SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2024
ORGANIZATION AND MANAGEMENT SERIES NO. 236

HUMAN-MACHINE COLLABORATION IN 3PL SERVICES – BIBLIOMETRIC ANALYSIS

Mariusz KMIECIK

Silesian University of Technology; mariusz.kmiecik@polsl.pl, ORCID: 0000-0003-2015-1132

Purpose: The purpose of this study is to examine the state of research on human-machine collaboration (HMC) in the third-party logistics (3PL) sector through bibliometric analysis, with a focus on identifying dominant research streams, knowledge gaps, and future directions.
Design/methodology/approach: The study applies bibliometric methods to a dataset of 299 publications retrieved from the Scopus database. Using VOSviewer software, keyword co-occurrence networks and thematic clusters were generated to capture the structure of the literature. The analysis covers scientific articles, conference papers, and review papers published up to September 2025.
Findings: The results reveal five main thematic clusters: decision support systems and 3PL provider selection, supply chain management and digital market contexts, optimization and metaheuristics in logistics operations, 3PL services and economic conditions, and outsourcing and digital transformation. The analysis shows a strong emphasis on technological aspects such as artificial intelligence and decision support, whereas strictly human-centric issues such as ergonomics, trust, and acceptance are less prominent. The findings indicate that HMC is often framed implicitly through automation and AI, leaving space for more explicit research on socio-technical interactions.
Research limitations: The study is limited to Scopus-indexed publications and relies on bibliometric techniques, which emphasize frequently occurring terms and may underrepresent emerging or niche topics. Qualitative insights from case studies or in-depth empirical research are not captured.
Originality/value: This research contributes to the understanding of HMC in 3PL services by providing a structured overview of publication dynamics, thematic clusters, and global research distribution. The study also identifies specific areas where research remains scarce, particularly on the human side of collaboration, and points to directions for future investigation. Greater attention to human factors – such as trust, acceptance, and ergonomics – should complement technological progress.
Keywords: 3PL, human-machine, bibliometric analysis.
Category of the paper: Research paper.

1. Introduction

Over the past two decades, technologies such as advanced analytics, automation, and artificial intelligence have reshaped supply chains, particularly in the areas of demand forecasting, transport coordination, and warehouse management. Logistics operators, particularly third-party logistics (3PL) providers, face increasing pressure to improve efficiency, reduce costs, and ensure high-quality customer service under conditions of global competition. In this context, the use of tools based on artificial intelligence, automation, and cyber-physical systems, which support the planning, monitoring, and execution of logistics operations, has gained increasing importance (Ivanov, Dolgui, 2020). One of the key issues accompanying these transformations is human-machine collaboration (HMC). In practice, HMC combines human strengths – such as adaptive decision-making and problem solving – with machine capabilities in rapid data processing and precision execution (Wilson, Daugherty, 2018). The literature emphasizes that the effective implementation of HMC is a necessary condition for fully exploiting the potential of Industry 4.0 and Logistics 5.0 and at the same time reshape managerial approaches in 3PL services (Loo, 2025; Klumpp, Zijm, 2019).

Existing studies indicate that applications of HMC in logistics include order picking with the involvement of collaborative robots, transport route optimization, demand forecasting, and warehouse process automation (Ramachandran Venkatapathy et al., 2017; Yang et al., 2025). At the same time, attention is drawn to a number of challenges associated with implementing such solutions, including issues of trust in artificial intelligence systems, employee acceptance, and the design of ergonomic human-machine interfaces (Pantera et al., 2024; Haesevoets et al., 2021). Consequently, there is a need for in-depth literature analyses that can capture the current state of knowledge and identify key areas for further research. Bibliometrics, as a tool for the quantitative analysis of scientific publications, makes it possible to identify research trends, authors, institutions, and thematic areas that dominate a given field (Donthu et al., 2021; Aria, Cuccurullo, 2017). Its application in the context of research on HMC in 3PL services allows for obtaining an objective picture of the literature structure, as well as identifying research gaps and future directions.

The purpose of this article is to conduct a bibliometric analysis of the literature on human-machine collaboration in the 3PL services sector. The analysis is based on data obtained from the Scopus database and was conducted using the VOSviewer software. The results of the study enable the determination of publication dynamics, the identification of key authors, countries, and sources, and the presentation of a keyword co-occurrence map that reflects the main research streams in this field.

