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Research Article

Research Development of Logistics Efficiency

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Abstract

This article discusses logistics efficiency. It deliberates knowledge of logistics efficiency, aims to contribute to future studies, a preliminary on logistics efficiency research, and the beginning of another logistics efficiency research. A literature review is employed as the method, which was applied systematically to 32 articles that discussed logistics efficiency and derived from three journal databases. Based on previous research, they could be grouped into five main topics: logistics efficiency on product and measurement; framework, model, and approach of logistics efficiency; logistics efficiency and supply chain; logistics efficiency in the perspective of customer and macroeconomics; logistics efficiency and environment. From all reviewed research, studies on the framework, model, and approach of logistics efficiency are considered the most often discussed topics. Future potential studies are also suggested from all discussed research of all categories.

***Keywords*:** Logistics Development; Innovation Efficiency; Productivity Efficiency; Sustainable Logistics

1. Introduction

In the COVID-19 pandemic, technological advancement motivates numerous areas and commercial sectors. Supply chain systems are being restructured, while the medical and manufacturing industries are also dealing with the crisis through technological advancements (Akhtar, Khan, Mahroof Khan, Ashraf, Hashmi, Khan & Hishan). Supply and demand for distribution have become crucial issue and requires a reliable distribution system. Logistics efficiency is defined as efficiency in logistics, in which the customers will eventually obtain the appropriate product at the right place and time at the lowest price (Ballou, 2007). Logistics efficiency is considered important to all companies, yet the empirical study on the above topics is rarely found, likewise the literature review on logistics efficiency. A literature review assists in the development of theory by identifying potential research gaps and emphasizing areas where further or additional research is required within the existing literature on the topic (Khan, Qureshi, Mustapha, Irum, & Arshad, 2020). Therefore, the search for previous research is conducted to complement the above information. This article is considered preliminary research on logistics efficiency's influence on company performance. It is expected to be able to contribute to future research, particularly research on logistics efficiency.

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2. Literature Review

A literature review is employed for this research. It is applied systematically to 32 research articles that contain logistic efficiency in the title. They include specified keywords on the title, recorded in the last 12 years' publication. The designated keyword is "logistics efficiency." They are sourced from three journal databases: ProQuest, ScienceDirect, and Google Scholar. The steps of literature review can be arranged by organizing articles based on the year of publishing, examining the research background, the research's objective, the result, and conclusion, the advantages, and disadvantages of the research, as well as the potential future research. Next, the categorization will be based on the objective of the research, which the conclusion will follow.

A graph representing the research percentage on logistics efficiency based on category is illustrated in Fig. 1.

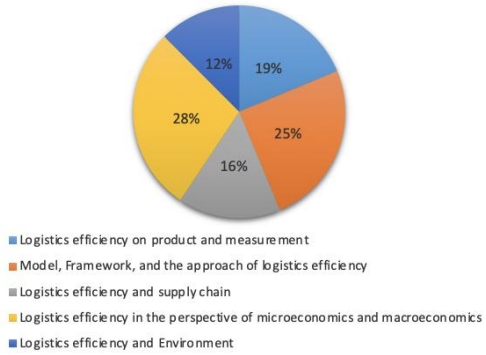

Fig. 1. Logistics Efficiency Based on Category

In its correlation with the effect of logistics process determination, there is research carried out by Bielecki, Madej, and Skoczylas that indicated the effect of determination towards logistics process on the market's selected samples (Bielecki, Madej, & Skoczylas, 2014). The result shows the identification of significant logistics factors that interpret themselves as the alteration in the main design element, which should be the basis of the product's design vulnerability analysis. This analysis not only could yield the identification of the design's element but also determine the specific strategy selection for the company.

