IIETA International Information and Engineering Technology Association
Advancing the World of Information and Engineering

Journal Européen des Systèmes Automatisés
Vol. 56, No. 2, April, 2023, pp. 309-315
Journal homepage: http://iieta.org/journals/jesa

The Impact of ICT on Supply Chain Management Efficiency and Effectiveness: A Literature Review

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https://doi.org/10.18280/jesa.560216

Received: 13 March 2023
Accepted: 3 April 2023

Keywords:
ICT, supply chain, literature review

ABSTRACT

ICT plays a vital role in enhancing supply chain operations, leading to improved efficiency and productivity within the industry. This study aims to examine how information and communication technologies can improve supply chain management's efficiency and effectiveness through a comprehensive literature review. The study utilized various databases such as Scopus, Emerald, Sage, spring link and Taylor. The study employed a predefined search strategy that used "ICT in Supply Chain" as the primary keyword search term. Additionally, the study examined research articles published from 2018 to 2023. Initially, 1086 references were retrieved, but eventually, only 10 articles were deemed eligible and met the inclusion criteria for the analysis. The key findings and suggestions of each selected publication have been carefully considered and synthesized. The study outlines future research opportunities and highlights the consequence of continued leveraging ICT for sustainable and competitive supply chain management practices. Nevertheless, the study suggested that there is a need to strengthen the implementation of ICT in supply chain management to enhance the performance and efficiency of supply chain operations and their members. Furthermore, the study emphasizes the importance of implementing ICT tools in supply chain sectors while considering factors hindering ICT utilization in supply chains.

1. INTRODUCTION

Information Technology and Communication (ICT) has become an essential aspect of supply chain management (SCM) that helps improve the organization's performance. Moreover, implementing ICT will enhance the performance of supply chain management. Many companies seek to improve their supply chain management effectiveness through ICTs. ICT innovations are creating new ways for companies to manage their supply relationships with and access suppliers. Hence, using ICT can improve supply chain activities [1].

ICT's effect on the SCM process can be seen in different ways that make a company more competitive, such as a shorter response time, better logistics management, better collaboration between the upstream and downstream for better demand forecasting, and establishing international vertical integration across the Company's divisions. According to several studies, an ICT-enabled supply chain process that includes control technology and sensing tools can significantly contribute to making supply chain operations more environmentally friendly [2, 3].

Similarly, one of the primary benefits of ICT in SCM is the real-time and accurate exchange of information (EI) made possible by using ICT advances such as the internet, ERP, SCI, CRM, and others in the supply chain. Additionally, every SC member uses ICT, which also has the added advantages of increasing productivity, promoting more environmentally friendly behaviors, reducing costs, and eliminating the requirement for inventory [4].

ICT has significantly and effectively changed many industrial and transportation operations. It enables the digitalization of information, the virtualization of products, a reduction in storage space and the de-materialization of transport [5].

According to the study [6], implementing ICT significantly enhances supply chain operations. Adding to that, electronic mail (Email), enterprise resource planning (ERP), Supply chain communication system (SCCS), barcoding, radio frequency identification (RFID), and electronic data interchange (EDI) are examples of ICT tools that improve SC efficiency. As a result, the authors contend that it is clear that information and communication technology (ICT) serves as the core of supply chain management, helping to provide real-time critical information by eliminating inconsistency and ambiguities in the system [7-11].

Information and communication technology (ICT)-based information sharing encourages information consumption, increasing supply chain actors' willingness to share [12]. Information and communication technology (ICT) enables partners in the supply chain to share information more reliably and correctly, improving demand forecasting and reducing costs by optimizing inventory at each level of the supply chain [13]. The quality of information significantly reduces the risks associated with demand uncertainty for supply chain partners [14].

The research also demonstrated that ICT enhances quality information by providing a consolidated view of data from several sources used in the supply chain ecosystem. In order

to increase supply chain resilience, information quality contributes to developing a shared vision and strategic partnerships among supplier members [15, 16].