2. Theoretical background

Human-machine collaboration (HMC) is currently one of the most important areas of research on digital transformation in logistics and the operations of 3PL providers. In the context of increasing complexity in global supply chains, the integration of human competencies and the potential of artificial intelligence and automation allows for achieving synergistic effects that translate into both operational efficiency and social acceptance of new management models (Dashaputre, 2023; Jarrahi, 2018). The origins of artificial intelligence date back to the 1950s; however, practical applications in logistics only emerged with the development of data analytics and computing power in the 2000s (Dashaputre, 2023). Initially, these technologies primarily supported routine tasks such as route planning and demand forecasting (Russell, Norvig, 2020). Over time, their applications expanded to decision-making processes and tasks requiring greater human-machine interaction (Haesevoets et al., 2021).

Research shows that the greatest benefits are achieved in hybrid models, where decisions result from collaboration rather than competition between humans and technology. Wilson and Daugherty (2018) emphasize that organizations gain the most when AI supports humans in decision-making rather than completely replacing them. This approach is also relevant to 3PL services, where automation and human competencies are combined in areas such as order picking, transport planning, and documentation handling. The development of Industry 4.0 has brought the proliferation of cyber-physical systems (CPS) and the Internet of Things (IoT), which in logistics have enabled the decentralization of process control (Schuhmacher, Hummel, 2016). In the next phase – Industry 5.0 and Logistics 5.0 – the focus shifts to human-centric manufacturing and value-driven supply chains, where humans regain a central role as creative and adaptive partners to machines (Loo, 2025). Ramachandran Venkatapathy et al. (2017) indicate that in intralogistics, the synergy of humans and machines is made possible through digital twins and real-time data analytics. Yang et al. (2025) demonstrate that considering learning and forgetting effects among employees can significantly improve planning system performance, which is particularly important for 3PL providers, where workforce turnover is high.

The implementation of human-machine collaboration requires appropriate human-machine interfaces (HMI), which should be intuitive, ergonomic, and ethically designed. Pantera et al. (2024) emphasize that HMI design within the Industry 5.0 paradigm should focus on user needs and the creation of environments conducive to collaboration. Similarly, Seeber et al. (2020) note that treating machines as "coworkers" in teams requires redefining communication rules and shared responsibility. The acceptance of machines as partners in logistics processes is not straightforward. Haesevoets et al. (2021) showed that managers prefer a model in which machines have a limited decision-making role (about 30%), with humans holding the dominant

position. This reflects the phenomenon of algorithm aversion, described by Dietvorst et al. (2015), whereby people avoid using algorithms if they observe an error, even if such solutions are statistically more accurate. At the same time, studies indicate that in many tasks AI outperforms humans – for example, in medical diagnostics or forecasting (Grove et al., 2000; Wang et al., 2020). Building trust models that enable constructive collaboration is therefore crucial. McAfee and Brynjolfsson (2017) note that it is not "competition" with machines but rather the ability to use them effectively that determines competitive advantage.

Klumpp (2018, 2019), however, warns against the risk of creating an "artificial divide" between humans and AI systems, which could weaken the social sustainability of logistics processes. In this context, Fleming et al. (2019) argue that the future of work requires a new approach to human-technology relations, in which soft skills, empathy, and collaboration abilities become as important as technical skills. In practice, 3PL providers are increasingly implementing human-machine collaboration models that combine the capabilities of cobots, automated transport systems, and demand forecasting algorithms. Such solutions not only increase efficiency but also support sustainable development goals by reducing resource consumption and enhancing workplace safety (Klumpp, Zijm, 2019). Malone (2018) highlights that future organizations will operate as "superminds", combining the potential of humans and machines to solve complex problems. Bigman and Gray (2018) add that a particular challenge is the development of ethical frameworks that define the scope of human and machine responsibility in critical situations. In the case of 3PL, this is significant not only for operational efficiency but also for legal and social accountability. Human-machine collaboration in 3PL logistics constitutes a key element of the sector's transformation. It requires, on the one hand, investments in technological development and, on the other, building trust and developing employee competencies. Only then will it be possible to fully exploit the potential of HMC synergy as a foundation for resilience and innovation in future logistics.

3. Methods

In this study, bibliometric analysis was chosen because it allows a structured examination of scientific output on HMC in 3PL logistics, highlighting publication trends, co-author networks, and keyword patterns. (Donthu et al., 2021). By employing tools such as VOSviewer or Bibliometrix, it is possible to visualize relationships between publications and concepts and to create science maps. The literature highlights that bibliometrics is particularly applicable in the social sciences, management, and logistics, where the dynamic development of new technologies and concepts requires continuous assessment of research directions (Aria, Cuccurullo, 2017). These methods rely on the analysis of large bibliographic datasets (e.g., from Scopus or Web of Science), which allows for the objective capture of phenomena

that cannot be identified solely through traditional literature reviews. As Zupic and Čater (2015) note, bibliometrics enables not only a quantitative summary of research but also the creation of intellectual maps that reveal relationships between research streams. For this reason, it constitutes a valuable tool in identifying research gaps and directions for future analysis. In this study, a five-stage procedure (Figure 1) was adopted, presented in the diagram. Each step was designed to reflect a key stage of the bibliometric process, ensuring that the outcomes remain coherent and interpretable.

