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Shipping line digital workflow efficiency on service quality and delivery

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Abstract *— In this paper, we examine the influence of digital workflow efficiency on service quality and delivery performance outcomes in the Philippine shipping line industry. As global logistics evolve through digital transformation and rising e-commerce demands, shipping lines face increasing pressure to modernize operations and eliminate manual inefficiencies. Using a quantitative descriptive-correlational design, the researchers surveyed 50 logistics professionals in Metro Manila to assess perceptions of digitalization across key areas: real-time data, tracking portals, e-documentation, delivery orders, online freight payment, quotation rates, and container management. Statistical analysis, including Pearson correlation, revealed significant positive relationships between digital workflow systems and operational efficiency indicators. The findings show that digital tools enhance transparency, responsiveness, coordination, and overall operational agility, leading to improved service quality and customer satisfaction. Real-time data and tracking portals emerged as the most influential factors, while e-documentation also contributed to streamlined processes and reduced administrative delays. Despite these benefits, challenges such as system errors, data accuracy, user adaptation, and staff training remain. The study concludes that digitalization is a strategic enabler of competitiveness, resilience, and long-term sustainability in maritime logistics, and recommends continued investment in digital infrastructure, workforce development, and system integration to fully realize its transformative potential in the Philippine shipping sector.*

Keywords *— **Digital workflow, shipping lines, service quality, delivery performance, maritime digitalization***

I. INTRODUCTION

For centuries, the shipping industry has been a cornerstone of trade across regions and continents. It serves as a key driver of global and national economies, allowing markets to connect, sustain supply chains, and support trade activities. The Philippines being an archipelagic nation has relied heavily on maritime transport to ensure the steady flow of commodities across Luzon, Visayas, and Mindanao. Along with its importance is the demand for extensive documentation and coordination to ensure the steady flow and for years, the local industry has grown accustomed to the traditional manual processes which have long been plagued by inefficiencies such as delays, miscommunication, and service disruptions that compromise service quality and timely delivery. These challenges became more pronounced with the increasing complexity of trade and consumer expectations for faster services. With the advent of emerging technologies and the rapid growth of e-commerce, there has been a significant shift toward digital transformation in logistics. Shipping lines have then adopted digital workflows to streamline operations, minimize human error, and enhance service delivery. Integrating technology into the core processes has benefitted both parties, as it improves efficiency in their operations thus elevating the quality of service provided to clients.

As mentioned by (Pucihar, 2022), the maritime transport sector is undergoing a significant shift due to the global trend of digitalization, which promises enhanced operational efficiency, sustainability, and competitiveness. However, despite its potential, the adoption of digital technologies in maritime operations remains uneven and fraught with challenges. One of the core issues is the high cost of digital transformation, which includes investments in training and system integration. These costs can be prohibitive, especially for smaller operators or developing countries, creating a digital divide within the industry.

Moreover, stakeholder alignment is a critical barrier. Maritime operations involve a complex network like shipping lines, port authorities, terminal operators, logistics providers, each with their own systems, priorities, and readiness levels. Achieving seamless collaboration and data sharing among these entities is difficult. The sector also faces technological and organizational resistance. Legacy systems, manual processes, and a lack of digital skills among personnel hinder the transition. In many cases, there is uncertainty about the return on investment, which slows down decision-making and implementation.

In the study of (Petraska, 2022) global competition in the container shipping industry continues to intensify, making the pursuit of competitive advantage a critical objective for shipping companies. Despite its essential role in international trade and logistics, the industry has faced turbulent times in recent years, marked by low profitability and heightened competition. Differentiation has become increasingly difficult, especially with the rise of strategic alliances among major shipping lines. At the same time, the expectations of shippers and freight forwarders, the primary customers of container lines, are becoming more demanding and complex, driven by evolving consumer needs and global market pressures. In response key challenges have been identified that hinder digital transformation: leadership, process standardization, employee training, skills development, and the effective use of both internal and external knowledge. Furthermore, the logistics sector often lags behind industries like banking in terms of digital adoption, it is crucial for shipping lines to understand these factors that influence the successful implementation of digital services. More importantly, they must identify which resources are essential to driving digital transformation and enhancing the quality of service delivery.

In terms of the national environment, digitalization of the Philippines' maritime industry continues to face challenges with many shipping lines continuing with a fragmented and manual system that results in inefficiencies and quality issues. According to the National Feasibility Study on Cross-Border Electronic Exchange of Trade-Related Data and Documents of (UN-ESCAP, 2023), although some digital trade facilitation aspects have been developed, interoperability between systems, standardization of data and stakeholder coordination gaps still persist. These problems serve as barriers to efficient document handling and real-time tracking, which would in turn help deliver better schedules and higher customer satisfaction. Maritime must become increasingly digital with end-to-end processes in order to remain competitive.

On top of that, the archipelagic composition of the Philippines magnifies logistics complications and therefore, efficient digital systems are even more critical. Domestic Shipping (Francisco, 2023) points out that domestic shipping still remains expensive although low in-service reliability because of frequent operational blockages despite the introduction of policies to modernize the sector. Disrupted information systems are known to cause unnecessary duplication, miscommunication and reduce the level of service provided by the shipping lines and port authorities in lack of well-coordinated digital platforms between these. Through understanding the barriers and enablers of maritime logistics, a more agile, transparent, customer-focused approach to maritime logistics can be addressed.

In Manila's main ports (e.g., Port of Manila, MICP, NAIA), traders and customs brokers face persistent challenges due to manual, paper-based customs processes. These outdated systems cause delays, inconsistent procedures, and higher transaction costs, leading to inefficiencies in the logistics chain. To address this, the Philippines has supported regional digital trade initiatives like the ASEAN Single Window (ASW) and TradeNet, which aim to streamline customs through paperless trade

and digital documentation (Department of Finance & Bureau of Customs, 2022).