Furthermore, ICT has supported companies and individuals who collaborate with them to manage supply chains more transparently and effectively while also increasing their resilience to unanticipated disturbances. It also enables collaboration and the sharing of quality information between a company and its suppliers, empowering efficient supply chain operations that positively promote the firm's competitiveness [17].

In light of the growing adoption of information and communication technology (ICT) in supply chain management (SCM), there is a need for a comprehensive literature review to fully comprehend the impact of ICT on the efficiency and effectiveness of supply chain operations. The main goal of this review is to identify the key ICT factors, evaluate their effects, and uncover the underlying mechanisms that contribute to improving SCM performance. By addressing this knowledge gap, the study aims to provide valuable insights to practitioners and researchers, assisting them in optimizing supply chain processes.

In essence, the study's ultimate objective is to enhance the understanding of how ICT can optimize supply chain processes, thereby increasing efficiency and effectiveness. To achieve this objective, the following research questions were identified:

1. What are the key ICT factors identified in the literature that significantly influence supply chain management efficiency and effectiveness?
2. How do ICT integration and utilization contribute to enhancing supply chain performance, as measured by metrics such as cost reduction, lead time improvement, and customer satisfaction, according to the existing research?

2. METHODOLOGY

To justify the need for this systematic review, we looked at existing systematic reviews in various databases such as Scopus, ProQuest, Wiley, Sage, Taylor, Springer Link, and Emerald in the fields of ICT and supply chain. We did a preliminary keyword search for "information communication and technology in the supply chain" and discovered 1086 matching items in the database (our results were limited to citations and abstracts). Only the publications released during 2018-2023 were selected for further evaluation, while the rest were excluded.

The process of selecting articles can be seen in Figure 1, which involves multiple steps. At the end of this process, a total of 10 empirical studies were chosen from 89 papers based on three criteria: i) the studies must have evaluated the impact of ICT on the supply chain empirically, ii) the research methodology had to be clearly stated, and iii) the research findings had to be fully available.

This study aims to engage in further research processes by studying the purpose, methodology, key findings, and recommendations of 10 selected articles. The researchers assessed if the studies met the set standards and criteria, then collected information from those that did and evaluated the study's quality and likelihood of prejudice. This process aimed to ensure the study was up-to-date and significant. Moreover, the authors also checked the abstracts and final thoughts of the remaining publications for relevancy to the study's objectives. The final 10 articles were reviewed in depth and sorted based on their addressed topic, research aims, and findings.

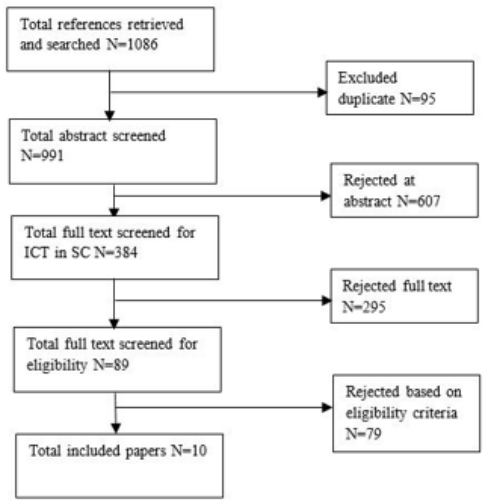

Figure 1. Study selection process overview

3. RESULTS AND DISCUSSION

This section, as shown in Table 1, summarizes the importance, theories, key findings, recommendations, and methods used in previous research on the effects of information and communication technology (ICT) in supply chain management (SCM) of the 10 selected papers.

Table 1. A content review of the selected articles

Author	Purpose	Methodology	Key findings	Recommendation
1. Sundram et al. [18]	To discover how IT and IS influence supply chain integration (SCI), performance (SCP), and the success of Malaysian manufacturing companies (FP).	Questionnaire	The results stated that putting in place IT, IS, and SCI is strongly linked to both firm and SCP.	Further research is recommended to analyze whether the relationship between supply chain performance and firm performance is influenced by moderating or mediating factors. In addition, to improve the study's external validity and the accuracy of the metrics analyzed, it would be beneficial to include businesses from a variety of industries.