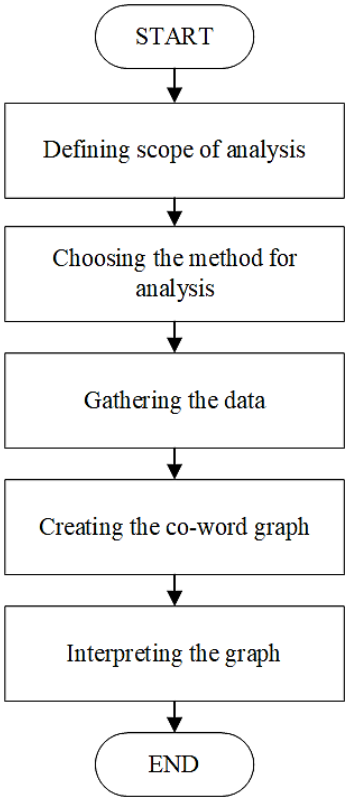

Figure 1. Bibliometric analysis procedure.

Source: own elaboration based on Donthu et al. (2021).

The first stage was to define the subject and scope of the analysis. The study focused on the issue of human-machine collaboration in the context of 3PL logistics providers. The time frame covers publications released up to September 2025, and the analysis included scientific articles, conference papers, and review papers. A precise definition of the research objective makes it possible to limit the number of analyzed documents to those relevant to the research topic. The second stage involved identifying the analytical technique. A keyword co-occurrence analysis was applied, which allows for the identification of thematic clusters and the main research streams in the analyzed area. This is one of the most commonly used methods in bibliometric studies, as it enables capturing the structure of the examined field of knowledge and the relationships between concepts (Aria, Cuccurullo, 2017). The tool used for constructing and visualizing the co-occurrence network was VOSviewer.

In the next step, bibliographic data were collected from the Scopus database. This is one of the largest and most reliable databases indexing scientific publications in the social sciences, technical sciences, and natural sciences. Table 1 presents the query used for data retrieval.

Table 1.
Query used in bibliometric analysis

Advanced search in SCOPUS based on query:
TITLE-ABS-KEY(*(* *"human-machine collaboration" OR "human-machine collaboration" OR "human-machine interaction"* *OR "human-computer interaction" OR "human-AI collaboration" OR "human artificial intelligence collaboration"* *OR "man-machine collaboration" OR "cobotics" OR "collaborative robots" OR "human-robot interaction"* *OR "automation" OR "autonomous systems" OR "decision support systems"* *OR "artificial intelligence" OR "cyber-physical systems" OR "logistics 4.0" OR "logistics 5.0"* *)* *AND* *(* *"3PL" OR "third-party logistics" OR "third party logistics"* *OR "logistics service provider" OR "logistics service providers"* *OR "outsourced logistics" OR "contract logistics"* *OR "logistics outsourcing" OR "logistics operator" OR "logistics providers"* *)* *)* *AND (LIMIT-TO(DOCTYPE, "ar") OR LIMIT-TO(DOCTYPE, "re") OR LIMIT-TO(DOCTYPE, "cp"))* *AND (LIMIT-TO(LANGUAGE, "English"))* *AND (EXCLUDE(SRCTYPE, "k"))*

Source: own work.

The data were obtained in CSV format, containing information on publication titles, authors, keywords, sources, and citation counts. These data form the basis for further quantitative and qualitative analysis. Based on the collected records, a keyword co-occurrence network was developed. This process includes, among other steps, identifying the frequency of individual terms, establishing thresholds for the minimum number of occurrences, and analyzing the strength of associations between words. The result is a map visualizing thematic clusters that represent the main research areas related to the examined issue.

The final step was the interpretation of the results. The analysis of keyword clusters enables the identification of dominant research areas, such as the automation of logistics processes, the role of artificial intelligence in 3PL services, and the social aspects of human-machine collaboration. The interpretation of the map allows for linking the results with the existing literature, as well as identifying potential research gaps and future directions.