Additionally, importers and customs brokers encounter issues with shipping lines, such as inconsistent delivery order procedures, high terminal charges, demurrage, container deposits, and refund difficulties. These factors further increase shipping costs and operational burdens. Despite the importance of shipping to the economy, local studies on shipping line selection in Manila are limited, highlighting a research gap. The goal is to identify solutions that simplify processes, reduce costs, and enhance efficiency for customs brokers, importers, and the broader shipping industry (Dela Cruz Jr. 2023).

The purpose of this study is to explore the ongoing digital transformation journey and understand how the integration of advanced technologies is reshaping its operations, service delivery, efficiency and strategic direction in the shipping line industry. It aims to highlight the role of digital innovation in maintaining leadership, workflow efficiency and competitiveness in the shipping industry while addressing the evolving demands of international logistics.

The objective of this study is to understand how digital workflow efficiency influences service quality and delivery performance for shipping lines. It also aims to identify how digital workflows improve accuracy, timeframes and consistency in service provisions. Furthermore, it intends to identify the relationship between workflow efficiency and customer satisfaction in the context of shipping operations. Overall, the research focuses on understanding how digitalization supports better workflow management that leads to improved service quality and delivery outcomes.

II. RESEARCH QUESTIONS

The set of questions on the digital transformation journey serves as a valuable framework for evaluating the company's current processes and identifying areas for improvement. These questions allow stakeholders to critically assess how digital technologies are being utilized to enhance operational efficiency and customer satisfaction. By exploring these topics, organizations can better understand the gaps in service delivery and develop targeted strategies to address them.

1. What is the factor of digitalization that affects operational efficiency on shipping line industry in terms of:

   1.1 Real Time Data

   1.2 Tracking Portals

   1.3 E-documentation (Bill of lading)

2. What is the level of efficiency achieved through digitalization in providing service quality and delivery in terms of:

   2.1 Delivery Order

   2.2 Online Freight Payment

   2.3 Quotation Rates

   2.4 Detention and Demurrage

3. Is there a significant relationship between shipping line digitalization workflow efficiency on service quality and delivery?

III. RELATED LITERATURE

Real Time Data

The study of Pires (2025) explains that the rapid advancement of technology has led to the development of the Internet of Things (IoT), where everyday devices such as phones, cars, and buildings are connected to the internet to share data. In logistics, particularly in cargo transport, IoT plays a crucial role in space management and cost reduction. Through the use of smart sensors and real-time data, companies like Sensefinity are able to track the location of items inside trucks and containers, thereby improving operational efficiency and promoting eco-friendly practices.

Furthermore, the article by Julio et al. (2023) explores how modern technologies can enhance the efficiency and reliability of shipping operations. The study focuses on the use of real-time monitoring systems and control mechanisms to streamline logistics and maritime transport. These systems may include GPS tracking, IoT sensors, and centralized dashboards that provide live updates on vessel location, cargo conditions, and fuel consumption. By leveraging these technologies, shipping companies can optimize routes, reduce delays, and improve safety. Additionally, the article discusses predictive maintenance and automated alerts, which help prevent equipment failures and ensure timely deliveries.

Similarly, (Yerra, 2023) explores how automated ETL processing and real-time data insights can significantly improve shipping efficiency. The study focuses on ETL (Extract, Transform, Load) techniques, which allow companies to collect and organize data from various sources into a centralized system for analysis. Moreover, Yerra points out that traditional shipping operations often suffer from delays due to fragmented systems and manual processes. By automating ETL workflows, logistics

firms can gain real-time visibility into shipment status and potential disruptions. Consequently, this enables proactive decision-making, such as rerouting shipments or adjusting delivery schedules based on live traffic or weather conditions. In addition, the research highlights benefit like reduced lead times, improved delivery accuracy, and enhanced customer satisfaction. However, it also notes challenges such as data quality, system integration, and the need for skilled personnel.

Tracking Portals

The study by Garg et al. (2021) explores how Natural Language Processing (NLP) can be used to enhance shipment tracking systems in logistics. Traditionally, tracking systems face challenges such as inefficiency, lack of real-time updates, and poor user interaction, which often lead to increased operational costs and customer dissatisfaction. To overcome these issues, the authors propose an innovative NLP-based solution that allows users to interact with the tracking system using natural language queries. This approach makes the system more intuitive and accessible, enabling stakeholders to retrieve shipment information quickly and accurately. By integrating technologies like speech-to-text and query interpretation, the system improves responsiveness and decision-making in logistics operations.

Meanwhile, Ulle et al. (2024) explores the transformative role of advanced tracking technologies in maritime logistics, particularly in response to rising e-commerce demands. The authors emphasize that shipping services are essential for global product transit but face numerous operational challenges such as fuel price volatility, complex tax systems, and increasing customer expectations. As a result, these issues often lead to delays, lost shipments, and customer dissatisfaction. To address these problems, the chapter advocates for the integration of cutting-edge technologies especially robust shipment tracking systems as a strategic solution to enhance operational efficiency and customer trust. Moreover, the review highlights how modern tracking systems can reduce resource consumption, improve delivery accuracy, and streamline logistics operations. It also underscores the importance of continuous innovation and academic research to develop scalable, intelligent tracking solutions that can adapt to the evolving landscape of maritime logistics.