2. Van Campenhout [19]	To Think about the contribution of ICT in the marketing of small businesses and the development of value chains in general.	Literature review	ICTs are still a powerful way to improve information flow and reduce information gaps between actors in the agricultural value chain. However, farmers, traders, processors, and input suppliers seem to get more informal and bottom-up benefits from ICTs.	Developing applications capable of resolving these complex information issues using technology accessible to and available to the impoverished.
3. Yadav et al. [20]	To examine these main agriculture food supply chain (AFSC) technologies to comprehend their applications and current trends.	Literature review	The research shows that combining the technologies that have been looked at may be a better way to deliver low-cost solutions and promote sustainability in AFSC. Also, blockchain technology can make a big difference in food safety and security.	Bibliometric software packages could be used for a bibliometric analysis to get a broader view of this topic. Also, the current problems and what research needs to be done agendas for the concerned themes are listed to encourage researchers to continue working in this area.
4. Kumar [21]	To figure out how ICT, which is one of the variables in SCM, affects the financial and market performance of an organization.	Qualitative and Quantitative Methods.	The results show that ICT is a key part of improving how well dairy businesses do through increasing the performance matrix indicators.	Further research can broaden the scope of SCM practices by looking at Geographic proximity, cross-functional coordination, logistics integration, environmentally friendly practices, and a consensus on supply chain leadership which haven't been looked at in depth in the current research.
5. Mendoza-Fong et al. [22]	To state how much ICT and their updates affect the accomplishment of implementing the green supply chain (GSC) and what benefits this brings.	Questionnaire	The study revealed a direct, positive, and significant effect (PE) among the four latent variables (LTV) that were examined. However, the most intriguing aspect is the indirect effect that the variable updating ICT has on the benefits of GSC through the variable mediators' implementation of a GSC since the direct effect of updating ICT on the benefits of implementing GSC is not significant.	In future studies, researchers want to include factors associated with the staff's level of education and training because it takes much skill to re-program these technologies for other jobs and fit them into different production lines.
6. Intalar and Jeenanunta 2019 [10]	To find out how a customer's investments in ICT and product innovation affect a manufacturer's and its next-tier suppliers' ICT investments.	Questionnaire	The study identified that investment in ICT and product innovation by the customer has a significant impact on the manufacturer's ICT investments and exerts pressure on the manufacturer's next-tier suppliers to implement compatible ICT systems.	A real-world study could look at how cultural or organizational differences affect SC relationships and ICT investments in different industries and countries, like the service industry.
7. Kumar et al. [23]	To investigate the problems in the food supply chain for agri-food. The study also establishes the impact of ICT in the agri-food SC and how SCM practices affect how well a business does.	Questionnaire	The results indicated that there is a strong connection between ICT and SCM practices (logistics integration and supplier relationships). Also, SCM practices like sharing information, keeping good relationships with suppliers, and integrating logistics greatly affect how well an organization does.	More research could be done to see how SCM practices affect the relationship between ICT and organizational performance (OP). Adding companies from other industries to the research study can make it more externally valid and improve the parameters' accuracy.
8. Shiralkar et al. [24]	To observe through experiments how ICT in different parts of the retail SC helps improve its general performance.	Questionnaire	The overall performance of the downstream supply chain of the retail industry improves by between 9 and 41% when ICT is used. Also, the study found the functional parts of the supply chain that, when ICT is used, make a big difference in the overall performance of the supply chain.	In the future, more research may be needed to determine if this model can be used in different retail stores.