4. Results

Based on the Scopus query, a set of 299 publications related to the issue of human-machine collaboration in 3PL services was obtained (Figure 2). This number was large enough to capture diverse research streams, while still keeping the co-occurrence map clear and free from excessive noise. The VOSviewer software was used to construct the keyword co-occurrence network, with the settings shown in the figures. Node size was defined based on the number of occurrences (Weights: Occurrences), which made it possible to highlight the most frequently used terms in the research. Labels were limited to a maximum of 30 characters, and the graphic layout was enriched with colored, curved lines illustrating the strength of associations between individual terms. The use of the Cluster Colors option allowed for the visual separation of thematic clusters, which greatly facilitates the interpretation of the map. The analysis employed the Association strength normalization method, commonly used in bibliometric studies, as it ensures a balance between frequency of occurrence and co-occurrence strength of terms. Default layout settings were applied (attraction = 2, repulsion = 0), which allowed for generating a clear network structure. The clustering process was carried out at a resolution of 1.0 with the Merge small clusters function enabled, thus capturing the main thematic groups while avoiding fragmentation of the map.

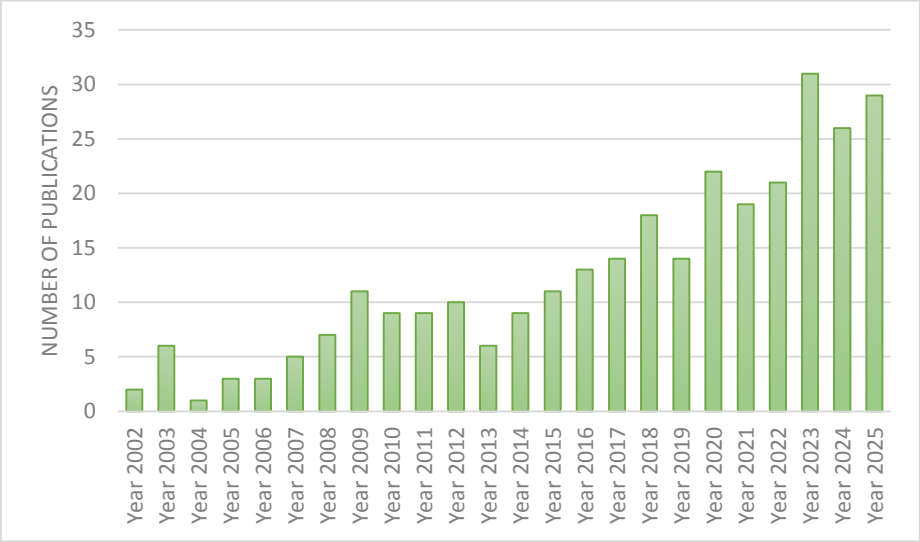

Figure 2. Number of publications per year.

Source: own work.

The analysis of the annual number of publications indicates a clearly increasing interest in the issue of human-machine collaboration in the context of 3PL providers (Figure 2). In the initial period (2002-2010), the number of articles was relatively low and did not exceed a dozen publications per year, confirming the exploratory nature of the research. Between 2011 and 2017, a gradual increase in interest was observed, followed by a marked acceleration in publication dynamics after 2018. Particularly noteworthy is the period after 2020, during

which the number of publications increased significantly, reaching its highest level in 2023 (over 30 publications). The upward trend suggests that HMC has become a recognized research area within logistics and 3PL services. This increase coincides with broader supply chain digitalization and with the practical roll-out of AI-driven tools such as automated picking systems and predictive analytics. Figure 3 presents the percentage share of individual publication types in the total number of publications.

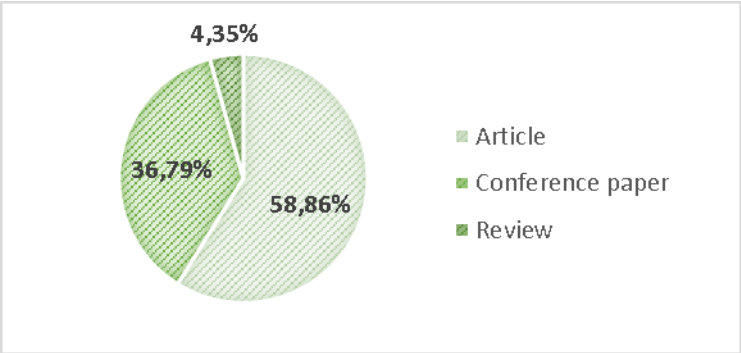

Figure 3. Shares of particular publications types.

Source: own work.

The structure of the analyzed set of publications indicates that the dominant form is scientific articles, which account for 58.86% of all documents (Figure 3). Conference papers rank second (36.79%), suggesting that research on human-machine collaboration in the context of 3PL is a dynamically developing area, often presented at academic and industry forums prior to journal publication. Review articles constitute a small share (4.35%), which confirms that this field is still in a phase of intensive exploration and that the literature is only beginning to undergo systematic syntheses. These results highlight the need for further review studies and meta-analyses that could organize the existing knowledge and indicate directions for future research. Figure 4 shows the number of publications in the top 10 countries based on the number of authors affiliated with the publications.