Similarly, the paper by Shah et al. (2021) investigates how digital tracking technologies are reshaping the operations of third-party logistics providers. The authors point out that the logistics sector has undergone significant transformation due to digitalization, which has disrupted traditional business models and forced TPLs to adapt to remain competitive. While much of the existing literature focuses on digital disruption in travel, retail, and e-commerce, this study shifts attention to the broader supply chain and logistics domain. Using a case study of a leading technology development company in Malaysia, the paper explores the implementation of a tracking application across three stages: the fundamental stage, the development stage, and the future improvement stage. This staged approach demonstrates how digital tracking systems can enhance service standards, improve operational transparency, and support continuous improvement.

E-Documentation (Bill of Lading)

The digital transformation of shipping documentation, particularly the Bill of Lading (B/L), has become a cornerstone of operational efficiency in maritime logistics. Traditionally, the B/L was a paper-based document that served as a receipt, contract, and title of goods. However, recent innovations have led to the adoption of electronic Bills of Lading (e-BL), which streamline workflows and reduce administrative delays. Based on McKinsey (2022), digitizing trade documentation, including the B/L, could save up to $6.5 billion in direct costs and unlock $40 billion in global trade potential. This shift aligns with the principles of Transaction Cost Theory, which assumes that digital systems reduce coordination and communication costs between parties, thereby enhancing service quality and delivery speed.

Moreover, the implementation of eBLs has shown measurable improvements in delivery timelines and customer satisfaction. As FasterCapital (2025) highlights, electronic documentation not only accelerates trade processes but also mitigates risks associated with document fraud and loss. The integration of blockchain encryption and secure verification mechanisms ensures authenticity and traceability across the supply chain. This evolution resonates with the Resource-Based View (RBV) theory, which emphasizes that firms gain competitive advantage by leveraging unique, inimitable resources such as secure digital platforms to enhance operational capabilities and service delivery.

In addition, Enigio (2025) highlights that traditional paper and PDF bills of lading introduce bottlenecks and inefficiencies in the supply chain due to manual processing and courier delays. In contrast, digital bills of lading serve the same legal functions such as contract evidence, receipt of goods, and title document while minimizing risks of data loss, fraud, and human error. The use of eBLs supports real-time tracking and automated validation, which contributes

to improved delivery accuracy and customer satisfaction in shipping operations.

Delivery Order

To begin with, the delivery order process has evolved significantly due to digital transformation in logistics. Annamuhamedov et al. (2025) emphasize the role of Cyber-Physical Systems (CPS) in modern delivery workflows. CPS integrates physical logistics operations with digital control systems, enabling real-time monitoring and adaptive decision-making. In shipping lines, this means delivery orders can be dynamically adjusted based on cargo status, port conditions, and customer requirements. This framework supports predictive logistics and enhances service quality through responsive coordination.

Building on this, Alavi-Borazjani et al. (2024) propose the Digital Shipping Corridor Model, which outlines critical success factors for digitizing maritime logistics. Within this model, delivery orders are treated as key transactional nodes that must be standardized, automated, and securely exchanged across stakeholders. The model emphasizes interoperability, data transparency, and smart contract integration, ensuring that delivery orders are not just documents but active components of a synchronized digital workflow.

Furthermore, Gavalas et.al. (2022) explored the broader impact of digital adoption including delivery order automation on operational efficiency in shipping firms. Their findings suggest that integrating digital tools like automated delivery systems enables better decision-making, reduces bottlenecks, and supports real-time tracking. This digital shift is especially crucial in post-pandemic recovery, where agility and responsiveness are key to maintaining service quality.

Online Freight Payment

The study by Pinyanitikorn et al. (2024) highlights that payment and financial-settlement mechanisms are essential components of digital freight platforms, as they directly affect transaction speed, transparency, and trust, which in turn shape users' intention to adopt such systems. Secure and well-integrated payment tools such as escrow arrangements, automatic invoicing, and reconciliation enhance system performance and reduce transaction friction, while risks such as fraud, payment failure, and data breaches can discourage adoption. To address these challenges, the Unified Theory of Acceptance and Use of Technology (UTAUT) model has been expanded to include constructs such as trust, perceived risk, and payment security, providing a more comprehensive understanding of user behavior in financial transactions. Empirical evidence from Thailand further reveals that bank integration, compliance, and payment security are key factors influencing companies to adopt platform-based freight services.

Similarly, Kumar (2024) examined how digital payment systems including online banking, blockchain-enabled platforms, and mobile wallets contribute to modern logistics operations. The study found that these technologies help reduce manual errors, accelerate payment processing, provide real-time visibility of cash flow, and support cross-border trade by enabling multi-currency and regulatory compliance. These digital innovations strengthen transparency and trust among logistics partners while improving overall operational efficiency.

Consistent with these findings, Linbis (2024) emphasized that freight-specific digital payment solutions such as virtual cards, automated invoicing, and real-time settlement are increasingly replacing traditional payment methods. These systems promote faster transactions, lower operational costs, and stronger trust between shippers, carriers, and freight forwarders, further reinforcing the positive impact of digital payment technologies on service quality and delivery efficiency.

Quotation Rates

Quotation rates refer to the pricing estimates provided by carriers or logistics service providers to clients before the shipment process begins. These quotations generally cover ocean freight charges, terminal handling costs, documentation fees, fuel surcharges, and other applicable charges (United Nations Conference on Trade and Development [UNCTAD], 2021). The precision and timeliness of quotation processes significantly affect customer satisfaction and profitability. Errors in manual rate computation or documentation often is the cause of billing discrepancies, revenue losses, delays and dissatisfaction of clients. The implementation of digital workflows, such as automated rate management systems and e-quotation platforms, minimizes these issues by standardizing data entry, automating calculations, and ensuring that pricing is consistent with the prevailing market prices (World Bank, 2020).

