

Logistics Outsourcing as a Strategy for Business Efficiency: Mediating Role of ICT

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Abstract: The purpose of this article is to validate the impact of logistics outsourcing, a strategy that has become much more relevant in recent years, on business efficiency, as well as to investigate the mediating role of information and communication technologies in this relationship. The following investigation bases on the premise that logistic outsourcing is not only related to cost minimization but also has a positive effect on how companies adapt to the new environment that surrounds them, while also achieving efficiency in different areas and using all their technological resources from the new digital world. The study is based on a methodological design of instrumental research, using a questionnaire of 18 items, which was applied to 518 people in the sectors of interest. Subsequently, a thorough quality control and a rigorous validation of the data was carried out, consolidating the final sample in 512 respondents. With these data, statistical analyses were carried out, including descriptive and reliability measures to proceed with the exploratory factor analysis (EFA), the confirmatory factor analysis (CFA) and to continue with the process of testing the previously stated hypotheses. The results revealed adequate levels of reliability, the exploratory factor analysis reported that the 18 items load two factors, with a very acceptable KMO and a good Bartlett with an explained variance within the scientific parameters; on the other hand, the confirmatory factor analysis reported 2 models, where model 2 (M2) with 15 items is the one with most adequate 'goodness of fit' determinants that positively confirm the factor structure of the model that measures logistic outsourcing (LO) to improve business efficiency (BE) using information and communication technologies (ICTs) as a mediating variable. This study establishes substantive reference framework to future research and for companies a way to achieve business efficiency using advanced technology and outsourcing activities and/or processes.

Keywords: Outsourcing logistics, Business efficiency, Information technologies and communications, Productivity and logistics providers

1. Introduction

The current landscape is characterized by intense business competition, according to Arshad Ali & Mahmood (2024) corporations confront pressure to improve their business efficiency. Both Ali et al. (2023) and Sternberg et al. (2023) highlight logistics outsourcing as an alternative to alleviate this pressure, as it allows companies to reduce expenses and focus on their core activities. Doratiotto et al. (2023) suggest that increased collaboration in processes, including the hiring of external specialists, can result in favourable logistical performance. Valashiya & Luke (2023) emphasize the importance of cooperation with logistics providers to strengthen the supply chain. This view is supported by Gunawan et al. (2023) who assert that sustained interaction within the collaborative network positively impacts performance.

It is evident that logistics outsourcing leads to cost reduction, which is appealing to companies; however, there are other reasons and expectations associated with this strategy. For example, a Brazilian study reveals that some companies place more value on the collaboration and willingness of logistics providers (Doratiotto et al., 2023), while others prioritize efficiency in waste elimination and process streamlining (Zarbakshnia & Karimi, 2024). Additionally, research in the pharmaceutical sector in the United Kingdom found that logistics outsourcing improved the reliability, quality, and flexibility of the supply chain, while also enhancing competitive advantage Ali et al. (2023). Essentially, the decision to work with 3PL providers is based on the reliability and capability they have to improve service efficiency, as noted by Sakas et al. (2023)

In this context, efficiency emerges as a crucial concept in business management to ensure long-term sustainability and success, maximizing results and optimizing resources. Aziegbe and Worlu (2020) highlight that businesses today are striving to offer high-quality products and services without compromising their operational margins and profitability. Geminarqi & Purnomo (2023) emphasize efficiency as a key factor impacting various areas, including "productivity, product quality, customer satisfaction, and profitability," which can be driven by both basic actions and more complex strategies. Aziegbe and Worlu (2020) recommend detailed and proactive planning of all production-related activities. In this regard, Sakas et al. (2023) point out that monitoring indicators related to inventory allows businesses to detect excess purchases or stock production that could increase operational costs.

Furthermore, technology has become involved in logistics outsourcing, demonstrating its influence on corporate efficiency. Abouzid and Saidi (2023) present the digital twin as a tool that rapidly executes processes, optimizes delivery times, and streamlines decision-making. Liu and Zhao (2023) underscore that logistics strategies supported by advanced technologies can significantly improve coordination, visibility, control, and performance within the supply chain.