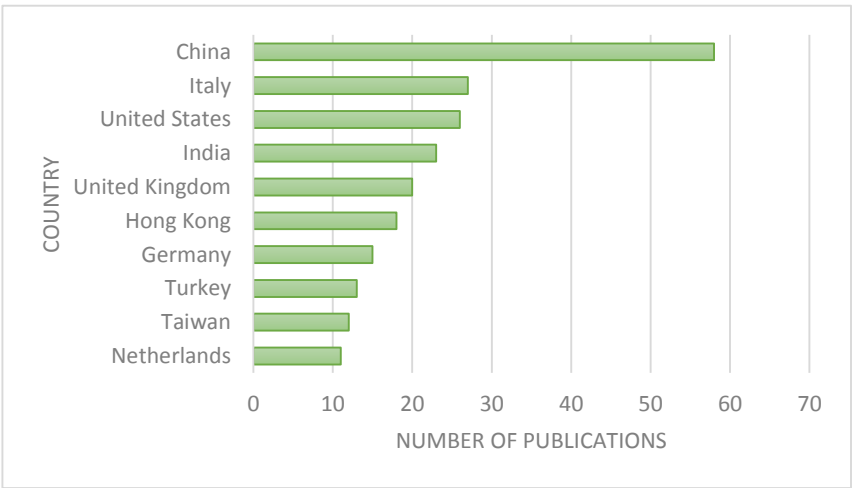

Figure 4. Number of publications in TOP10 countries (accordingly to affiliations numbers).

Source: own work.

The analysis of the geographical distribution of publications indicates that the largest number of studies on human-machine collaboration in 3PL services comes from China (nearly 60 publications), confirming the dominant role of this country in the development of research on automation and artificial intelligence in logistics (Figure 4). Italy and the United States follow (about 25 publications each), reflecting both the importance of these countries as scientific centers and the practical implementation of technologies in the logistics sector. Also included in the top ten are India, the United Kingdom, Hong Kong, and Germany, which have strong research traditions in supply chain management and logistics process digitalization. Countries such as Turkey, Taiwan, and the Netherlands complete the top ten, indicating a growing interest in HMC issues in both developing regions and smaller research centers. The geographical diversity underscores the global nature of the analyzed issue, while also highlighting differences in research intensity across regions.

As a result, a co-occurrence network was created in which each identified cluster represents a specific research stream (Figure 5). This map can be interpreted as a reflection of the literature structure concerning the application of artificial intelligence, automation, and human-machine collaboration solutions in the 3PL sector. These results provide the basis for further analysis aimed at a detailed discussion of the dominant themes and research directions in the examined area.

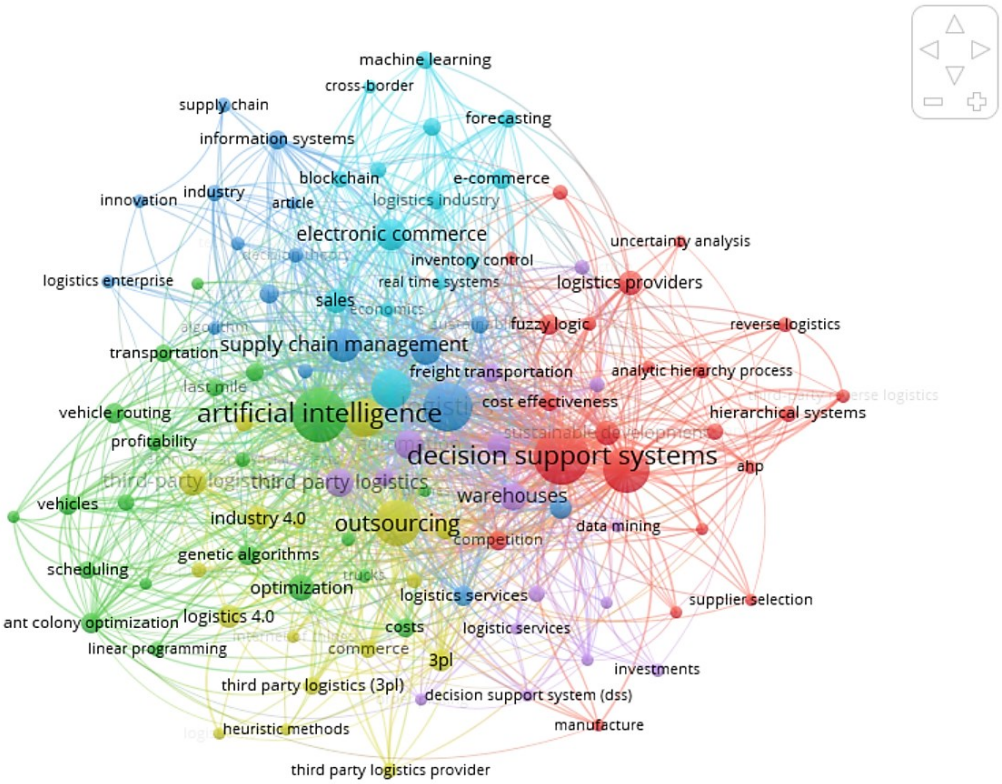

Figure 5. Co-occurrence map.