Detention and Demurrage

Detention and demurrage charges are imposed by shipping lines when containers are held beyond the allowed free time either inside or outside the port terminal. Demurrage pertains to fees charged when a container remains within the port premises beyond the allotted free days, while detention refers to charges incurred when a container is kept by the consignee after release and not promptly returned to

the depot (Maritime Industry Authority [MARINA], 2023). These charges encourage efficient container movement and resource utilization. However, manual processing errors, inaccurate documentation, and communication lapses between shipping agents, freight forwarders, and consignees often result in unnecessary detention and demurrage costs.

The adoption of digital workflows including electronic documentation systems, automated container tracking, and port community systems has been shown to improve coordination and reduce operational inefficiencies. Digitalization enhances transparency, speeds up data exchange, and minimizes human error in logistics operations (Asian Development Bank (ADB, 2022). In the Philippines, digital transformation efforts such as the TradeNet platform and the Bureau of Customs Electronic-to-Mobile (E2M) system are notable examples of initiatives that aim to streamline shipping processes, improve accuracy in documentation, and mitigate cost-related errors in logistics management.

IV. METHODOLOGY

This study employed a quantitative descriptive-correlational research design, which is appropriate for identifying and describing attitudes, opinions, and trends by analyzing relationships between measurable variables. According to Creswell and Creswell (2023), quantitative designs allow researchers to objectively analyze numerical data to uncover patterns and correlations. (Saunders et al., 2023) further emphasize that descriptive quantitative research is useful for examining organizational contexts without manipulating variables. A systematic survey instrument was used to ensure consistent data collection and enable reliable comparisons across organizational functions.

The research was conducted in Metro Manila, the Philippines' main commercial and logistics hub, chosen for its concentration of shipping lines, freight forwarders, and logistics service providers. Its high economic activity and digital transformation initiatives make it an ideal setting for studying the impact of digitalization on service quality and delivery. The presence of diverse roles from managers to rank-and-file employees provided a comprehensive view of digital workflow integration across organizational levels.

A total of 50 respondents from the logistics industry participated, including managers, supervisors, and operational staff. All had at least six months of tenure and were actively involved in workflow processes affecting service quality. Purposive sampling was used to select individuals knowledgeable about digitalization tools such as real-time data systems, tracking portals, and e-documentation. Those without relevant experience were excluded to maintain data validity.

The sampling frame was developed in coordination with HR departments of participating companies, ensuring access to qualified respondents. Descriptive statistics (mean scores and standard deviations) were used to summarize perceptions of digitalization factors, while Pearson's correlation coefficient assessed the strength and significance of relationships between these factors and operational efficiency indicators (e.g., Delivery Order, Online Freight Payment, Quotation Rates, Detention and Demurrage). Results showed statistically significant correlations, supporting the hypothesis that digitalization positively influences service quality and delivery efficiency.

The study adhered to ethical standards to protect respondent privacy and ensure research credibility. Informed consent was obtained, participation was voluntary, and data were anonymized and securely disposed of after the study. An independent statistician conducted the analysis to ensure objectivity and reliability, and all sources were properly cited to uphold academic integrity.

V. RESULTS AND DISCUSSION

After the data-gathering and tabulation of answers from the questionnaires submitted by the respondents, the result was interpreted using correlation analysis to interpret the data. Correlation coefficient (r-value) was used to determine the strength and direction of the linear relationship between the digitalization factors and operational efficiency. It also provides a guide for interpreting the size of the correlation, ranging from negligible to very high positive or negative correlation. The p-value was used for hypothesis testing to determine if the observed relationship was statistically significant. The "Remarks" and "Decision" columns in Table 3 indicate that a relationship was considered "Significant" and the null hypothesis was "Rejected" when the p-value was less than a predetermined significance level, which is specified as 0.01 in the footnote.

The analysis is organized around three core dimensions of digitalization—Real-Time Data, Tracking Portals, and Electronic Documentation (Bill of Lading)—and examines their association with key operational efficiency indicators, namely Delivery Order processing, Online Freight Payment, Quotation Rates, and Detention and Demurrage management.

Subsequently, the detailed discussions on the results interpret these statistical outcomes within the broader context of shipping operations, highlighting their implications for improving workflow efficiency, service reliability, and customer satisfaction in the logistics sector.

1. The factor of digitalization that affects operational efficiency on shipping line industry in terms of Real Time Data, Tracking Portals, E-documentation (Bill of Lading)

Table 1.1: The factor of digitalization that affects operational efficiency on shipping line industry in terms of Real Time Data

	INDICATORS	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
1.	Real-time data improves the accuracy of shipping operations.	3.82	Strongly Agree	2.5
2.	Access to real-time information enhances decision-making in port operations.	3.82	Strongly Agree	2.5
3.	Real-time data reduces delays and improves workflow coordination.	3.78	Strongly Agree	5
4.	Real-time updates help prevent operational errors and duplication of tasks.	3.82	Strongly Agree	2.5
5.	The use of real-time systems improves communication among shipping departments.	3.86	Strongly Agree	4
GENERAL ASSESSMENT		**3.82**	**Strongly Agree**	

Legend: 3.26 – 4.00 Strongly Agree (SA) / Very High 1.76 – 2.50 Disagree (D) / Low

2.51 – 3.25 Agree (A) / High 1.00 – 1.75 Strongly Disagree (SD) Very Low

The data from Table 1.1 reveals that real-time data is perceived as a highly influential factor in enhancing operational efficiency within the shipping line industry. With an overall weighted mean of 3.82, all indicators fall under the "Strongly Agree" category, indicating a very high level of agreement among respondents. Specifically, the use of real-time systems is most appreciated for improving communication among shipping departments, which received the highest mean score of 3.86, suggesting that timely information sharing plays a crucial role in coordination and collaboration. The lowest score, though still high at 3.78, pertains to reducing delays and improving workflow coordination, implying that while real-time data contributes positively, other factors may also influence these aspects. Overall, the findings affirm that real-time data systems are essential tools for improving accuracy, responsiveness, and communication in shipping operations, thereby supporting more efficient and reliable logistics processes.