Li et al. (2024), in their strategic analysis of a shared delivery point network in the last-mile logistics market, demonstrate how technology facilitates the functioning of this system, making it more efficient and cost effective. Kousiouris et al. (2019) indicate that the use of microservices-based frameworks to integrate IoT management platforms, semantic services, and AI helps to better understand and manage the supply chain. Additionally, Zhang and Ma (2022) emphasize that marketplaces enable multiple businesses to share logistics services, such as storage and dispatch, thus increasing business efficiency and reducing logistics costs.

2. Literature Review

Rivo López (1999) states that outsourcing begins with basic tasks before extending to strategic functions. Battistelli & Campanella (2020) describe outsourcing as "a phenomenon that intertwines business strategies and labour dynamics." Closa (2018) emphasizes the importance of considering both economic and productivity perspectives when making outsourcing decisions, while Wang et al. (2023) highlight that well informed decisions contribute to business growth and success.

Kumar & Singh (2012) emphasize on third-party logistic providers (3PL) being a competitive advantage for enterprises, with transportation, warehousing and custom clearance being the most outsourced activities. In addition, Giri & Sarker (2017) mention that the relationship between 3PL's and the contracting companies "lead to effective planning and mutual satisfaction of interests". Moreover, it is crucial to align logistics outsourcing decisions with the company's overall strategy and objectives (Closa, 2018). Nault et al. (2015) propose that logistics providers implement dynamic pricing strategies, which involve "adjusting prices in real time according to demand fluctuations and available capacity."

In this regard, several factors influence business efficiency, including supply chain aspects. Masson et al. (2016) define efficiency as the optimal utilization of assets and resources to deliver high-quality products. Reed et al. (2018) conceptualize efficiency as the ability to provide goods or services profitably without compromising quality. Similarly, Shaheen (2024) describes efficiency maximization as involving cost reduction and the application of effective strategies. Aziegbe & Worlu (2020) agree that ensuring superior performance requires businesses to effectively utilize their capacity and minimize costs. It is worth noting that this concept is widely recognized as part of continuous improvement strategies that drive competitive advantage and process agility (Izquierdo Gaitan et al., 2021).

In the academic field, supply chain integration (SCI) is identified as a key aspect of efficiency, Veeragoudar & Bharamanaikar (2023) describe three dimensions of SCI: Internal Integration (II), which focuses on harmonizing various departments and functions to eliminate inefficiencies; Supplier Integration (SI), which seeks coordination with external suppliers to optimize organizational performance; and Customer Integration (CI), which aims to balance supply and demand by involving customers. In this research, SI is the most relevant dimension.

Along the same lines, effective demand management is a key factor for efficiency, as it leads to reduced operational costs (Debala et al., 2023), particularly when strategies for maximizing material utilization and waste elimination are applied (Aziegbe & Worlu, 2020). Likewise, periodic and appropriate maintenance interventions minimize delays and associated costs, ensuring effective demand fulfilment (Modgil & Sharma, 2016).

Additionally, business success depends on selecting partners with specialized personnel, as these professionals are critical complementary elements for achieving efficiency (Izquierdo Gaitan et al. 2021). López et al. (2016) confirm that skilled employees facilitate "business process improvement". Geminarqi & Purnomo (2023) argue that they exhibit higher productivity levels.

Now then, since the onset of digitalization, ICT has played a crucial supporting role in corporations. In the 1980s, ICT was perceived as a valuable tool for developing strategic initiatives (Gratzer and Winiwarer, 2003). The integration of technologies for rapid data acquisition has enabled companies to deliver products to customers more accurately and efficiently (Garrido et al., 2007). In logistics, ICT usage not only enhances process efficiency and effectiveness but also significantly impacts logistics strategies and organizational structures (Liu & Zhao, 2023). Furthermore, ICT has been demonstrated as a key factor in achieving competitive advantages (Zhang &

Ma, 2022). Modern business strategies emphasize partnerships with technology-driven firms to expand supply capacity, compete globally, and meet rising consumer expectations (Garrido et al., 2007).

As a result, the evolution of ICT has reshaped industries by reducing communication, information-gathering, and transaction costs (Lollar et al., 2010). For example, identification technologies such as barcodes and RFID facilitate logistics data collection and sharing, improving both management and control processes (Pérez-López et al., 2019). Tiwari (2021) highlights that the implementation of GPS and GPRS devices in India's logistics industry has significantly enhanced supply chain visibility and control, improving logistics operations planning through real-time analysis and decision automation also according with Xiaolan (2013).