Source: own work.

The co-occurrence map (VOSviewer, association strength normalization, weights = occurrences, colors = clusters) for the set of 299 records reveals five distinct thematic clusters:

- Cluster 1 (red) – Decision support systems and 3PL provider selection.
- Cluster 2 (blue) – Supply chain management (SCM) and digital market contexts.
- Cluster 3 (green) – Optimization and metaheuristics in 3PL operations.
- Cluster 4 (purple) – 3PL as a service category and the economics of operations.
- Cluster 5 (yellow) – Outsourcing and digital transformation.

The first cluster encompasses issues related to decision support systems and the selection of 3PL providers. At its core are terms such as decision support systems, logistics providers, supplier selection, AHP, fuzzy logic, and data mining. This cluster highlights a concentration of research on methods supporting the evaluation, selection, and management of logistics providers. The second cluster focuses on supply chain management and digital market contexts. The most important concepts include supply chain management, electronic commerce, forecasting, information systems, real-time systems, and freight transportation. This indicates a strong link between research on 3PL and the development of e-commerce and the digitalization of logistics processes.

The third cluster covers optimization and the application of metaheuristics in logistics operations. It is dominated by terms such as vehicle routing, scheduling, optimization, genetic algorithms, ant colony optimization, linear programming, and transportation. Research in this cluster addresses operational challenges common to 3PL providers, such as vehicle routing in last-mile delivery or the use of metaheuristics for large-scale scheduling. The fourth cluster directly addresses 3PL services and their economic conditions, with terms such as 3PL, third-party logistics, logistics services, costs, investments, competition, warehouses, and manufacture. This cluster includes research concerning the role and scope of services provided by operators, as well as their impact on cost efficiency and business competitiveness. The fifth cluster relates to outsourcing and digital transformation, including the concepts of Industry 4.0 and Logistics 4.0. At its core are outsourcing, Industry 4.0, and Logistics 4.0, which connect the issue of external service providers with processes of digitalization and automation in logistics.

Two central “hubs” – artificial intelligence and decision support systems – have the highest total link strength, serving as bridges between the methodological optimization cluster (green) and the application-focused 3PL clusters (purple) and supplier selection (red). This reflects a pattern of AI/DSS → decision-making → 3PL operations. Outsourcing lies at the intersection of 3PL and digital transformation, confirming that a significant portion of the literature conceptualizes 3PL primarily as a tool for outsourcing logistics functions rather than solely as a network integrator. Warehouses appears near the DSS and 3PL nodes, pointing to a large body of research on decision-oriented warehouse automation (e.g., technology selection, automation levels, resource planning).

Strictly "human-centric" terms (human-robot interaction, cobotics, HMI/HMC) are less represented or peripheral – the theme of human-machine collaboration in 3PL is most often implied through the presence of AI/DSS/automation, and less frequently explored as a distinct research thread. This highlights a research gap concerning the role of humans (trust, acceptance, ergonomics, XAI) in 3PL processes.

5. Discussion

5.1. Findings

The findings of this study confirm that research on human-machine collaboration (HMC) in 3PL services is expanding rapidly, with a notable focus on artificial intelligence, decision support systems, and logistics process automation. However, the bibliometric analysis also shows that strictly human-centric aspects, such as ergonomics, acceptance, and trust, remain underrepresented. This observation aligns with Grosse (2024), who emphasized that despite significant technological progress in supportive and substitutive solutions for order picking, human factors continue to be central determinants of operational outcomes. In particular, Grosse's content analysis highlights that while technologies such as augmented reality, exoskeletons, or automated guided vehicles can enhance efficiency, their adoption is constrained by psychosocial aspects, resistance to change, and concerns over job autonomy. These insights reinforce our observation that human-centric considerations in HMC research are often marginalized in favor of efficiency-driven perspectives.

In parallel, the role of HMC extends beyond warehouse operations to the wider supply chain context. Lv et al. (2018) illustrate this by proposing a human-centered IoT-based framework for omni-channel logistics services, which directly links consumer behaviors with logistics operations. Their model suggests that IoT-enabled, human-centered systems can ensure seamless omni-channel experiences by integrating customer data, in-transit inventory, and flexible delivery solutions such as crowd-sourced transport. This perspective broadens the interpretation of HMC in logistics, moving it from an operational tool within the warehouse to a systemic enabler of customer-centric supply chain management. Compared to our bibliometric findings, this indicates that future research should more strongly connect HMC with omni-channel distribution and digital retail transformation.