9. Aderibigbe [25]	To explore how ICT changes the way SCM is done.	Case study	The study's results disclose that ICT has an effect on SCM practices by making the Company's finances better. It was also found that better access to and visibility of information led to better customer service and higher customer satisfaction.	ICT adoption for security and reliability perception on SCM could be the subject of more study.
10. Schilling and Seuring [26]	To look at how ICTs that give people access to information, money, and transaction applications help reduce transaction costs (TC) and improve SCM in the agricultural sector.	Case study	ICT helps the base-of-the-pyramid (BoP) market get better at its SCM tasks. There are three different types of ICT models: Some ICTs only affect 1) the flow of information, while others affect 2) Flows of money or 3) Flows of things.	Future research could build on the results of this study by talking to farmers who use ICT services.

Several stakeholders and businesses involved in supply chain management (SCM) have recently seen the growth of ICT-based SCM applications that boost efficiency and effectiveness. Furthermore, it has been pointed out as a management field that is becoming increasingly important in helping businesses improve their supply chain operations [25]. The author also indicates that using ICT in the supply chain creates new enrichment opportunities for suppliers and stakeholders.

The study [19] stated that ICT significantly impacts supply chain management as the latest technological innovations enable information to flow quickly and spread over all the operations within the organization. Moreover, ICT in SCM also enhances the efficiency of distribution channels by decreasing cycle times, reductions in inventories, and minimizations of bullwhip effects [27, 28, 23].

ICT has been contributing to the supply chain process from the point of origin to the point of consumption. For example, Vendor-Managed Inventory has made information exchange between buyers and sellers possible. Buyers might grant suppliers access to their data upon request. The provider, in turn, manages this data and makes forecasts based on the knowledge they have. Thus, the effective use of supply chain management systems is also associated with increased company productivity [29].

It has been demonstrated in another study that ICT actually improves supply chain effectiveness due to speedy communication and a higher level of competency. For instance, the widespread use of IT systems in container cargo transit improves the supply chain partners' communication, information sharing, and supply chain integration [25, 26].

On the other hand, In the era of globalization of the market, it is very critical to manage information effectively while selecting and managing supply chain partners with global locations. However, due to organizational, legal, collaborative, and informational obstacles, the globalization of the supply chain partner base challenges information integration and exchange [30]. Consequently, it is essential to acquire sophisticated and well-designed information systems that efficiently manage information resources to reduce costs and fulfil organizational and legal compliance requirements [31].

The study [32] found that enterprise resource planning (ERP) systems are essential for integrating internal and external business processes, making information flow between supply chain members easier. So this makes it possible for supply chain stakeholders to work together and get along better. Traceability is a vital part of the supply chain that helps reduce losses caused by theft or lost raw materials and finished goods. ERP and RFID technology improves the flow of materials and minimizes theft and lost items [7]. Thus, using ICT for traceability has many benefits, including safety, risk management, efficiency, compliance, and achieving sustainability goals.

Furthermore, IoT and AI-based technologies offer a quicker prediction of supply chain partners' capabilities, enabling real-time decision-making and greatly enhancing supply chain performance [33, 34]. Thus, integrated ICT platforms and systems can provide a proper solution to companies, enabling them to make the supply chain more responsive, keep business going, and give it more flexibility.

As a result, supply chains must be flexible in order to make quick decisions and provide operational freedom through efficient collaborative planning and partnership formation [35]. ICT improve supply chain flexibility by facilitating modifications carried out by uncertain demand [36, 37]. Besides, IoT and sensor-enabled virtual supply chains allow members to communicate from anywhere, adding agility to supply chains [38]. By efficiently inspecting information flow and physical item movement, IoT and blockchain technologies enable organizations to run their supply chains more efficiently [39, 40].

According to the study [41], when a supply chain is closely interconnected, information and knowledge can be shared more efficiently among its members and become valuable production assets. Nonetheless, this can also lead to a higher risk of confidential information and knowledge being exposed. Thus, privacy becomes vital when sharing sensitive information [42-44]. Consequently, supply chain actors need a reliable network to develop information privacy [45].

Conversely, accurate and efficient information sharing is essential for building trust among supply chain actors, promoting transparency, and ensuring information disclosure. ICT serves as a distributed ledger and facilitates the open sharing of supply chain transactions while maintaining confidentiality, stability, and security by protecting data privacy while sharing [46, 47].