3. Methodology

To ensure representativeness, participants were selected from 71,070 active companies registered in Peru until January 2024, this data is according to INEI (2024). To determine the specific target population for the survey, was refined by excluding 10,454 companies that ceased operations during the first quarter of the year (INEI, 2024). Additionally, companies in the categories of transportation and warehousing (4,431), business loan services (6,908), and real estate (839) were excluded, resulting in 48,438 companies, representing the firms of interest for this study. The required sample size was calculated using standard statistical parameters: a 95% confidence level, a z-value of 1.96, and a 5% margin of error. Based on these criteria, the minimum number of valid responses needed was 424.

The data collection instrument consisted of 30 questions, using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree), and aimed to assess how companies implement logistics outsourcing (LO), its impact on business efficiency (BE), and the mediating role of information and communication technology (ICT). The instrument of this study was adapted from Sakas et al. (2023), Nga & Tam (2023) and Oledinma et al. (2021) and was elaborated using Google Forms.

Finally, it's important to mention that the final respondents were professionals with experience in the sectors that were included in this research (Food & Drinks, Agriculture, livestock, forestry and fisheries, Manufacturer, Information and communications, Mines and quarries, Retail & mass consumption, other) and contacted by mail, social and professional media or personal contacts. The details of how the data collected were validated is much more explained in point 4, which corresponds to the results obtained, but in summary responses were screened for completion, logical consistency, and duplication. The survey platform enforced single-response limitations and included control questions. Six responses were discarded for incompleteness or failure to meet quality standards, yielding a final validated sample of 512 participants to start the analysis.

3.1 Hypotheses

The first hypothesis would be "logistics outsourcing has a direct positive impact on business efficiency", with Doratiotto et al. (2023) indicating this practice as a way to enhance both logistical and business performance through close collaboration with providers, while Ali et al. (2023) mention that it can be more cost-effective and allows companies to focus on their core activities and help them achieve outstanding performance.

The second hypothesis states that "information and communication technology mediate the causal relationship between logistics outsourcing and business efficiency", as Zhang & Ma (2022) mentions that digital platforms optimize shared logistics services and reduce costs, while Kousiouris et al. (2019) highlight the use of microservices-based frameworks to integrate IoT [Internet of Things], therefore improving supply chain coordination and efficiency.

The third hypothesis proposes: "Information and communication technology for logistics positively influences the implementation and effectiveness of logistics outsourcing" based on Tiwari (2021) and Xiaolan (2013) work, which emphasize that GPS and GPRS devices enhance supply chain visibility and responsiveness, while underscoring the importance of information systems for successful integration.

The fourth hypothesis suggests "Sourcing outsourcing is a strategy that enhances the effectiveness of logistics outsourcing" as John & Wallenburg (2021) explain that delegating supply functions to specialized providers improves focus and efficiency, while Vázquez & Orozco (2019) mention it increases competitiveness and supply chain adaptability.

The fifth hypothesis affirms that "Transportation outsourcing is a strategy that enhances the effectiveness of logistics outsourcing", with Nikolaeva & Ivshin (2020) highlighting digital platforms to make smarter decisions

for transportation services and Yang et al. (2024) demonstrating this strategy increases flexibility, reduces costs and boosts logistics performance.

The sixth hypothesis would be “warehousing outsourcing is a strategy that enhances the effectiveness of logistics outsourcing” as Baglio et al. (2023) and Benatiya Andaloussi (2024) show that it improves inventory management, allows access to advanced systems and strengthens operational efficiency.

4. Results and Discussion

A total of 518 questionnaire responses were collected between August 21, 2024, and October 11, 2024. However, only 512 responses were included in the study, as they passed strict validation filters designed to maintain data quality. The sample was subsequently divided into two groups: one representing 60% of the responses was used to perform the Exploratory Factor Analysis (EFA), and the other 40% was used for the Confirmatory Factor Analysis (CFA).