The study confirms that real-time data and tracking portals significantly enhance operational efficiency in the shipping line industry by improving accuracy, decision-making, communication, and customer satisfaction. This aligns with the concept of the Internet of Things (IoT), as discussed by Pires (2025), where connected devices and smart sensors enable better logistics coordination. Supporting literature from Julio et al. (2023) and Yerra (2023) highlights the role of real-time monitoring and automated data integration in optimizing routes and reducing delays. Additionally, studies by Garg et al. (2021), Ulle et al. (2024), and Shah et al. (2021) emphasize the strategic importance of digital tracking systems in improving transparency, operational visibility, and service standards. Overall, the literature reinforces the study's conclusion that digitalization through real-time data, IoT, and tracking technologies is a key driver of efficiency and competitiveness in modern logistics.

Table 1.2: The factor of digitalization that affects operational efficiency on shipping line industry in terms of Tracking Portals

	INDICATORS	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
1.	Tracking portals provide transparency throughout the shipment process.	3.76	Strongly Agree	3
2.	Customers benefit from accurate shipment status through tracking portals.	3.86	Strongly Agree	1
3.	Tracking portals reduce manual inquiries and improve staff productivity.	3.70	Strongly Agree	5
4.	The integration of tracking portals enhances operational visibility.	3.74	Strongly Agree	4.5
5.	Tracking systems help in resolving shipment issues more efficiently.	3.74	Strongly Agree	4.5
	GENERAL ASSESSMENT	**3.76**	**Strongly Agree**	

Legend: 3.26 – 4.00 Strongly Agree (SA) / Very High 1.76 – 2.50 Disagree (D) / Low
2.51 – 3.25 Agree (A) / High 1.00 – 1.75 Strongly Disagree (SD) Very Low

The data in Table 1.2 shows that tracking portals are perceived as highly beneficial to operational efficiency, with an overall weighted mean of 3.76, indicating a "Strongly Agree" interpretation across all indicators. The highest-rated item, with a mean of 3.86, is the benefit of tracking portals in providing customers with accurate shipment status, ranked 1st, highlighting their critical role in enhancing customer satisfaction and transparency. The lowest-rated indicator, with a mean of 3.70, is the reduction of manual inquiries and improvement of staff productivity, ranked 5th, suggesting that while tracking portals help streamline communication, their impact on internal productivity may be less pronounced compared to customer-facing benefits.

Overall, the data supports the conclusion that tracking portals are essential digital tools that improve visibility, reduce errors, and enhance both customer experience and operational coordination in the shipping line industry. The findings in the table strongly support the themes discussed in the reviewed literature. Garg et al. (2021) emphasize that NLP-based tracking systems improve transparency and user interaction, which aligns with the indicator showing that tracking portals provide transparency throughout the shipment process (weighted mean = 3.76). Similarly, Ulle et al. (2024) highlight the importance of accurate shipment status and operational efficiency in maritime logistics, reflected in the highest-ranked indicator where customers benefit from accurate shipment status (weighted mean = 3.86). Furthermore, Shah et al. (2021) discuss how digital tracking technologies reduce manual tasks and enhance service standards, which corresponds to the indicator on reducing manual inquiries and improving staff productivity (weighted mean = 3.70). The indicators on integration and issue resolution (both weighted mean = 3.74) also resonate with the literature's emphasis on continuous innovation and system integration to improve visibility and responsiveness. Overall, the strong agreement across all indicators confirms that advanced tracking systems, whether through NLP, digitalization, or maritime innovations, play a transformative role in enhancing transparency, accuracy, and efficiency in logistics operations.

Table 1.3: The factor of digitalization that affects operational efficiency on shipping line industry in terms of E-documentation (Bill of Lading)

	INDICATORS	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
1.	E-documentation simplifies the process of issuing and receiving Bills of Lading.	3.78	Strongly Agree	1
2.	Digital documents reduce errors compared to manual paper-based systems.	3.64	Strongly Agree	4.5
3.	The use of e-documents speeds up cargo release and clearance.	3.76	Strongly Agree	2.5
4.	E-documentation improves record-keeping and traceability.	3.64	Strongly Agree	4.5
5.	Digital documents reduce errors compared to manual paper-based systems.	3.76	Strongly Agree	2.5
	GENERAL ASSESSMENT	**3.72**	**Strongly Agree**	

Legend: 3.26 – 4.00 Strongly Agree (SA) / Very High 1.76 – 2.50 Disagree (D) / Low
2.51 – 3.25 Agree (A) / High 1.00 – 1.75 Strongly Disagree (SD) Very Low

The findings in Table 1.3 indicate that e-documentation, particularly in terms of the Bill of Lading, substantially contributes to the operational efficiency of shipping line companies. The computed overall weighted mean of 3.72, verbally interpreted as Strongly Agree, reflects a high level of agreement among respondents that digital tools significantly enhance shipping processes.