On the other hand, three studies deliberate a product's logistics efficiency. First, research by Zhong learned about the logistics efficiency of agricultural products in China from 2008 to 2011 (Zhong, 2014). It is resumed that overall, Total Factor Productivity (TFP) in China has increased accordingly from 2008 to 2011 due to the technical level improvement of national agriculture product's logistics. From 2009 to 2010 and from 2010 to 2011, the improvement stopped. Pure technology efficiency was undeveloped, yet the efficiency scale kept raising. Second, research conducted by Cai, Zheng, and Ma objected to learning logistics efficiency and factors that affect products of China's agriculture by considering the impact of capital investment and human resources as input in logistics and exogen environment variables (Cai, Zheng, & Ma, 2016). This research employs panel data analysis in 30 provinces in China. The conclusion could be drawn that the average technical efficiency in agriculture product logistics is counted as 0.384; the average technical efficiency in the eastern area is calculated as the highest, while the western area is considered the lowest. Exogen environment variable also has a significant influence on the logistics efficiency of agriculture products. Information service level also has a positive significance towards logistics technical efficiency on agriculture products in China.

Third, research by Bielecki and Hanczak presented the definition of a product's logistics efficiency as well as its evaluation concept (Bielecki & Hanczak, 2016). It results in product selection for assessing and measuring selected logistics efficiency aspects. This research provides a resume that showcases the benefits and the disadvantages of implemented methods and guidelines.

2.1. Framework model and the approach to logistics efficiency

Research by Bottani, Rizzi, and Vignali proposed a more detailed framework to design sustainable and efficient logistics scenarios for the food industry (Bottani, Rizzi, & Vignali, 2015). It was also proposed to assess the economics and environmental performance. It integrates warehouse and distribution activities that have the potency to improve the economic and environmental performance indicators of logistics in the food industry. It prefers to design integrated management of logistics activity rather than to identify the actors of the supply chain that will run the industry, which becomes one of the advantages of the research.

Later, three studies are dedicated to a model of logistics efficiency. First, research by Jiao generated the analysis model of city port logistics arrangement (Jiao, 2012). This research adopts Fuzzy Comprehensive Evaluation Method to comprehensively evaluate the city port's efficiency and make a qualitative, quantitative assessment. It reveals the source of city port management's problems and weak spots. Later, research by Li reviewed the effective logistics model of American agriculture, then the recent logistics situation of China's agriculture products was analyzed, and later references were proposed to enhance logistics efficiency in China to be equal to America's logistics efficiency (Li, 2014). It concludes the differences between Sino-America in national condition; best practices in the United States only can be used as references, not for mechanical practice.

Next, Ma, Jiang, and Yu conducted research to consider different 8 models for estimating efficiency in the logistics industry in mainland China from 1999-2012 (Ma, Jiang, & Yu, 2016). It resumes that the spatial-temporal model with latent spatial effect in efficiency is the better choice, among others. The efficiency gap is mostly caused by the difference in the district rather than the time gap. Potential future research is suggested to explore how temporal-spatial could affect productivity in the logistics industry and by implementing designated models in other types of industries. Fourth, the research proposed by Wang and Luo aimed to measure the integration level of smart technology and the logistics industry by using Grey Correlation Model (Wang & Luo, 2019). The research recommended that level of smart logistics technology applied in five provinces of northwest China is higher than in five countries in Middle Asia; logistics industry efficiency is low in the "core area," yet it indicates an escalation trend on the annual average (Sikandar, Vaicondam, Khan, Qureshi, & Ullah, 2021). The effect of smart logistics technology on logistics efficiency is significant at the level of 10% of the "core area." It is consistent with mechanism analysis; the efficiency of the logistics industry cannot be balanced with the recent opening level at the "core area."

In correlation with the logistics efficiency approach, there are three research involved. First, the research by Chen, Wang, Cheng, Fang, Sun, and Chien was objected to illustrate the implementation of lean management and radio frequency identification (RFID) technology to improve logistics efficiency at the distribution center (Chen, Wang, Cheng, Fang, Sun, & Chien, 2011). It is finally concluded that a static RFID reader obtains 100% reading with the antenna located on the garage door and a passive tag of high frequency attached at each pallet. This research could become benchmarking model and reference for further promotion of efficiency improvement in the logistics system.

