Technological adoption in logistics management: Review of literature and agenda setting

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ABSTRACT

In this research, the existing literature on the major antecedents influencing and impeding the adoption of technology in managing logistics was examined. The main antecedents examined include the sorts of technological applications used, the degree of application integration, cost reduction and service level improvement, process management and monitoring, safety and security enhancements, and company features. There was also a discussion of the internal and external obstacles to technology adoption. To improve technology adoption in logistics management, the study recommends raising investment in technology, effectively integrating both new and old technologies, establishing industry-based standards, and boosting employee participation.

Keywords: Antecedents, Logistics, Obstacles, Supply chain, Technology

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INTRODUCTION

Logistics management, a key function in production system, entails the movement of materials (raw or finished items) from the point of production to the ultimate consumer (Parfenov *et al.*, 2021). It focuses on creating plans, controlling them, and putting them into action in relation to the transit and storage of products. Logistics management is the transfer of goods, services, data, and money from the stage of raw materials to the consumer end-product (Stock & Lambert, 2001). Global logistics administration includes various tasks, including network design, purchasing, material handling, order processing, inventory control, packaging, warehousing, and transportation, among others. Logistics management is crucial for improving customer service, guaranteeing prompt delivery of goods, increasing cost effectiveness, fostering efficient order administration, and raising supply chain system transparency (Chen, Jin & Huo, 2020; Winkelhaus & Grosse, 2020).

Before the COVID-19 virus, the logistics sector and most other industries were slowly or gradually adopting new technologies. Due of the strong restrictions placed on the movement of people and commodities, the pandemic severely impacted the operations of logistics companies. Technology adoption in the sector was accelerated to encourage the development of a robust and effective supply chain system to address the issues brought on by the epidemic. Adopting new technology helps with global logistics management by improving supply chain productivity, lowering operational costs, and decreasing errors (Orji *et al.*, 2020; Tu, 2018). The focus of this review is to examine the literature that has already been published on antecedents and obstacles relating to the use of technology in logistics management and draw appropriate business implications. The rationale for focusing on logistics is motivated by the high logistics costs associated with transporting items to their destination, which can be reduced using the appropriate technology.

REVIEW OF LITERATURE

Technology adoption in logistics

The emergence of new and more effective technology is transforming how businesses are conducted around the world. For instance, Amazon, one of the pioneering and top companies in the logistics sector, uses technology to collect orders, process them, and deliver the product(s) to the consumer (depending on where the customer lives) in less than an hour. Technology adoption

is the acceptance, integration, and application of new technology in society (Xu *et al*., 2021). The use of technology to manage logistics is advantageous in a variety of ways. These advantages include better information access, insights, agility, teamwork, and customer loyalty (Parola *et al*., 2021). Marchet *et al.* (2009) and Perego *et al.* (2011) categorized technological applications in logistics and freight transportation firms into four, namely: transportation management (TM) applications, supply chain executive (SCE) applications, field force automation (FFA) applications, and fleet and freight management (FFM) applications. In a similar vein, Mouha (2021) identified the Internet of Things (IoT) and Radio Frequency Identification (RFID), autonomous trucks and drones, improved GPS accuracy, social media, shipment tracking systems, and IoT and RFID are five major technological facilities or systems that are changing the logistics industry's landscape.

Technology adoption in logistics has significantly transformed the way the industry operates (Mathauer & Hofmann, 2019). The use of new technologies has increased efficiency, reduced costs, and improved customer service. Some notable examples include Internet of Things (IoT), autonomous vehicles, blockchain, artificial intelligence and cloud computing (Mathauer & Hofmann, 2019; Lagorio *et al.*, 2022). IoT devices such as sensors and trackers can be attached to products and vehicles to monitor their location, temperature, and condition in real-time. This enables logistics providers to optimize delivery routes, monitor inventory levels, and improve supply chain visibility. Autonomous vehicles are self-driving trucks and drones are being developed to automate the transportation of goods, reduce labor costs, and improve delivery times. Blockchain technology enables secure and transparent tracking of products through the supply chain. This can help reduce fraud, counterfeiting, and theft and improve traceability and accountability. AI technologies such as machine learning algorithms and natural language processing can be used to analyze data from IoT devices and other sources, identify patterns, and make predictions. This can help logistics providers optimize routes, improve inventory management, and enhance customer service. Cloud-based logistics platforms can provide real-time access to data and analytics, enabling logistics providers to make informed decisions and improve efficiency. Overall, technology adoption in logistics has the potential to revolutionize the industry and create new opportunities for businesses to optimize their operations and improve customer service.