The highest-rated indicator was "*E-documentation simplifies the process of issuing and receiving Bills of Lading*" with a weighted mean of 3.78, suggesting that stakeholders view digital tools as essential in streamlining documentation workflows. This finding aligns with FasterCapital (2025), which emphasizes that electronic Bills of Lading reduce administrative complexity and improve coordination between shipping agents, consignees, and customs authorities.

In contrast, the lowest-rated indicators were "*Digital documents reduce errors compared to manual paper-based systems*" and "*E-documentation improves record-keeping and traceability*", both with a weighted mean of 3.64. While still interpreted as Strongly Agree, these slightly lower scores may reflect ongoing concerns about system reliability, data security, or user adaptation. However, Enigio (2025) argues that digital Bills of Lading enhance traceability and reduce human error, especially when integrated with secure platforms and standardized formats.

The strong overall agreement in this study suggests that Philippine shipping stakeholders are receptive to digital transformation, though further investment in infrastructure and digital literacy may be necessary to fully realize its potential.

2. The level of efficiency achieved through digitalization in providing service quality and delivery in terms of Delivery Order, Online Freight Payment, Quotation Rates and Detention and Demurrage

Table 2.1: The level of efficiency achieved through digitalization in providing service quality and delivery in terms of Delivery Order

	INDICATORS	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
1.	Digital delivery orders are sometimes delayed due to system downtime.	3.38	Strongly Agree	4
2.	The use of digital delivery orders requires continuous staff training.	3.18	Agree	5
3.	Errors in electronic delivery orders affect the timely release of shipments.	3.46	Strongly Agree	3
4.	The system for delivery orders is easy to access and reliable. (reverse-coded)	3.52	Strongly Agree	2
5.	Digital delivery order streamlines the process and ensures prompt shipment release	3.68	Strongly Agree	1
	GENERAL ASSESSMENT	**3.44**	**Strongly Agree**	

Legend: 3.26 – 4.00 Strongly Agree (SA) / Very High 1.76 – 2.50 Disagree (D) / Low
2.51 – 3.25 Agree (A) / High 1.00 – 1.75 Strongly Disagree (SD) Very Low

The findings presented in Table 2.1 indicate that digitalization has significantly contributed to improving efficiency in delivery order processes within the shipping industry. The overall weighted mean of 3.44, interpreted as Strongly Agree, suggests that respondents perceive a high level of efficiency resulting from digital delivery systems. This implies that the integration of digital workflows enhances service quality, reliability, and operational speed in shipping documentation and cargo release.

Among the indicators, the highest-rated item was "*Digital delivery order streamlines the process and ensures prompt shipment release*" with a weighted mean of 3.68, reflecting a strong consensus that digital systems expedite shipment handling and coordination. This aligns with the findings of Gavalas et al, (2022), who emphasized that digital adoption in maritime logistics directly improves operational performance and reduces administrative bottlenecks. Similarly, Annamuhamedov et al. (2025) highlighted that Cyber-Physical Systems in logistics enhance the synchronization of digital delivery orders, ensuring more efficient and transparent transaction flows.

Conversely, the lowest-rated indicator, "*The use of digital delivery orders requires continuous staff training*" (weighted mean = 3.18, Agree), reveals that human factors remain a challenge in digital transition. This observation resonates with Alavi-Borazjani et al. (2025), who noted that digital shipping corridors require not only technological integration but also workforce readiness and capability building. Overall, the results underscore that while digitalization strengthens delivery efficiency, sustained employee training and adaptive strategies are crucial for maximizing the benefits of maritime digital transformation.

Table 2.2: The level of efficiency achieved through digitalization in providing service quality and delivery in terms of Online Freight Payment

	INDICATORS	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
1.	Online freight payment platforms are secure and convenient.	3.52	Strongly Agree	2
2.	Payment processing delays occur due to system errors.	3.38	Strongly Agree	4
3.	Clients find online payment procedures user-friendly.	3.34	Strongly Agree	5
4.	The online payment system enhances transparency in transactions.	3.62	Strongly Agree	1
5.	Online freight payment expedites payment timelines.	3.48	Strongly Agree	3
	GENERAL ASSESSMENT	**3.47**	**Strongly Agree**	

Legend: 3.26 – 4.00 Strongly Agree (SA) / Very High 1.76 – 2.50 Disagree (D) / Low
2.51 – 3.25 Agree (A) / High 1.00 – 1.75 Strongly Disagree (SD) Very Low

The results show an overall weighted mean of 3.47, verbally interpreted as "Strongly Agree." This indicates that respondents have a generally positive perception of digital payment systems in freight operations, agreeing that these technologies enhance transaction efficiency, transparency, and security.

The highest-rated indicator, "*The online payment system enhances transparency in transactions,*" obtained a weighted mean of 3.62, which signifies that respondents strongly believe transparency is one of the major advantages of digital payment systems. This finding supports the view of Pinyanitikorn et al. (2024), who emphasized that well-integrated payment and settlement mechanisms promote transparency and trust—two essential factors influencing the adoption of digital freight platforms. Similarly, Kumar (2024) highlighted that technologies such as blockchain-enabled platforms and online banking improve visibility and accountability in logistics transactions, further strengthening trust among users.

Conversely, the lowest-rated indicator, "*Clients find online payment procedures user-friendly*," with a weighted mean of 3.34, though still interpreted as "Strongly Agree," suggests that some users may experience minor challenges in navigating digital payment systems. This is consistent with Pinyanitikorn et al. (2024), who noted that risks and perceived complexities such as potential system errors or data security concerns can affect user adoption. Despite these issues, the overall agreement indicates that users generally find the systems reliable and effective.