It is noted that ICT has played an important role in supply chain management and its relationship with supply chain members. It also helps the supply chain run smoothly and efficiently, and effectively. This led organization to solve several challenges, including workload, long lead times, responsiveness, and inconsistence information and data for supply chain activities. Moreover, ICT also helps businesses expand and enhance the effectiveness of supply chain operations, increasing their production and performance. Additionally, ICT tools facilitate the coordination of supply

chain activities such as inventory management, raw materials, distribution and transport channels.

As a result, supply chain management solutions increase the transaction value, decreasing the supply chain's cost. Additionally, managing the flow and dependability of data processing ensures that the Company has eliminated the inconsistencies and deficiencies caused by the collaboration among supply chain players. In a nutshell, there is no doubt that ICT has significantly enhanced the performance and efficiency of supply chain management activities and processes. Therefore, organizations, policymakers and other stakeholders should implement and use ICT tools effectively in supply chain channels in order to enhance the performance of the supply chain process.

4. CONCLUSION

In order to accomplish strategic goals of customer satisfaction and profitability through cost management, using ICT tools in supply chain activities is a viable strategy. Additionally, it improves the overall operational effectiveness of supply chain processes and operations. Moreover, ICT in supply chain management eliminates several issues such as long cycle time, poor responsiveness, misled cost, inconsistence information and data, and insufficient supply chain process. Hence, ICT has become a core strategy to improve the efficiency of supply chain performance.

The study of the selected articles examines some of the crucial elements of ICT in supply chain management. The study discovered that several innovative factors need to be considered when designing and implementing ICT platforms in supply chain management. Furthermore, ICT expertise should be taken into consideration these issues in order to produce a sophisticated system which will meet the requirements of organizations, especially supply chain management sections.

On the other hand, it also indicates that some organization has not paid attention to the supply chain management operation, and they declared this process. This leads to their inefficient supply chain tasks. Hence, the study recommends adopting the ICT tools in SCM to enhance business performance and supply chain operation. In addition, it is crucial to provide both internal and external supply chain management components with the attention they require.

Nevertheless, ICT platforms have ensured efficient and effective supply chain performance. For instance, Technology advances such as the Internet of Things (IoT), enterprise resource planning systems (ERP), material requirement planning systems (MRP), barcodes, blockchains, and RFID have improved firms' ability to achieve a competitive edge in material management, and more and more organizations are adopting these technologies.

The study demonstrates that several elements, including awareness, ICT readiness for implementation, and IT infrastructure, are necessary for supply chain management sectors to integrate ICT successfully. These are the crucial factors that the SCM must consider to enhance the supply chain processes and operations successfully.

The study also indicates that ICT is essential for supply chain management activities. Although it cannot fully assess the literature, the study highlights the significance of understanding the influence of ICT in supply chain management and the potential advantages of employing mathematical modelling and simulation to improve this understanding. By leveraging these tools, researchers and practitioners can identify new opportunities for optimization, improve decision-making processes, and enhance the overall efficiency of the supply chain.

REFERENCES

[1] Sambamurthy, V., Bharadwaj, A., Grover, V. (2003). Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. MIS Quarterly, 27(2): 37-263. http://dx.doi.org/10.2307/30036530

[2] Cleaver, K.M. Schreiber, G.M. (1994). Reversing the spiral: The population, agriculture and environment nexus in Sub-Saharan Africa. Academic Press.