Second, the research of Markovits-Somogyi and Bokor was performed to present the existing approach for assessing logistics efficiency on site (Markovits-Somogyi & Bokor, 2014). It emerges with discrete event simulation to model the workflow of the production system with a discrete manufacturing process in the company's logistics process. Also, the supply chain process is connected with the production process during input and output manufacturing (Shahatha Al-Mashhadani, et al., 2021). Next, the research could develop an appropriate approach

to holistically capture the entire system's efficiency and evaluate the efficiency of the entire manufacturing system, including the warehouse activities. Next, Straka, Malindzakova, Trebuna, Rosova, Pekarcikova, and Fill conferred the implementation of a computer simulation approach to lean up the production logistics at certain companies (Straka, Khouri, Lenort, & Besta, 2020). Simulation Extendsim is applied as the tool. It is stated that expensive tools are no longer required to solve production issues. On the contrary, there is a possibility to advance the utilization capacity, obtain time reservations and overcome traffic issues while maintaining low production costs. Next research could be focused on the appropriate time or "critical point" for new technology purchasing for customized products and how to implement specific changes in production technology.

2.2. Logistics efficiency and supply chain

Five studies explain logistics efficiency and supply chain, consecutively arranged based on the year of publishing, as follows; First, research by Onyemechi intended to assess the inter port hub connectivity and transportation network in their efforts to bring up sustainable transportation system in the supply chain of global multi-capital transportation (Onyemechi, 2010). This research employs Data Envelopment Analysis (DEA) and an ecosystem approach. It can be resumed that the implementation of the border efficiency model in evaluating the port's performance should be moved forward in the direction of the port's environmental assessment. It also introduces a new methodology for overcoming inefficiency problems in the total multi-capital logistics chain.

The second research was conducted by Ha, Park, and Cho, who tried to measure the trust level for the perception of logistics/supply chain management (SCM) managers towards SCM managers from buyer's companies, as well as to investigate the effect of trust to the collaboration of supply chain and logistics efficiency (Ha, Park, & Cho, 2011). Data are derived from Korean companies by mail survey with 256 usable responses. It concludes that affective trust significantly influences the collaboration for information sharing and benefit/risk sharing, while trust in competence influences collaboration in sharing decisions as well as information and benefit/risk sharing; in terms of supply chain collaboration, sharing decisions and information is found to influence logistics efficiency; insignificant correlation is detected between affective trust and sharing decision making, between trust in the competence and information sharing as well as between benefit/risk sharing and logistics efficiency. The superiority of this research, it analyses the causal effect of suppliers' trust at the interpersonal level on supply chain collaboration and logistics efficiency. It also discusses the result compared with those who focused on buyers' trust. The survey is conducted on Korean companies, and the majority of samples, around 60 percent, are from manufacturing industries. Further research could explore the perception gap of benefit/risk sharing between supplier and buyer, including the intervention effect of this relationship strategy to the correlation among trust, collaboration, and logistics efficiency; put the proposed model to further test to be implemented in other countries and industries.

The third referred research was conducted by Liu, Li, Feng, and Rong, intended to understand whether logistics efficiency in supply chain systems will be related to network categorization structure (Liu, Li, Feng, & Rong, 2012). It is said that network grouping is preferred in terms of fulfilling the requirement for a supply chain system since it has a faster response to customer demands and better system utilization. This research provides a new method for learning logistics process efficiency in supply chain systems from a topology perspective. For further research, it is suggested to initiate the task capacity processing strategy for an individual entity to enhance system performance; to design and modify the supply chain network structure to fulfill the specific requirement of a different system.