Historically, technology was related with increasing productivity in the industrial industry. However, its significance in the service business has also expanded dramatically (Chen, Jin & Huo, 2020; Ezenwa, Whiteing, Johnson & Oledinma, 2020). Technology is critical in helping service providers increase their operations' efficiency and effectiveness. Lin (2007) broadly categorized logistics technology innovation into four: data acquisition technologies, information technologies, warehousing technologies, and transportation technologies.

Information Technologies

These tools and infrastructures enable effective transfer of business information among numerous firms. Many logistics experts acknowledge the importance of information technology in increasing efficiency and competitiveness. Implementing information technology can boost organizational productivity, flexibility, and competitiveness while encouraging the growth of inter-organizational networks (Winkelhaus & Grosse, 2020). Examples of information technologies in logistics services include electronic data interchange (EDI), the Internet, value-added networks (VAN), point of sale (POS) systems, electronic ordering systems (EOS), logistics information systems, computer telephony integration, and enterprise information portals

Data acquisition technologies

Logistics service providers handle large amounts of commodities and data, and efficient data collection and sharing are critical for effective logistics information management and control (Golpîra, Khan & Safaeipour, 2021). High-quality data capture is critical for logistics service providers to deliver items to clients with precision and efficiency. The bar code system and radio frequency identification system (RFID) are two data acquisition technologies that aid in the collecting and sharing logistical data. These technologies help in the precise and effective collection of logistical data.

Warehousing technologies

A warehouse is primarily utilized for inventory storage. Warehousing is critical to the overall operation of a logistical system. When building a warehouse management system, keep the facility's physical characteristics and movement of items in mind. Several warehousing technologies, such as the automated storage and retrieval system (AS/RS), automatic sorting system, computer-aided picking system, and thermostat warehouse, are extensively used in

logistics (Lin, 2007). For example, AS/RS offers high-density, hands-free material buffering in distribution and industrial contexts.

Transportation technologies

Transportation is a vital function in logistics operations, providing as a visible function for transporting things. Its primary goal is to effectively carry commodities from their origin to a predetermined destination while minimizing damage-related expenditures and expenses. Commonly used transportation technologies include transportation information systems, global positioning systems (GPS), geographical information systems (GIS), radio-frequency communication systems, and transportation data recorders (Humayun et al., 2020). Logistics managers may use transportation and geographic information systems to plan, manage, and control transportation-related challenges. Global positioning systems and radio-frequency communication devices can track and guide drivers.

Role of technology adoption in logistics management

Technology adoption provides both tangible and intangible benefits: Emerging technologies are helpful in enhancing logistics operations. These technologies include advanced analytics applications, machine learning, artificial intelligence, the Internet of Things, robotics and automation tools, digital twins, and auction delivery systems. These technologies confer both tangible and intangible benefits to organisations. Increased efficacy and efficiency in logistics operations exemplify a tangible benefit. The delivery of products effectively and efficiently is made possible by the usage of applications. Technology adoption and usage improve logistics managers' ability to monitor operations and reduce unnecessary overhead expenditures. Adopting new technology makes it easier to identify discrepancies early and take the necessary corrective action to get the best results. An illustration of an intangible advantage is a better corporate image. Every business looks for ways to enhance its reputation. Using proper technology to deliver services effectively is one method to accomplish this. As an illustration, logistics companies' deployment of a tracking and tracing system aids in promoting operational transparency and fostering customer confidence in business operations.

Seamless information sharing and supply chain visibility: The adoption of SCE applications encourages transparent supply chains and easy information sharing. According to Patterson *et al.* (2003), technology like SCE apps boost corporate efficiency, improve flexibility,

and speed up and simplify communication exchange. Real-time visibility, ordering cost savings, and a decrease in the need to examine invoices were all cited by scholars like Perego *et al.* (2011) and Auramo *et al.* (2005) as advantages of implementing SCE systems in the logistics sector. Adoption of new technologies promotes advanced planning and coordination, streamlines order fulfillment, and improves inter-organizational coordination. As employees involved in front-line customer operations are transferred to handle more strategic business operations, it also improves operational performance and firm competitiveness.

Improved managerial attitude toward adoption of technology: One of the significant internal obstacles to the adoption of technology in logistics organizations is managerial attitude toward technology adoption. The traits and perspectives of senior management influence the decision-making and procedures for implementing new technology. The realization of the requirement for technology is determined by top management's knowledge of the internal and external environments based on environmental scanning, forecasting, and other measurements. Managers must be creative, flexible, encouraging, dedicated, and confident in the implementation of new technologies. It is believed that the attitude of managers of logistics organization will improve positively as they embrace modern technologies in carrying out their operations.