Cronbach's alpha (α) was used to assess the internal consistency of the questionnaire, yielding a coefficient of 0.841, exceeding the 0.700 threshold required for academic research acceptance. This validates the coherence of the questions and the robustness of the method. Specifically, reliability scores were 0.759 for logistics outsourcing, 0.620 for business efficiency, and 0.717 for ICT. Additionally, **McDonald's omega** (ω) was calculated, as it is considered a more robust alternative, according to Campo-Arias & Oviedo (2008) [7], acceptable omega values range from .70 to .90. The questionnaire achieved an overall omega of .84, confirming the strong interrelation of items. The individual scores were 0.701 for logistics outsourcing, 0.625 for business efficiency, and 0.729 for ICT. Lastly, the **Greatest Lower Bound** estimator was applied, which does not assume tau-equivalence and is useful for multidimensional constructs. The instrument yielded GLB coefficients of 0.908 for logistics outsourcing, 0.812 for business efficiency, and 0.761 for ICT, with an overall score of 0.940, indicating high reliability.

The **Exploratory Factor Analysis** using principal components with oblique promax rotation confirmed the underlying structure of the data, with factors aligning with theoretical expectations. The **Kaiser-Meyer-Olkin** scores were 0.708 for logistics outsourcing, 0.725 for ICTs, and 0.531 for business efficiency, indicating adequate item correlations and construct validity. **Bartlett's test of sphericity** showed significant results for all variables (logistics outsourcing: $\chi^2 = 1084.401$, $p < 0.001$; ICTs: $\chi^2 = 243.409$, $p < 0.001$; business efficiency: $\chi^2 = 382.518$, $p < 0.001$), confirming the suitability for factor analysis. **Total variance** analysis revealed that logistics outsourcing had two factors explaining 53.5% of the variance, ICTs had one factor explaining 40.6%, and business efficiency had two factors explaining 49.3%.

Table 1: Performance of items for each dimension of the variables

Variable	Question	Factor 1	Factor 2
LO	Experience	0.976	
	Reputation	0.891	
	Price	0.611	
	Technological infrastructure		0.713
	Knowledge of information technology		0.624
	Cost reduction efforts		0.618
	Problem-solving skills		0.618
	Speed of execution		0.547
ICTs	Extension of information	0.734	
	Facility	0.716	
	Acquisition	0.604	
	Efficiency	0.454	
BE	Shared database (company – 3PL)	1.179	
	Open access and development of technology	0.420	
	Internal promotion of digitalisation		0.659
	Technological training		0.634

Variable	Question	Factor 1	Factor 2
	Better IT infrastructure		0.525
	Digital transformation policies		0.521

An initial Confirmatory Factor Analysis (CFA) of 18 items showed that the instrument performed adequately, but the model fit indices were outside acceptable ranges, with a chi-square of 7.397, an RMSEA of 0.177, and incremental fit indices below 0.9. As a result, three items were removed, reducing the instrument to 15 items for reanalysis. The second model produced improved fit indices, with a chi-square of 2.568, an RMSEA of 0.088, and incremental fit indices (CFI, TLI, and IFI) all exceeding the 0.9 threshold, indicating better model performance with 7 items in the LO dimension and 4 items in each of the BE and ICTs dimensions.

Table 2: Confirmatory Factor Analysis

Model	Covariances	Fit indices	Variables:		
			LO	ICTs	BE
M1	18 items	R ²	0.5463	0.5378	0.3595
		Chi – square	7.397		
		RMSEA	0.177		
		CFI	0.898		
		TLI	0.881		
		IFI	0.898		
M2	15 items	R ²	0.6029	0.5164	0.5513
		Chi – square	2.568		
		RMSEA	0.088		
		CFI	0.985		
		TLI	0.978		
		IFI	0.985		