Later, research by Cudzilo, Voronina, Dujak, and Kolinski presented the concept of logistics activities efficiency analysis in the complex supply chain (Cudziło, Voronina, Dujak, & Kolinski, 2018). It results in the concept development of efficiency analysis performance focused on logistics activities, elements that have been verified in their correlation with their utilization in economics practices. It is more focused on illustrating the concept of efficiency analysis towards logistics activities that provide specific characteristics of the distributed supply chain. Hence, a coherent concept could be developed for future research to analyze logistics activities' efficiency and verify its implementation in business practices.

Fifth research was performed by Jung, who examined the product's effect with RRP (Retail Ready Packaging) run by discount shops toward collaboration achievement, such as loading efficiency (Jung, 2018). The research suggests several implications for the future basic direction of environment-friendly management. Chi-square analysis is employed to validate 16 items. Later, it can be concluded that producers and distributors clearly have different perspectives that lead to packaging system operation problems. Without efforts to identify the problems, despite the existing packaging system, it will lead to social problems due to conflict between producers and distributors.

2.3. Logistics efficiency from the perspective of costumers and macroeconomics

Research related to costumer's perception of logistics efficiency was made by Garrouch, Mzoughi, Slimane, and Bouhlel to verify the correlation among costumer's perception of logistics efficiency, satisfaction, and behavior intention (Garrouch, Mzoughi, Slimane, & Bouhlel, 2011). The research distributed a questionnaire with 290 respondents and concludes that sensitivity towards logistics efficiency covers three dimensions: sensitivity towards merchandising, the availability of products and related information, logistics sensitivity at the department level, and logistics sensitivity at the level of the factory; loyal yet less sensitive costumers toward logistics efficiency, positively influenced by buyer's mood; satisfaction and patronage intention that only influenced by logistics efficiency at the level of farmers.

This research suggests that sensitivity towards logistics is a factor that could explain customers' behavior in terms of retail. Next, the research could employ a certain scale to measure before-after loyalty after exposure to clear problems or logistics performance.

Then, six studies discuss regional logistics efficiency and its review from the perspective of customers and macroeconomics. Zhang and Zhang (2010) conducted research by generating an evaluation and analysis of regional logistics development efficiency. Data Envelopment Analysis (DEA) was used as the research method, with data derived from 31 areas at the level of a prefecture in East China in 2008. The research concludes that efficiency in big areas is superior to the small and middle areas; the input element fails to have a role in logistics development in a different area; generally, the scale of the area's logistics investment is quite big. Second, the research by Markovits-Somogyi and Bokor adapted the non-parametric DEA method and DEA-PC to the logistics field from the perspective of macroeconomics (Markovits-Somogyi & Bokor, 2014). It employs DEA-PC (pairwise comparison) methodology using efficiency data from 29 European countries. It is said that DEA and DEA-PC could assess a single performance dimension, efficiency, so it can be used as an additional method that enables it as a performance measurement technique and other efficiencies. Sample extending could be considered for the next research to change the efficiency score.

The next research by Andrejic analyzed the efficiency of logistics activities globally (Andrejic, 2014). A methodology is generated as a proper basis for new model development. This research proposes a new methodology that combines internal indicators (domestic) and external (international) in a single efficiency score. Extending the examined set, using the proposed approach to analyze time efficiency modification, and determining proper steps to enhance the efficiency could be options for future research. Later, research by Sharipbekova and Raimbekov was conducted to investigate not only the transportation sector but also the telecommunication and national component (Sharipbekova & Raimbekov, 2018). The researchers compare the total LPI of CIS countries with the top 10 and bottom 10 countries from 2007 to 2016. It can be recommended that logistics development mostly correlates with the overall country's development. Logistics efficiency influences not only economic growth but also the country's further development globally.