The role of technology adoption in logistics management is significant and has transformed the way logistics companies operate. Technology adoption has become increasingly important in logistics management as it enables companies to operate more efficiently, provide better service to customers, and remain competitive in an ever-evolving industry.

Antecedents of technological adoption in logistics management

Various important elements that influence the adoption of technology in the logistics sector have been identified and discussed in extant literature. Some of the antecedents or factors identified include cost savings and service level improvement, process control and monitoring, safety and security enhancements, company features, technological application kinds currently being used in a company, and application integration level. The following is a succinct explanation of these antecedents:

Cost savings and service level improvement: The main motivation for implementing technology in logistics management, as mentioned by Perego *et al.* (2011), is to reduce costs and raise service standards. In similar vein, Piplani *et al.* (2004) and Pokharel (2005) noted that the

main goal of technology adoption is to save operational costs, free up time, and lessen the cost of inventory and order cycle time. By incorporating new technology into logistical operations, businesses can cut costs, improve planning, forecasting, inventory replenishment, and better meet consumer requests at the correct time. Effective inventory management and item tracking can also help to save costs. Technology adoption can raise service levels, as pointed out by Piplani *et al.* (2004) and Pokharel (2005). This is because clients can simply place orders and make payments online, allowing for the accurate handling of a huge volume of work with minimal data entry errors. Continuous cost reduction is the best strategy for economically aligning the company's operations with the industry best practices because industry participants or firms are continually under pressure to improve service levels.

Process control and monitoring: The anticipated improvement in monitoring and controlling transportation processes is another important factor driving technology adoption. Without the creation of suitable technologies, monitoring transportation activities can be difficult and tedious. Using wireless and mobile-based technology can close this gap. Logistics managers can utilize the FFM program as a reporting tool to learn about vehicle travel times, service times, and delivery points visited. To effectively distribute a fleet of vehicles across various uses, the program can offer real-time inputs that can be used for distribution plans. Real-time data on client orders, vehicle positions at any given time, traffic conditions, and other travel-related information can all be gathered with the right tools (Perego *et al.*, 2011). Similar findings were made by Button *et al.* (2001), who discovered that a courier firm's deployment of TM applications improved records management, streamlined report generation, forecasted weather and traffic conditions, and allocated driver time.

Safety and security enhancement: A crucial concern in logistics management is security. It makes it easier to move people around safely and manage resources like products, information, and other resources. Cloud logistics, artificial intelligence, self-driving cars, robots and automation, and other popular technologies are some that can improve safety and security in logistics management (Stough, 2017). Integrating these technologies into the operations of logistics firms will aid in preventing mishaps that could disrupt the supply chain network, which could result in transit delays or a shutdown to production. Technology can also be used to gather information about potential security breaches in a business's facilities or other locations.

Company features: Previous research has demonstrated how the characteristics of a firm, such as its size, the services it provides, its ownership structure, and so on, affect how technology is adopted (Kinkel *et al.,* 2022; Nnaji *et al.,* 2019; Perego *et al.,* 2011; Pokharel, 2005). For instance, Pokharel (2015) discovered that the size of a company affects the adoption of ICT, with larger organizations adopting and using the technology more frequently. In a similar vein, Davis et al. (2006) discovered that the size of logistics enterprises and the adoption of technology (ICT) are inversely related. According to the report, smaller haulage businesses with fewer than eleven cars rely more on conventional systems of communication and business operations. The kind of services provided has an impact on how technology is used in logistics companies. Perego *et al.* (2011) discovered that logistics managers use technology as a reporting tool to understand vehicle travel times, service hours, delivery places visited, and carry out distribution plans to distribute a fleet of vehicles for various objectives effectively.

Technological application types in use: For tracking orders and verifying delivery of orders, SCE applications have been discovered to be the most widely used application in logistics organizations. As found by Perego *et al.* (2011, p. 469), "large fleets, movers, and carriers that provide refrigerated, hazardous materials, high value, or just-in-time services are more likely to adopt automatic vehicle location systems and identification".

Applications integration level: In order to offer real-time data throughout the supply chain, apps must be integrated into logistics management. This will support making quick decisions in response to shifting circumstances and averting disruptions. Mason *et al.* (2003) noted that integrating applications across supply chains is crucial for lowering costs and reducing lead-time unpredictability. Perego *et al.* (2011) also stated that the higher the integration degree, the larger the corresponding benefits. Handling logistical operations with real-time and fully integrated systems is simple and effective. In logistics management, other factors that influence technology adoption include retaining market share, improving competitiveness, and proactively identifying client requirements, among others.