[3] Evangelista, P., Hallikas, J. (2022). Exploring the influence of ICT on sustainability in supply management: Evidence and directions for research. Cleaner Logistics and Supply Chain, 4: 100051. https://doi.org/10.1016/j.clscn.2022.100051

[4] Khan, M., Hussain, M., Saber, H.M. (2016). Information sharing in a sustainable supply chain. International Journal of Production Economics, 181, 208-214. https://doi.org/10.1016/j.ijpe.2016.04.010

[5] Börjesson Rivera, M., Håkansson, C., Svenfelt, Å., Finnveden, G. (2014). Including second order effects in environmental assessments of ICT. Environmental Modelling and Software, 56, 105-115. https://doi.org/10.1016/j.envsoft.2014.02.005

[6] Mohammadi, A., Sahrakar, M., Yazdani, H.R. (2012). Investigating the effects of information technology on the capabilities and performance of the supply chain of dairy companies in Fars province. African Journal of Business Management, 6(3): 933-945. https://doi.org/10.5897/AJBM11.1417

[7] Terrada, L., Alloubane, A., Bakkoury, J., Khaili, M. El. (2019). IoT Contribution in supply chain management for enhancing performance indicators. In 2018 International Conference on Electronics, Control, Optimization and Computer Science, ICECOCS 2018, Kenitra, Morocco. https://doi.org/10.1109/ICECOCS.2018.8610517

[8] Barnett, I., Hernandez, K., Ramalingam, B., Levy, A., Oppenheimer, C., Valters, C. (2019). Can ICT enabled real-time data contribute to adaptive management in development programming? Development in Practice, 29(3): 287-299. https://doi.org/10.1080/09614524.2018.1557596

[9] Amarnath, G., Simons, G.W.H., Alahacoon, N., Smakhtin, V., Sharma, B., Gismalla, Y., Mohammed, Y., Andriessen, M.C.M. (2018). Using smart ICT to provide weather and water information to smallholders in Africa: The case of the Gash River Basin, Sudan. Climate Risk Management, 22: 52-66. https://doi.org/10.1016/j.crm.2018.10.001

[10] Intalar, N., Jeenanunta, C. (2019). Effects of customer's investment in ICT on partners' decisions through the supply chain: An empirical study of the manufacturing industry in Thailand. Asian Journal of Technology Innovation, 27(2): 239-256. https://doi.org/10.1080/19761597.2019.1655655

