F., Bouncken, R.B., & Covin, J.G. (2023). Corporate sustainability entrepreneurship: The role of green entrepreneurial orientation and organizational resilience capacity for green innovation. *Journal of Business Research, 169*, 114296. https://doi.org/10.1016/j.jbusres.2023.114296

Kot, M. (2022). Sustainable supply chain management in the meat industry in Poland. *Acta Logistica, 9*(4), 487–499. https://doi.org/10.22306/al.v9i4.356

Kot, S. (2018). Sustainable supply chain management in small and medium enterprises. *Sustainability, 10*(4), 1143. https://doi.org/10.3390/su10041143

Leon, R.D. (2023). Employees' reskilling and upskilling for industry 5.0: Selecting the best professional development programmes. *Technology in Society, 75*, 102393. https://doi.org/10.1016/j.techsoc.2023.102393

Marshall, D., McCarthy, L., McGrath, P., & Claudy, M. (2015). Going above and beyond: How sustainability culture and entrepreneurial orientation drive social sustainability supply chain practice adoption. *Supply Chain Management an International Journal, 20*(4), 434–454. https://doi.org/10.1108/SCM-08-2014-0267

Mondal, S., & Samaddar, K. (2023). Reinforcing the significance of human factor in achieving quality performance in data-driven supply chain management. *TQM Journal, 35*(1), 183–209. https://doi.org/10.1108/TQM-12-2020-0303

Mukhsin, M., & Suryanto, T. (2022). The effect of sustainable supply chain management on company performance mediated by competitive advantage. *Sustainability, 14*(2), 818. https://doi.org/10.3390/su14020818

Ogunbiyi, O.E., Goulding, J.S., & Oladapo, A.A. (2014). An empirical study of the impact of lean construction techniques on sustainable construction in the UK. *Construction Innovation, 14*(1), 88–107. https://doi.org/10.1108/CI-08-2012-0045

Olde, E.M.D., Carsjens, G.J., & Eilers, C.H.A.M. (2016). The role of collaborations in the development and implementation of sustainable livestock concepts in the Netherlands. *International Journal of Agricultural Sustainability, 15*(2), 153–168. https://doi.org/10.1080/14735903.2016.1193423

Ooi, L.L., Teh, S.Y., & Cheang, P.Y.S. (2023). The impact of lean production on sustainable organizational performance: The moderating effect of industry 4.0 technologies adoption. *Management Research Review, 46*(12), 1802–1836. https://doi.org/10.1108/MRR-06-2022-0448

Pandita, D., & Ray, S. (2018). Talent management and employee engagement – A meta-analysis of their impact on talent retention. *Industrial and Commercial Training, 50*(4), 185–199. https://doi.org/10.1108/ICT-09-2017-0073

Paul, S., Ali, S.M., Hasan, M., Paul, S.K., & Kabir, G. (2022). Critical success factors for supply chain sustainability in the wood industry: An integrated PCA-ISM model. *Sustainability, 14*(3), 1863. https://doi.org/10.3390/su14031863

Rethlefsen, M.L., Kirtley, S., Waffenschmidt, S., Ayala, A.P., Moher, D., Page, M.J., & Koffel, J.B. (2021). PRISMA-S: An extension to the PRISMA statement for reporting literature searches in systematic reviews. *Systematic Reviews, 10*(1), 1–19. https://doi.org/10.1186/s13643-020-01542-z

Reyes-Martínez, R.M., Maldonado-Macías, A.A., & Prado-León, L.R. (2012). Human factors identification and classification related to accidents'causality on hand injuries in the manufacturing industry. *Work, 41*(S1), 3155–3163. https://doi.org/10.3233/WOR-2012-0577-3155

Reynolds, S. (2024). *Exploring the role of governance mechanisms in promoting sustainability across supply chains*.

Siyal, A.W., Chen, H., Shahzad, F., & Bano, S. (2023). Investigating the role of institutional pressures, technology compatibility, and green transformation in driving manufacturing industries toward green development. *Journal of Cleaner Production, 428*, 139416. https://doi.org/10.1016/j.jclepro.2023.139416

Sullivan, Y.W., & Wamba, S.F. (2022). *Artificial intelligence, firm resilience to supply chain disruptions, and firm performance*. Springer.

Tazin, F., & Hakim, E.B. (2022). Impact of talent management on employee performance in the banking industry of Bangladesh. *European Journal of Business and Management, 14*(14), 38–51.

Vrontis, D., Chaudhuri, R., & Chatterjee, S. (2022). Adoption of digital technologies by SMEs for sustainability and value creation: Moderating role of entrepreneurial orientation. *Sustainability, 14*(13), 7949. https://doi.org/10.3390/su14137949

Wang, S., & Esperança, J.P. (2023). Can digital transformation improve market and ESG performance? Evidence from Chinese SMEs. *Journal of Cleaner Production, 419*, 137980. https://doi.org/10.1016/j.jclepro.2023.137980

Wang, Z., & Sarkis, J. (2013). Investigating the relationship of sustainable supply chain management with corporate financial performance. *International Journal of Productivity and Performance Management, 62*(8), 871–888. https://doi.org/10.1108/IJPPM-03-2013-0033

Warner, K., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning, 52*(3), 326–349. https://doi.org/10.1016/j.lrp.2018.12.001

Weissenberger-Eibl, M.A., & Hampel, T. (2021). Bridging the gap: Integrating external knowledge from open innovation platforms. *Sn Business & Economics, 1*(7), 98. https://doi.org/10.1007/s43546-021-00101-5

Whysall, Z., Owtram, M., & Brittain, S. (2019). The new talent management challenges of industry 4.0. *The Journal of Management Development, 38*(2), 118–129. https://doi.org/10.1108/JMD-06-2018-0181

Wijaya, O.Y.A. (2023). The role of strategic entrepreneurship and social capital on sustainable supply chain management and organizational performance. *Uncertain Supply Chain Management, 11*(1), 53–60. https://doi.org/10.5267/j.uscm.2022.12.001

Wu, J., Zhang, X., & Lu, J. (2018). Empirical research on influencing factors of sustainable supply chain management – Evidence from Beijing, China. *Sustainability, 10*(5), 1595. https://doi.org/10.3390/su10051595

Xavier, A.F., Reyes, T., Aoussat, A., Luiz, L., & Souza, L.F.D. (2020). Eco-innovation maturity model: A framework to support the evolution of eco-innovation integration in companies. *Sustainability, 12*(9), 3773. https://doi.org/10.3390/su12093773

Xiao-xia, L., & Zhou, Y. (2022). Potential food security risks and countermeasures under the background of seed industry innovation based on Industry 4.0. *Mobile Information Systems, 2022*(12), 1–11. https://doi.org/10.1155/2022/9905894

Xing, C. (2023). Critical success factors for a sustainable supply chain: The case of Apple Inc. *Advances in Economics Management and Political Sciences, 39*(1), 11–16. https://doi.org/10.54254/2754-1169/39/20231923

Yin, S., & Yu, Y. (2022). An adoption-implementation framework of digital green knowledge to improve the performance of digital green innovation practices for industry 5.0. *Journal of Cleaner Production, 363*, 132608. https://doi.org/10.1016/j.jclepro.2022.132608

Zhu, X., Shi, Y., & Liu, N. (2022). Artificial intelligence technology in modern logistics system. *International Journal of Technology Policy and Management, 22*(1/2), 66. https://doi.org/10.1504/IJTPM.2022.122537