In summary, the overall strong agreement (3.47) reflects that digital payment technologies are widely accepted in freight operations for their ability to improve transparency, efficiency, and trust. These findings align with the conclusions of Linbis (2024) and Kumar (2024), both of whom emphasized that digital payment innovations enhance operational performance and strengthen relationships among logistics stakeholders.

Table 2.3: The level of efficiency achieved through digitalization in providing service quality and delivery in terms of Quotation Rates

	INDICATORS	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
1.	Digital quotation systems provide accurate and timely rate information.	3.44	Strongly Agree	3
2.	Some quotation systems experience delays or inconsistencies in pricing updates.	3.26	Strongly Agree	5
3.	The use of digital quotation tools improves customer satisfaction	3.58	Strongly Agree	1.5
4.	The quotation process is simplified through digitalization.	3.58	Strongly Agree	1.5
5.	Digital quotations provide accurate and competitive rates.	3.34	Strongly Agree	4
	GENERAL ASSESSMENT	**3.44**	**Strongly Agree**	

Legend: 3.26 – 4.00 Strongly Agree (SA) / Very High 1.76 – 2.50 Disagree (D) / Low
2.51 – 3.25 Agree (A) / High 1.00 – 1.75 Strongly Disagree (SD) Very Low

The results reveal an overall weighted mean of 3.44, verbally interpreted as "Strongly Agree." This indicates that respondents generally have a positive perception of digital quotation systems, recognizing their contribution to improving pricing accuracy, customer satisfaction, and operational efficiency. This finding supports the view of the United Nations Conference on Trade and Development (UNCTAD, 2021), which emphasized that accurate and timely quotation rates are essential for ensuring transparency and reliability in freight operations.

The highest-rated indicators, "*The use of digital quotation tools improves customer satisfaction*" and "*The quotation process is simplified through digitalization,*" both obtained a weighted mean of 3.58. This reflects that respondents strongly agree that digitalization enhances customer experience by simplifying quotation procedures and providing faster, more reliable rate information. This aligns with the World Bank (2020), which highlighted that automated rate management systems and e-quotation platforms minimize manual errors and standardize pricing data, resulting in improved service quality and client satisfaction.

On the other hand, the lowest-rated indicator, "*Some quotation systems experience delays or inconsistencies in pricing updates,*" with a weighted mean of 3.26, suggests that although digital quotation tools are highly effective, minor challenges such as system delays or data inconsistencies may still occur. This observation is consistent with the World Bank (2020) report, which noted that even with digital workflows, occasional technical issues can affect quotation timeliness and accuracy.

In summary, the overall strong agreement (3.44) indicates that respondents perceive digital quotation systems as reliable tools that enhance pricing precision, simplify operations, and improve customer satisfaction, supporting the insights of UNCTAD (2021) and the World Bank (2020) on the vital role of digitalization in ensuring accuracy, transparency, and efficiency in freight quotation processes.

Table 2.4: The level of efficiency achieved through digitalization in providing service quality and delivery in terms of Detention and Demurrage

	INDICATORS	WEIGHTED MEAN	VERBAL INTERPRETATION	RANK
1.	The system efficiently notifies clients about detention and demurrage charges.	3.40	Strongly Agree	5
2.	Digital platforms help reduce disputes regarding detention and demurrage fees.	3.50	Strongly Agree	4
3.	Inaccurate data entry sometimes leads to miscalculated charges.	3.64	Strongly Agree	1
4.	Automated updates improve transparency in detention and demurrage billing.	3.60	Strongly Agree	2
5.	Detention and demurrage fees help enforce time limits on container usage.	3.56	Strongly Agree	3
	GENERAL ASSESSMENT	**3.54**	**Strongly Agree**	

Legend: 3.26 – 4.00 Strongly Agree (SA) / Very High 1.76 – 2.50 Disagree (D) / Low
2.51 – 3.25 Agree (A) / High 1.00 – 1.75 Strongly Disagree (SD) Very Low

As presented in Table 2.4, the overall weighted mean of 3.54 (interpreted as Strongly Agree) indicates that respondents generally perceive a high level of efficiency achieved through digitalization in enhancing service quality and delivery particularly in the management of detention and demurrage. This finding is consistent with current trends in the Philippine logistics sector, wherein digitalization has been shown to significantly streamline operations. The broader macro-economic context supports this: digital economy indicators in the Philippines show that digital services now contribute significantly to GDP and logistics move is a key enabler based on the International Trade Administration's overview on the state of the digital economy in the Philippines.

The highest mean score of 3.64 for the statement "Inaccurate data entry sometimes leads to miscalculated charges" suggests that although digital workflows have successfully streamlined many manual operations, challenges related to data accuracy still persist. This aligns with international research, "Tackling Inefficiencies in the Maritime Supply Chain." (2025) indicating that while digitalization can reduce human error, it cannot eliminate it without strong data governance, validation rules, and integration across systems.

Conversely, the statement "The system efficiently notifies clients about detention and demurrage charges" recorded the lowest mean of 3.40, while still falling under Strongly Agree, indicates relatively weaker performance compared with other indicators. This result implies that while digital workflows have improved notification and client-communication mechanisms, there is still room for enhancement in system responsiveness and client engagement.

Overall, the results reinforce the notion that digitalization contributes significantly to the efficiency of service quality and delivery particularly in relation to detention and demurrage processes. However, the literature cautions that digitalization is not a panacea: persistent issues in data integrity and communication persistence must be addressed. For instance, policy reports on the Philippines emphasize that digital inertia and under-investment in process optimization still hamper full benefits of workflow digitization, as mentioned by Maheshwari, A. (2025).