Results confirm earlier literature emphasizing the hybrid nature of HMC models, where humans and machines complement rather than replace each other (Wilson, Daugherty, 2018; Haesevoets et al., 2021). Yet, the dominance of AI and DSS as central nodes in bibliometric maps reveals that the literature frequently frames HMC implicitly through technological components, rather than explicitly analyzing the socio-technical balance. This corresponds with

Klumpp's (2018, 2019) concern about an "artificial divide" between humans and AI systems, which could undermine social sustainability.

5.2. Limitations and further research

The study is not without limitations. First, the bibliometric analysis was restricted to Scopus-indexed publications, which, although comprehensive, may omit relevant studies published in other databases or in grey literature. Second, the use of co-occurrence analysis privileges frequently used terms, potentially underrepresenting emerging but less frequently mentioned concepts such as trust-building mechanisms, algorithm aversion, or gamification in logistics. Third, while the bibliometric method provides a structured overview of research trends, it does not capture the depth of qualitative insights that case studies or ethnographic research could provide regarding HMC implementation in 3PL services.

Future research should build on the identified gaps by integrating human-centric factors into analyses of HMC in logistics. As emphasized by Grosse (2024), further empirical studies are needed to evaluate the psychosocial impacts of supportive and substitutive technologies, including stress, motivation, and job satisfaction, particularly in hybrid order picking environments. The IoT-based framework proposed by Lv et al. (2018) indicates the potential for combining HMC with dynamic inventory management, crowd-sourced delivery, and big data-driven customer experience optimization. Exploring how 3PL providers can align HMC practices with omni-channel retailing will be a critical research area. Building on earlier calls for ethical frameworks (Bigman, Gray, 2018), further research should address responsibility-sharing, liability, and transparency in AI-supported decision-making in 3PL operations. As suggested by recent works in logistics technology, integrating digital twins with HMC could support predictive analytics, adaptive scheduling, and ergonomic interventions in 3PL networks.

6. Conclusions

The analysis examined how human-machine collaboration (HMC) has been addressed in research on third-party logistics (3PL) services. The results confirm that the field has gained increasing attention over the past two decades, with a particularly dynamic growth after 2020. The analysis highlighted the dominant role of artificial intelligence, decision support systems, and process optimization methods in shaping the current research landscape. At the same time, human-centric aspects such as ergonomics, trust, and employee acceptance remain underexplored, despite their critical importance for the successful implementation of HMC in logistics. The results demonstrate that HMC in 3PL services is most often framed through technological solutions, while explicit discussions of the human dimension are less frequent.

Nevertheless, evidence from the identified thematic clusters suggests that the integration of human competencies with machine capabilities offers significant opportunities for improving operational efficiency, flexibility, and resilience of logistics networks. From a managerial perspective, the study underlines the necessity of developing strategies that not only focus on technological investments but also address organizational culture, workforce development, and the design of collaborative processes. The global distribution of publications further emphasizes that HMC is a universal challenge and opportunity for logistics service providers across different regions and market conditions.

Looking ahead, future research on human-machine collaboration (HMC) in 3PL services should move toward longitudinal and interdisciplinary approaches. Longitudinal studies could capture how the integration of human and machine roles evolves over time, particularly in environments characterized by high employee turnover and rapid technological change. Interdisciplinary research that combines logistics, computer science, and organizational psychology would make it possible to investigate not only operational efficiency but also behavioral and cultural dimensions of HMC adoption. Moreover, expanding bibliometric analyses with complementary methods – such as systematic literature reviews or meta-analyses – could help validate bibliometric findings and provide a more holistic understanding of the field. Finally, close collaboration with industry stakeholders may facilitate the development of experimental or pilot studies that test the practical application of HMC models in real-world logistics operations, thereby bridging the gap between theory and practice.

References

1. Aria, M., Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics, 11, 4*, pp. 959-975.
2. Bigman, Y.E., Gray, K. (2018). *People are averse to machines making moral decisions. Cognition, 181*, pp. 21-34, doi: 10.1016/j.cognition.2018.08.003
3. Bigman, Y.E., Gray, K. (2018). People are averse to machines making moral decisions. *Cognition, 181*, pp. 21-34.
4. Dashaputre, T. (2023). *Enhancing logistics efficiency through a hybrid AI-human collaboration model: A case for operational optimization*. SSRN.
5. Dietvorst, B.J., Simmons, J.P., Massey, C. (2015). Algorithm aversion: people erroneously avoid algorithms after seeing them err. *Journal of experimental psychology: General, 144, 1*, 114.
6. Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., Lim, W.M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research, 133*, pp. 285-296.