The fifth research by Lee identified the recent logistics status of oil and gas industries in Iraq and measured its logistics relative efficiency by comparing it with other 157 countries using a two-stage data envelopment analysis (DEA) model with data comparison of 157 countries (Lee, 2018). The DEA projection results indicate that track and trace are the most important variables in improving the efficiency of supply chain delivery service. Therefore, Iraq should re-create its customs process to improve its infrastructure investment and enhance service quality to attract more global logistics service providers. This research suggests Qatar as one of the references. Future research could study the logistics performance of the other countries to be later compared in detail; implement actual data to measure the efficiency; apply other analysis models, such as SCOR and balanced scorecard model.

Next, the research from Kim and Shin was conducted to test whether the distribution of innovation efficiency value is measured differently in terms of consideration level to consider higher education and research and development (R&D) institution as the source of information (Kim & Shin, 2019). The input-oriented data envelopment analysis is used as a method with constant return to scale and Kruskal Wallis one-way ANOVA (analysis of variance) techniques. Researchers measure the innovation efficiency of 72 logistics companies in South Korea. It can be seen that logistics companies in Korea tend to consider higher education and R&D institutions not seriously as the source of important information to achieve logistics innovation. The companies' innovation efficiency will end up with a low score if they exclude or ignore the source of information for innovation activities. This research only considers Research and Development and higher education institution as a source of information in South Korea. Future research could utilize data from other countries or international data, which will come up with more varied results; analyze data from several other logistics companies and apply other references of information sources.

The next research by Nekhoroshkov et al. revealed that transportation is one of the prime issues in APEC, exposing the importance of considering the uneven economic growth in APEC and the urgency to eradicate it. It was a crucial scientific challenge to asses logistics efficiency as a development factor and find the best practice for overcoming it (Nekhoroshkov, Aroshidze, Nekhoroshkov, Yuchzhong, Avdokushin, Evgeniy, & Timukhain, 2022).

Table 1
Research Topics on Logistics Efficiency

Category	Topic	Authors
Logistics Efficiency Products and Measurement	To measure the efficiency of SMEs	Campos-Garcia, Garcia-Vidales, Garcia-Vidales, Gonzalez-Gomez, & Altamirano-Corro, (2012);
	To measure productive efficiency	
	Determination impact on the logistics process	
	Logistics efficiency of agriculture products	Sun (2013);
	Logistics efficiency and factors that affect agriculture products in China	Bielecki, Madej, & Skoczylas (2014);
	Definition and evaluation of product's logistics efficiency	Zhong (2014);
		Cai, Zheng, & Ma (2016);
		Bielecki & Hanczak (2016).
Framework Model and the Approach to Logistics Efficiency	Model of logistics on agriculture products	Bottani, Rizzi, & Vignali (2015);
	Model of logistics on city port	Jiao (2012);
	Eight models of efficiency	Li (2014);
	Grey correlation model	Ma, Jiang, & Yu (2016);
	The framework of sustainable logistics	Wang & Luo (2019);
	The implementation of lean management and RFID technology	Chen, Wang, Cheng, Fang, Sun, & Chien (2011);
	The approach to logistics efficiency at the factory	
	The approach of computer simulation for production logistics	Markovits-Somogyi & Bokor (2014);
	Assessing inter-port hub and transportation network.	Straka, Khouri, Lenort, & Besta (2020).
Logistics efficiency and supply chain	Trust effect on supply chain collaboration and logistics efficiency.	Onyemechi (2010);
	The correlation between logistics efficiency in the supply chain and network grouping structure.	Ha, Park, & Cho (2011);
		Liu, Li, Feng, & Rong (2012);
	Logistics activities efficiency in the supply chain.	Cudziło, Voronina, Dujak, & Kolinski (2018);
	Product's impact towards ready-packaging retail.	
		Jung (2018).
Logistics efficiency in the perspective of customers and macroeconomics	Costumer's perception of logistics efficiency, satisfaction, and behavior intention	Garrouch, Mzoughi, Slimane, & Bouhlel (2011);
	Evaluation and analysis of regional logistics development efficiency	Zhang & Zhang (2010);
	Adopting the DEA and DEA-PC methods to the logistics field	Markovits-Somogyi & Bokor (2014);
	Global efficiency of logistics activities	Seebacher, Winkler, & Oberegger (2015);
	Analyzing the transportation sector, telecommunication, and national component	Andrejic (2014);
		Sharipbekova & Raimbekov (2018);
	Identifying the logistics status of the oil and gas industry in Iraq	Lee (2018);
	Testing the distribution of innovation efficiency value that is measured differently.	Kim & Shin (2019).
	Logistics Efficiency of APEC Economies.	Nekhoroshkov, Aroshidze, Nekhoroshkov, Yuchzhong, Avdokushin, Evgeniy, & Timukhain (2022).
Logistics efficiency and environment	Environmental pollution of logistics industry developments in China.	Shi (2018);
	The innovative city development that promotes the environment-friendly logistics efficiency	Du, & Li (2022).
	The importance of logistics efficiency in terms of green economics efficiency.	Wang, Liu, Sui, & Li (2022); Liang, Chiu, Guo, & Liang (2022).
	Low-carbon logistics efficiency.	