[11] Siddh, M.M., Soni, G., Jain, R., Sharma, M.K., Yadav,

V. (2017). Agri-fresh food supply chain quality (AFSCQ): A literature review. Industrial Management and Data Systems, 117(9): 2015-2044. https://doi.org/10.1108/IMDS-10-2016-0427
[12] Lin, T., Lin, I. (2014). Factors for information technology acceptance willingness and adoption in logistics industry from supply chain perspectives. International Journal of Electronic Business Management, 12(3): 167-177.
[13] Tannady, H., Resdiansyah, Andry, J.F., Marta, R.F. (2020). Exploring the role of ICT readiness and information sharing on supply chain performance in coronavirus disruptions. Technology Reports of Kansai University, 62(5): 2581-2588.
[14] Nath, T., Standing, C. (2010). Drivers of information technology use in the supply chain. Journal of Systems and Information Technology, 12(1): 70-84. https://doi.org/10.1108/13287261011032661
[15] Lee, C., Ha, B.C. (2021). Interactional justice, informational quality, and sustainable supply chain management: A comparison of domestic and multinational pharmaceutical companies. Sustainability (Switzerland), 13(2): 1-16. https://doi.org/10.3390/su13020998
[16] Li, S., Lin, B. (2006). Accessing information sharing and information quality in supply chain management. Decision Support Systems, 42(3): 1641-1656. https://doi.org/10.1016/j.dss.2006.02.011
[17] Acar, A.Z., Uzunlar, M.B. (2014). The effects of process development and information technology on time-based supply chain performance. Procedia - Social and Behavioral Sciences, 150, 744-753. https://doi.org/10.1016/j.sbspro.2014.09.044
[18] Sundram, V.P.K., Chhetri, P., Bahrin, A.S. (2020). The consequences of information technology, information sharing and supply chain integration, towards supply chain performance and firm performance. Journal of International Logistics and Trade, 18(1): 15-31. https://doi.org/10.24006/JILT.2020.18.1.015
[19] Van Campenhout, B. (2022). ICTs to address information inefficiencies in food supply chains. Agricultural Economics (United Kingdom), 53(6): 968-975. https://doi.org/10.1111/agec.12731
[20] Yadav, V.S., Singh, A.R., Raut, R.D., Mangla, S.K., Luthra, S., Kumar, A. (2022). Exploring the application of Industry 4.0 technologies in the agricultural food supply chain: A systematic literature review. Computers and Industrial Engineering, 169: 108304. https://doi.org/10.1016/j.cie.2022.108304
[21] Kumar, R. (2022). Information and communication Technology (ICT) effect on supply chain performance in the dairy Industry: A study in the Indian Context. International Journal of Asian Business and Information Management, 13(1): 1-16. https://doi.org/10.4018/IJABIM.297850
[22] Mendoza-Fong, J.R., García-Alcaraz, J.L., Macías, E.J., Ibarra Hernández, N.L., Díaz-Reza, J.R., Fernández, J. B. (2018). Role of information and communication technology in green supply chain implementation and companies' performance. Sustainability (Switzerland), 10(6). https://doi.org/10.3390/su10061793
[23] Kumar, A., Singh, R.K., Modgil, S. (2020). Exploring the relationship between ICT, SCM practices and organizational performance in agri-food supply chain. Benchmarking, 27(3): 1003-1041. https://doi.org/10.1108/BIJ-11-2019-0500
[24] Shiralkar, K., Bongale, A., Kumar, S., Kotecha, K., Prakash, C. (2021). Assessment of the benefits of Information and Communication Technologies (ICT) adoption on downstream supply chain performance of the retail industry. Logistics, 5(4). https://doi.org/10.3390/logistics5040080
[25] Zhang, G., Yang, Y., Yang, G. (2023). Smart supply chain management in Industry 4.0: The review, research agenda and strategies in North America. Annals of Operations Research, 322(2): 1075-1117. https://doi.org/10.1007/s10479-022-04689-1
[26] Schilling, L., Seuring, S. (2023). The role of information and communication technology in managing supply chains in Base-of-the-Pyramid markets. IEEE Transactions on Engineering Management, 70(3): 1186-1198. http://dx.doi.org/10.1109/TEM.2022.3156527
[27] Zhong, R., Xu, X., Wang, L. (2017). Food supply chain management: systems, implementations, and future research. Industrial Management and Data Systems, 117(9): 2085-2114. https://doi.org/10.1108/IMDS-09-2016-0391
[28] Vanpoucke, E., Boyer, K.K., Vereecke, A. (2009). Supply chain information flow strategies: An empirical taxonomy. International Journal of Operations & Production Management, 29(12): 1213-1241. https://doi.org/10.1108/01443570911005974
[29] Cainelli, G., Evangelista, R., Savona, M. (2004). The impact of innovation on economic performance in services. The Service Industries Journal, 24(1): 116-130. http://dx.doi.org/10.1080/0264206041233130116 2
[30] Messina, D., Barros, A.C., Soares, A.L. (2016). An information management perspective of supplier selection process in manufacturing networks. IFIP Advances in Information and Communication Technology, 480: 178-188. https://doi.org/10.1007/978-3-319-45390-3_16
[31] Colin, M., Galindo, R., Hernández, O. (2015). Information and communication technology as a key strategy for efficient supply chain management in manufacturing SMEs. Procedia Computer Science, 55(Itqm): 833-842. https://doi.org/10.1016/j.procs.2015.07.152
[32] Apiyo, R., Kiarie, D. (2018). Role of ICT tools in supply chain performance. International Journal of Supply Chain Management, 3(1): 17-26. https://www.iprjb.org/journals/index.php/IJSCM/article/view/598.
[33] Calatayud, A., Mangan, J., Christopher, M. (2019). The self-thinking supply chain. Supply Chain Management, 24(1): 22-38. https://doi.org/10.1108/SCM-03-2018-0136
[34] Abdullahi, H.O., Mohamud, A.H., Ali, A.F., Hassan, A.A. (2023). Determinants of the intention to use information system: A case of SIMAD University in Mogadishu, Somalia. International Journal of Advanced and Applied Sciences, 10(4): 188-196. https://doi.org/10.21833/ijaas.2023.04.023
[35] Khan, H., Wisner, J.D. (2019). Supply chain integration, learning, and agility: Effects on performance. Operations and Supply Chain Management, 12(1): 14-23. https://doi.org/10.31387/oscm0360218
[36] García-Alcaraz, J.L., Maldonado-Macías, A.A., Alor-