7. Fleming, M., Clarke, W., Das, S., Phongthiengtham, P., Reddy, P. (2019). *The future of work: How new technologies are transforming tasks.* MITIBM Watson AI Lab.
8. Grosse, E.H. (2024). Application of supportive and substitutive technologies in manual warehouse order picking: A content analysis. *International Journal of Production Research, 62, 3*, pp. 685-704, doi: 10.1080/00207543.2023.2169383
9. Haesevoets, T., De Cremer, D., Dierckx, K., Van Hiel, A. (2021). Human-machine collaboration in managerial decision making. *Computers in Human Behavior, 119*, 106730, doi: 10.1016/j.chb.2021.106730
10. Ivanov, D., Dolgui, A. (2020). Viability of intertwined supply networks: extending |the supply chain resilience angles towards survivability. A position paper motivated by COVID-19 outbreak. *International Journal of Production Research, 58, 10*, pp. 2904-2915.
11. Jarrahi, M.H. (2018). Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making. *Business Horizons, 61, 4*, pp. 577-586.
12. Klumpp, M. (2018). Automation and artificial intelligence in business logistics systems: Human reactions and collaboration requirements. *International Journal of Logistics Research and Applications, 21, 3*, pp. 224-242, doi: 10.1080/ 13675567.2017.1384451
13. Klumpp, M., Zijm, H. (2019). Logistics innovation and social sustainability: How to prevent an artificial divide in human-computer interaction. *Journal of Business Logistics, 40, 3*, pp. 265-278, doi: 10.1111/jbl.12198
14. Loo, L.H. (2025). Logistics industry 5.0 in Malaysia: Human-machine synergy in workforce management. *International Journal of Recent Advances in Multidisciplinary Research, 12, 4*, pp. 11028-11035.
15. Lv, Y., Tu, L., Lee, C.K.M., Tang, X. (2018). IoT based omni-channel logistics service in Industry 4.0. In: *2018 International Conference on Service Operations and Logistics, and Informatics (SOLI)* (pp. 240-243). IEEE, doi: 10.1109/SOLI.2018.8476710
16. Malone, T.W. (2018). *Superminds: The surprising power of people and computers thinking together*. Little, Brown Spark.
17. McAfee, A., Brynjolfsson, E. (2017). *Machine, platform, crowd: Harnessing our digital future*. WW Norton Company.
18. Pantera, L., Ledera, R., Keiser, D., Freitag, M. (2024). Requirements for human-machine-interaction applications in production and logistics within Industry 5.0 – A case study approach. *Procedia Computer Science, 232*, pp. 1164-1171, doi: 10.1016/j.procs. 2024.01.114
19. Ramachandran Venkatapathy, A.K., Bayhan, H., Zeidler, F., ten Hompel, M. (2017). Human-machine synergies in intra-logistics: Creating a hybrid network for research and technologies. *Proceedings of the Federated Conference on Computer Science and Information Systems, 11*, 1065-1068, doi: 10.15439/2017F253

20. Russell, S., Norvig, P. (1995). *A modern approach. Artificial Intelligence*. Englewood Cliffs: Prentice-Hall, pp. 79-80.
21. Schuhmacher, J., Hummel, V. (2016). Decentralized control of logistic processes in cyber-physical production systems at the example of ESB Logistics Learning Factory. *Procedia CIRP, 54*, pp. 19-24, doi: 10.1016/j.procir.2016.04.095
22. Seeber, I., Bittner, E., Briggs, R.O., De Vreede, T., De Vreede, G.J., Elkins, A., Söllner, M. (2020). Machines as teammates: A research agenda on AI in team collaboration. *Information & Management, 57, 2*, 103174.
23. Wang, D., Churchill, E., Maes, P., Fan, X., Shneiderman, B., Shi, Y., Wang, Q. (2020, April). From human-human collaboration to Human-AI collaboration: Designing AI systems that can work together with people. In: *Extended abstracts of the 2020 CHI conference on human factors in computing systems* (pp. 1-6). New York: Association for Computing Machinery.
24. Wilson, H.J., Daugherty, P.R. (2018). Collaborative intelligence: Humans and AI are joining forces. *Harvard Business Review, 96, 4*, pp. 114-123.
25. Yang, W., Li, S., Luo, G., Li, H., Wen, X. (2025). A real-time human-machine-logistics collaborative scheduling method considering workers' learning and forgetting effects. *Applied System Innovation, 8, 2*, 40, doi: 10.3390/asi8020040
26. Zupic, I., Čater, T. (2015). Bibliometric methods in management and organization. *Organizational research methods, 18, 3*, pp. 429-472.