3. A significant relationship between shipping line digitalization workflow efficiency on service quality and delivery

Table 3: Test of significant relationship between shipping line digitalization workflow efficiency on service quality and delivery

FACTOR OF DIGITALIZATION	OPERATIONAL EFFICIENCY	r value	P value	Remarks	Decision
REAL TIME DATA	Delivery Order	.349*	.013	Significant	Reject H_o
	Online Freight Payment	.434**	.002	Significant	Reject H_o
	Quotation Rates	.539**	.000	Significant	Reject H_o
	Detention and Demurrage	.553**	.000	Significant	Reject H_o
TRACKING PORTALS	Delivery Order	.441**	.001	Significant	Reject H_o
	Online Freight Payment	.446**	.001	Significant	Reject H_o
	Quotation Rates	.571*	.000	Significant	Reject H_o
	Detention and Demurrage	.562**	.000	Significant	Reject H_o
E-DOCUMENTATION (BILL OF LADING)	Delivery Order	.386**	.006	Significant	Reject H_o
	Online Freight Payment	.374**	.007	Significant	Reject H_o
	Quotation Rates	.371**	.008	Significant	Reject H_o
	Detention and Demurrage	.429**	.002	Significant	Reject H_o

**Correlational at the level 0.05 (Two-tailed) Significance at the level 0.05

Size of Correlation	Interpretation
.90 to 1.00 (−.90 to −1.00)	Very high positive (negative) correlation
.70 to .90 (−.70 to −.90)	High positive (negative) correlation
.50 to .70 (−.50 to −.70)	Moderate positive (negative) correlation
.30 to .50 (−.30 to −.50)	Low positive (negative) correlation
.00 to .30 (.00 to −.30)	Negligible correlation

The results presented in Table 3 demonstrate statistically significant positive relationships between the factors of digitalization (real-time data, tracking portals, and e-documentation/bill of lading) and the operational efficiency dimensions of service quality and delivery (delivery order, online freight payment, quotation rates, detention and demurrage). Each ***r*** value is positive and each ***p*** value is below the conventional threshold for significance (often 0.01), leading to the rejection of the null hypotheses that there is no relationship.

For example, under "Real-Time Data," the correlation with "Detention and Demurrage" is r = 0.553, p = 0.000, indicating a moderate positive relationship (per the interpretation table: 0.50 to 0.70 = moderate positive correlation). This suggests that the more effectively real-time data is used in shipping line workflows, the higher the operational efficiency in managing detention and demurrage. This aligns with recent findings by World Bank and International Association of Ports and Harbors (2021) in a press release which highlight that improved data communication and digital systems in maritime supply chains yield efficiency and resilience gains.

The "Tracking Portals" factor showed the strongest correlations in the table — for instance, with "Quotation Rates" at r = 0.571, p = 0.000, which is still in the moderate positive range but very close to high. This underscores that when clients or stakeholders have access to tracking portals, shipping lines can offer more accurate quotation, faster responses, and more reliable delivery metrics. This is consistent with the literature indicating the value of visibility and connectivity for logistics performance: for instance, the 2023 paper by Tobias, et.al., (2024) found that real-time information exchange and automation significantly reduce internal process lag and error rates.

The "E-Documentation (Bill of Lading)" factor also produced statistically significant correlations, though the r values are somewhat weaker compared to the other two digitalization factors (e.g., with "Detention and Demurrage," r = 0.429, p = 0.002). This suggests that digitizing documents and workflows (such as bills of lading) does improve operational efficiency, but perhaps the effect is less strong than portals or real-time data. This observation is supported by Gavalas et al, (2022) which found that in shipping firms, digital adoption indeed promotes efficiency, but with heterogeneity: firms at varying maturity levels achieve different efficiency gains.

Overall, the pattern of results indicates that digitalization is a key enabler of service quality and delivery efficiency in shipping-line workflows. The significant positive correlations across all indicators confirm the hypothesis that digital workflows contribute to improved operational outcomes. From a theoretical standpoint, this supports the view that digital capabilities drive organizational agility and process efficiency in maritime logistics, as suggested by the reciprocal relationship between digitalization and organizational agility in a paper by Ciampi et. al. (2021) which links digitalization with improved agility and performance in logistics networks.

From a practical perspective in the Philippine context, these findings reinforce the need for shipping lines to invest in real-time data systems, client tracking portals, and digital documentation to reduce delays, human error, and cost inefficiencies, particularly in areas such as detention and demurrage where time and accuracy are critical.

However, despite strong positive relationships, the r values indicate that these are moderate rather than high correlations (none approach the 0.70+ "high positive" threshold). This suggests that there remain other factors not captured in this study which also influence operational efficiency, for example staff training, organizational culture, system interoperability, data quality, regulatory environment, and infrastructure. The research by the World Bank (2021) pointed out that legal or policy frameworks and stakeholder collaboration are major barriers to full digitalization of maritime workflows. Therefore, while digitalization is clearly important, it should be complemented by enabling conditions.

VI. CONCLUSION

The study found that digitalization has greatly improved the overall performance of shipping operations. Results showed that tools such as real-time data tracking, e-documentation, online freight payment, and digital quotation systems have enhanced accuracy, transparency, and timeliness, leading to faster transactions and greater customer satisfaction. The correlation analysis confirmed a significant positive relationship between digital workflows and service efficiency, indicating that digital tools play a vital role in improving communication, coordination, and delivery reliability.

Despite these advantages, minor issues such as system delays, technical errors, and the need for continuous employee training were observed, highlighting areas for improvement. Overall, the study concludes that digital transformation is a key

factor in achieving operational efficiency, competitiveness, and sustainable growth in the shipping industry. Strengthening system reliability and employee capability will ensure that digitalization continues to enhance service quality and customer trust in the long term.

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