2.4. Logistics efficiency and environment

Four studies deal with logistics efficiency and the environment, studied by Shi to analyze environmental pollution further to measure logistics efficiency with low-carbon. The DEA-BCC model is employed with data taken from 30 provinces in China in 2016. It is concluded that air, water, and noise are being polluted by the high volume of transportation and logistics industrial freight in Tiongkok; the low-carbon logistics efficiency is considered low; the comprehensive efficiency value of low-carbon logistics is counted as 20% of provinces. This research has a positive significance in fully understanding the quo status of environmental pollution caused by the logistics industry. Potential future research could involve calculating carbon emissions of logistics activities; factors that affect low-carbon logistics; innovation of low-carbon logistics development model; and implementation mechanisms as well as management for developing low-carbon logistics.

In the second research, Du & Li studied the innovative city development that encourages the efficiency of environmental-friendly logistics. The result indicates that innovative cities can effectively improve green efficiency. An innovative pilot city's policy can encourage and play a strong role in enhancing green efficiency, and innovative city strategy influences the effectiveness of green logistics (Du & Li, 2022).

In the third research, Wang, Liu, Sui, & Li applied a spatial measurement model to explore the burst effect of logistics efficiency on economic benefits. The result indicates that logistics efficiency gives benefits the productivity factor. The total carbon, which is positioned below the level of a low-carbon economy, proves that economic efficiency can be improved by reducing carbon dioxide emissions from the perspective of logistics efficiency (Wang, Liu, Sui, & Li, 2022).

Fourth research, Liang, Chiu, Guo, & Liang investigated low-carbon logistics efficiency using a three-stage Super-SBM model. The result suggests that the external environment and random factors gives a certain impact on

the measurement result. The analysis shows low logistics efficiency and relatively high carbon with insufficient technological advances (Liang, Chiu, Guo, & Liang, 2022). Therefore, to clarify the discussion, topics of logistics efficiency research are resumed in Table 1.

3. Conclusion

Logistics efficiency is important for all companies. Yet, empirical research about logistics efficiency is rarely found. Based on the objectives of the previous 32 studies, the research on logistics efficiency could be classified into five categories, which are: logistics efficiency on product and measurement; framework, model, and the approach of logistics efficiency; logistics efficiency and supply chain; logistics efficiency in the perspective of customer and macroeconomics; logistics efficiency and environment. Future potential studies are also suggested from all discussed research of all categories. From all reviewed research, studies on the framework, model, and approach of logistics efficiency are the most often discussed topics. If it is seen from topics distribution based on the year of publishing, that category was consistently discussed from 2011 to 2022, unlike others. Hence, the research on logistics efficiency should be improved by embodying the potential issues that emerged from previous research.

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