Obstacles to technology adoption in logistics management

Obstacles confronting the adoption of technology in logistics management can be broadly categorized into internal and external. The following is a discussion of the internal obstacles:

Economic and financial factors: Due to the difficulty in taking financial risks, logistics companies may find it difficult to adopt certain technologies (Perego *et al.,* 2011). Adoption of new technologies is often hampered by difficulties in calculating the payback period and return on investment of the technology.

Rapid technological obsolescence: The corporate world is dynamic, and changes happen quickly. Innovative technologies are created and used at a rapid rate, which poses a challenge to businesses with precarious financial positions. This is owing to the emergence of new and more advanced technologies. This may prevent today's technologies from providing a competitive advantage in the future.

Lack of managerial support: The level of managerial support affects how quickly technology is adopted in an organization. Management makes strategic choices on the use of expensive and complex technologies. Adoption and deployment of the choice throughout an organization become challenging or impossible once the management teams reject it.

Employee resistance to change: Things are always changing. Employees may, however, reject change if they believe it will negatively affect their continued engagement and relevance at work. Employees will adamantly oppose the adoption of technology that will lead to reduction in workforce via downsizing or layoff. Sabotage may occur if the process is not adequately handled.

Other internal obstacles include implementing new technology with old ones, employees' desire and willingness to adopt new technology, ignorance of applicable ICT solutions, and so on.

The external barriers are:

Supply chain environment of other partnering companies: The quality and reliability of the technology used by other collaborating companies' supply chains may determine how quickly a company adopts new technologies. Therefore, a company's participation in ICT projects will depend on the readiness and capability of its partners, particularly its strategic partners.

Integration of technology amongst cooperating companies: Compatibility issues with customers' or suppliers' systems may prevent a corporation from implementing new technologies. To make the best use of the technology that is now available, stakeholders must integrate the available technologies.

Technology adoption in logistics management in developed and developing economies

Developed countries usually have greater infrastructure and resources to support logistics management. However, there are challenges peculiar to logistics management in developed countries. Firstly, congestion in big cities and transportation hubs is common in developed countries. Traffic congestion can cause transit delays, greater fuel consumption, and higher logistical costs (Chen, Miller-Hooks & Huang, 2023). To address these issues, effective traffic management and transportation management systems must be implemented. Secondly, growing concerns about climate change and environmental sustainability throw extra strains on developed-country logistics management. Logistics operators have significant obstacles in meeting carbon emission reduction objectives, implementing green logistics practices, and optimizing transportation routes to reduce environmental effect (He, Prasad, Pignatta & Jupesta, 2022). Other logistics-related challenges in developed countries include complexity of regulatory environment, labour cost and workforce shortage, sophisticated and demanding customer expectation, among others. Overcoming these challenges necessitates proactive tactics such as using sophisticated technology, encouraging stakeholder engagement, streamlining supply chain operations, and constantly adjusting to changing market conditions (Bari, Chimhundu & Chan, 2022). By properly handling these challenges, logistics managers in industrialized nations may improve operational efficiency, customer satisfaction, and overall competitiveness.

Developing countries have particular logistics management problems such as limited infrastructure, insufficient resources, and institutional barriers. In developing nations, transportation networks are frequently inadequate, roads are poorly maintained, port facilities are restricted, and warehouse infrastructure is inadequate (Okyere et al., 2019). This impedes the efficient flow of products, raises transportation costs, and causes logistical delays and inefficiencies. Access to advanced logistics technologies and systems may be limited in developing countries thereby limiting their capacity to apply contemporary logistics techniques (Bamwesigye & Hlavackova, 2019). Ineffective customs and trade procedures characterize most developing countries. Time-consuming customs procedures, complex documentation requirements, and lengthy clearance processes all add to delays and raise the cost of international commerce. Harmonization and simplification of trade processes are required to improve the efficiency of cross-border logistics operations. Other challenges include lack of skilled workforce, security and theft risk, inconsistency regulatory environment and so on. Addressing these challenges requires

a multifaceted approach including government initiatives, public-private partnerships, capacity building, and infrastructure and technology investment (Lin, 2007).

Managerial implications of technology adoption in logistics management

Technology adoption in logistics management has several managerial implications that need to be considered by logistics companies. It requires significant changes in processes, workflows, and organizational structure. Managers need to effectively manage this change to ensure a smooth transition and minimize disruption to operations. Managers also need to invest in skill development and training to ensure that employees are equipped to use the new technologies effectively. This will require developing new skills and competencies in areas such as data analytics, machine learning, and automation. While technology adoption can lead to cost savings in the long run, there may be significant upfront costs associated with implementing new technologies. Managers need to carefully manage costs and ensure that the benefits of technology adoption outweigh the costs. With the increased use of data and technology, there are concerns around data security and privacy. Managers need to implement appropriate security measures and ensure that they are compliant with relevant data privacy regulations. Importantly also, technology adoption in logistics management requires the integration of different systems and platforms. Managers need to ensure that these systems are properly integrated and that data is effectively shared across different systems.