According to Doratiotto et al. (2023), outsourcing logistics services significantly enhances company performance, as confirmed by this study's strong correlation (0.744) between logistics outsourcing and business efficiency. Gunawan et al. (2023) and Ali et al. (2023) emphasise that outsourcing facilitates flexible operations, resource allocation, and cost-effectiveness. Cost is the most crucial factor in selecting logistics providers (0.920), aligning with Closa (2018), Shaheen (2024), and Valashiya & Luke (2023), who stress the importance of cost, trust, and innovation in achieving long-term advantages. The covariance of 0.758 between logistics outsourcing and business efficiency further supports its role in optimising operations, as noted by Geminarqi & Purnomo (2023)). Commonly outsourced services like procurement, transportation, and warehousing enhance efficiency by focusing on core competencies and reducing operational costs (John & Wallenburg, 2021; Yang et al., 2024; Arshad Ali & Mahmood, 2024; Benatiya Andaloussi, 2024). In Peru, transportation is the most outsourced service, with speed, problem resolution, and technological infrastructure being key factors in service provider selection (Wang et al., 2023; Closa, 2018; Veeragoudar & Bharamanaikar, 2023). Despite ICT's potential to improve logistics through data sharing (Tiwari, 2021; Kousiouris et al., 2019), this study found a lower covariance (0.602) between ICTs and logistics outsourcing, indicating underdeveloped integration. While ICTs show a strong correlation with business efficiency (0.694), their relationship with logistics outsourcing remains weak, suggesting the need for further research into their complementary roles (Zhang & Ma, 2022; Sakas et al., 2023). As noted by Ismail & Sharifi (2020) and Patel & Padhi (2022), ICTs have transformative potential, but their integration in logistics outsourcing requires stronger infrastructure and willingness to innovate (Pérez-López et al., 2019).

4.1 Hypothesis Testing

The mediation analysis was conducted using the SEM method with a bootstrap estimator (5,000 replications) to ensure result reliability. A strong direct relationship was identified between logistics outsourcing (LO) and business efficiency (BE), with key items such as LO1 (price importance) significantly impacting BE1 ($p = 0.045$). Additionally, LO3 (3PL responsiveness) and LO5 (technological infrastructure) had notable effects on BE1 and BE5. Regarding ICTs' mediating role, LO1 had an indirect effect on BE1 through TIC1 (technology acquisition

efficiency) ($p = 0.003$), while LO4 negatively influenced BE1 via TIC1 ($p = 0.011$), suggesting that excessive reliance on outsourcing problem-solving may hinder ICT effectiveness. LO6 (ICT knowledge) and LO7 (reputation) mediated through TIC1 and TIC2 to BE1 and BE2, reinforcing ICTs' role in facilitating outsourcing adoption for efficiency gains. Overall, ICTs partially mediate the relationship, amplifying but not solely determining the impact of LO on BE. Confirmed hypotheses include H1, H2, H3, H5, and H6, with statistically significant effects such as LO1 ($p = 0.003$) confirming H2, TIC1 and TIC2 impacting BE2 ($p = 0.002$) supporting H3, and LO3 strongly influencing BE5 ($p < 0.001$) validating H5. However, H4 was not supported, as no evidence indicated that outsourcing procurement significantly determines business efficiency.

5. Conclusions

This study analysed responses from a sample of over 500 individuals to examine the relationship between logistics outsourcing, ICT adoption, and business efficiency in Peruvian context. The results reveal a close relationship between logistics outsourcing and business efficiency, consistent with the findings of Doratiotto et al. (2023), who highlighted the direct impact of outsourcing on company performance. Additionally, Ali et al. (2023), emphasized how this practice allows organizations to focus on core activities, improving market adaptability.

Regarding the relationship between ICTs and logistics outsourcing, there is an opportunity for deeper investigation. Observations by Kousiouris et al. (2019), indicate that while ICTs optimize logistics management, their implementation is not always fully aligned with outsourced services. Thus, examining this connection in greater detail would be ideal. On the other hand, the study confirms the importance of technology in improving business efficiency, supporting the claims of Zhang & Ma (2022). Organizations that incorporate advanced technologies into their daily operations and processes significantly enhance performance and market competitiveness, achieving a differential competitive advantage.

In conclusion, this study offers new insights and contrasting perspectives on the complex relationship between logistics outsourcing, ICTs, and business efficiency. It also provides valuable contributions to the supply chain field, encouraging companies to establish relationships with third-party logistics (3PL) providers to optimize operations and improve logistics management by leveraging advanced technologies. Finally, this study acknowledges its limitations, including its focus on Peru and the exclusion of certain industrial sectors, which may restrict the generalizability of its findings. Nonetheless, it establishes a solid foundation for future research in this impactful field across dynamic and evolving markets.

Ethics declaration: The present investigation did not involve any human participants, animals or protected data that require ethical clearance. Consequently, no ethical approval was necessary for the research.

AI declaration: AI tools were used during the making of this research as a guide to structure the sections of the investigation and make it coherent. Nonetheless, all content, results and interpretation were entirely conducted by authors. The AI-generated material was meticulously reviewed and adapted to preserve authenticity and accuracy.

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