Hernández, G., Sánchez-Ramírez, C. (2017). The impact of information and communication technologies (ICT) on agility, operating, and economical performance of supply chain. Advances in Production Engineering and Management, 12(1): 29-40. https://doi.org/10.14743/apem2017.1.237

[37] Kim, S., Park, S., Noh, H., Kim, S.C. (2020). Impact of ICT capability on real time enterprise capability and supply chain performance. Journal of Society of Korea Industrial and Systems Engineering, 43(1): 110-122. https://db.koreascholar.com/Article/Detail/388696

[38] Kamble, S.S., Gunasekaran, A., Gawankar, S.A. (2020). Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications. International Journal of Production Economics, 219, 179-194. https://doi.org/10.1016/j.ijpe.2019.05.022

[39] Rejeb, A., Keogh, J.G., Treiblmaier, H. (2019). Leveraging the Internet of Things and blockchain technology in Supply Chain Management. Future Internet, 11(7): 1-22. https://doi.org/10.3390/fi11070161

[40] Mohamud, I.H., Kafi, M.A., Shahron, S.A., Zainuddin, N., Musa, S. (2023). The role of warehouse layout and operations in warehouse efficiency: A literature review. Journal Européen des Systèmes Automatisés, 56(1): 61-68. https://doi.org/10.18280/jesa.560109

[41] Tan, K.H., Wong, W.P., Chung, L. (2016). Information and knowledge leakage in supply chain. Information Systems Frontiers, 18(3): 621-638. https://doi.org/10.1007/s10796-015-9553-6

[42] Wu, H., Li, Z., King, B., Miled, Z. Ben, Wassick, J., Tazelaar, J. (2017). A distributed ledger for supply chain physical distribution visibility. Information (Switzerland), 8(4): 1-18. https://doi.org/10.3390/info8040137

[43] Lotfi, Z., Mukhtar, M., Sahran, S., Zadeh, A.T. (2013). Information sharing in supply chain management. Procedia Technology, 11(Iceei), 298-304. https://doi.org/10.1016/j.protcy.2013.12.194

[44] Bader, L., Pennekamp, J., Matzutt, R., Hedderich, D., Kowalski, M., Lücken, V., Wehrle, K. (2021). Blockchain-based privacy preservation for supply chains supporting lightweight multi-hop information accountability. Information Processing and Management, 58(3): 102529. https://doi.org/10.1016/j.ipm.2021.102529

[45] Surjandari, I., Yusuf, H., Laoh, E., Maulida, R. (2021). Designing a permissioned blockchain network for the halal industry using hyperledger fabric with multiple channels and the raft consensus mechanism. Journal of Big Data, 8(1). https://doi.org/10.1186/s40537-020-00405-7

[46] Kafi, M.A., Saifudin, A.B.M., Zainuddin, N.B., Shahron, S.A., Abualrejal, H., Mohamad, M. (2022). Essential of RFID technology in supply chain management: A review on digital perspective. In Proceedings of the International Conference on Intelligent Technology Systems and Services for Internet of Everything (ITSS-IoE 2022), Hadhramaut, Yemen. https://doi.org/10.1109/ITSS-IoE56359.2022.9990933

[47] Abdullahi, H.O., Hassan, A.A., Mahmud, M., Ali, A.F., Hassan, A.A. (2021). Determinants of ICT adoption among small scale agribusiness enterprises in Somalia. International Journal of Engineering Trends and Technology, 69(2): 68-76. https://doi.org/10.14445/22315381/IJETT-V69I2P210