The implementation of technology or automation has emerged as the key to improving efficiency in the logistics sector. In the logistics sector, technology plays a vital role in fostering operational effectiveness (Cui, Gao, Dai & Mou, 2022). Risk management, cost reduction, and customer satisfaction issues are all successfully handled with the automation of logistical tasks. The management of logistics businesses should, first and foremost, continue to invest in technologies that will increase operational effectiveness and improve the company's reputation. Advanced analytics applications, machine learning, artificial intelligence, the Internet of Things, robotics and automation tools, digital twins, and auction delivery systems are some of the cutting-edge technologies to invest in. Technology investment will give businesses a competitive edge by creating new goods and services that cater to consumers' requirements. Additionally, technology will increase companies' exposure in the logistics industry. With the installation of GPS, modern

technology will assist logistics and transportation companies in determining the productivity of their vehicles.

Secondly, to speed up product delivery and improve customer service, management should make sure that logistics and other related applications accepted and implemented by a company are well-integrated. To save expenses and the pace of technological obsolescence, logistics organizations should incorporate new technologies compatible with those already in use. Additionally, it is crucial that the technology used can coordinate the operations of various people, organizations, and processes so that they function as a single, cohesive whole. Thirdly, industry-based technical standards should be established and promoted to ease the flow of information among stakeholders in order to eliminate the barrier of technological incompatibility with customer and supplier systems.

Adoption of technology in logistics management promotes scalability and flexibility. Technology solutions can adapt to shifting demands as businesses develop or demand fluctuates. Scalability is provided through cloud-based technologies, which enable enterprises to effortlessly scale up or down their storage and processing resources based on their needs. This adaptability enables managers to respond to market dynamics efficiently, ensuring that logistics operations can support corporate development and changing client expectations.

Finally, employees are crucial to the acceptance of technology and the implementation of corporate strategy. Management should therefore promote employee engagement and empowerment. As a result, trust will be strengthened, stress levels will drop, resistance to change will be reduced, and communication and productivity will improve. Employees who will use the new technology should be given greater authority by exposing them to relevant training that will increase their competency and help them perform their jobs more effectively.

Conclusion

The COVID-19 pandemic outbreak has had a significant impact on the logistics sector's operations. The pandemic has interfered with logistics companies' operations, increasing the demand for quicker technology adoption to support a robust and effective supply chain system. In

this study, the existing literature on the antecedents and obstacles impeding the adoption of technology in logistics were examined. The main antecedents of technology adoption in logistics management include maintaining market share, gaining competitive advantage, and rapidly responding to customer requests. Others include cost reduction and improvement in service level, process control and monitoring, safety and security enhancement, company features, technology application types used in a company, and integration level among applications.

There was also a discussion of the internal and external obstacles to technology adoption in logistics management. By discussing the managerial/business implications, this review adds to the body of knowledge by reiterating the need for increased investment in technology to improve operational efficiency and enhance corporate image, efficient integration of new and existing technologies to reduce costs, the establishment of industry-based standards, and increased employee participation and empowerment. There are several ways that this review can be used to support upcoming research. A scale can be created and verified utilizing the main factors or antecedents highlighted in this study regarding the adoption of new technologies.

Limitations of review and agenda setting

A critical review of extant literature reveals the importance of integrating new and current applications within a company and to match them with the technologies of collaborating organizations. However, prior studies have not thoroughly investigated the adoption of many technologies or apps to deliver massive real-time data across the supply chain for effective and efficient decision-making. Without restricting the debate to recognizable or particular logistics organisations, this study offers a comprehensive overview of the major antecedents of logistics management and their associated obstacles. Future studies should do empirical research to identify the antecedents and obstacles affecting the operations of selected logistics firms in various contexts. The review makes no connections between the use of technology and any business results. Future research should examine how business outcomes may be impacted by technology adoption.

Although technological adoption can lead to automation and increased efficiency, it is important to consider the role of humans in logistics management. There is a need for future studies to explore the impacts of technological adoption on the workforce and how to effectively manage the transition to a more technology-driven logistics industry. While technological adoption can

lead to improved efficiency and reduced costs, there is a need to explore the impacts on sustainability in logistics management. For example, the increased use of drones and autonomous vehicles could lead to increased energy consumption and environmental impacts, which require further investigation.

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