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VAN CONG VU

LOGISTICS SERVICES AT SEAPORTS IN CENTRAL VIETNAM IN THE CONTEXT OF DIGITAL TRANSFORMATION

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INTRODUCTION

1. The urgency of the theme

Logistics services should not be viewed merely as a technical service sector or a field of business administration; from the perspective of political economy, they constitute a crucial stage in the process of social reproduction. Logistics services function as the linkage between production and consumption, as well as between commodity circulation and capital circulation. Accordingly, the study of logistics services within the seaport system of Central Vietnam represents an examination of a critical component of the circulation process - an integral element of social reproduction - aimed at identifying mechanisms to optimize circulation time, reduce transaction costs, and enhance the velocity of value turnover in the socialist-oriented market economy.

Central Vietnam currently comprises 11 coastal provinces and cities, extending from Thanh Hoa to Lam Đong, forming a relatively dense seaport system. This system contributes positively to regional and national socio-economic development, as well as to national defense and security. Owing to advantages related to the marine economy and the strategic geographical location of the seaport network, logistics services at seaports in Central Vietnam have experienced rapid expansion in recent years.

In the context of digital transformation, however, the rapid development of modern productive forces at seaports has not only altered the instruments of labor but also directly influenced the restructuring of economic relations. This dissertation analyzes how digital transformation in seaport logistics reshapes ownership relations, organizational and managerial structures, and benefit-distribution relations among key economic actors, including the State, service enterprises, and workers. Such analysis reflects the central concern of political economy in identifying emerging contradictions and facilitating the adaptation of production relations to rapid technological progress.

Empirical findings indicate that, despite substantial development potential, logistics services at seaports in Central Vietnam have not yet achieved commensurate growth and continue to face multiple challenges and structural limitations in the context of digital transformation. As a result, many logistics services remain unable to meet the requirements of digital transformation, which demand high levels of automation, connectivity, and system integration.

Furthermore, theoretical research on logistics services at seaports in Central Vietnam within the context of digital transformation remains limited, leaving significant analytical gaps. Therefore, the study entitled ***"Logistics Services at Seaports in Central Vietnam in the Context of Digital Transformation"*** is necessary to address these theoretical and practical gaps while supporting the development of the logistics sector and the broader socio-economic advancement of Central Vietnam in the process of international integration.

2. Research Objectives and Tasks

2.1. Research Objective

The dissertation aims to propose orientations and solutions that contribute to improving the quality of logistics services at seaports in Central Vietnam in the context of global digital transformation.

2.2. Research Tasks

To achieve the above research objective, the dissertation sets out the following research tasks:

First, to review studies related to the dissertation topic, synthesize their scientific contributions, and identify issues that require further investigation by the dissertation.

Second, to systematize the fundamental theoretical issues concerning logistics services, seaports, and the context of digital transformation.

Third, to examine and draw on lessons learned from regions and countries with seaports in the context of digital transformation.

Fourth, based on the established theoretical framework, to analyze and accurately assess the current state of logistics services at seaports in Central Vietnam during the period 2018-2024.

Fifth, to propose key perspectives and solutions aimed at improving the quality of logistics services at seaports in Central Vietnam.

3. Research Object and Scope

3.1. Research Object

The dissertation examines logistics services at seaports in Central Vietnam within the context of digital transformation, adopting a political economy perspective as a specialized scientific discipline.

3.2. Research Scope

-. Content scope: (1) Maritime transport services; (2) Warehousing and cargo storage services; (3) Cargo handling services; and (4) Customs clearance services. Within these areas, the study focuses primarily on service-providing entities.

- Spatial scope: The research focuses on seaports in Central Vietnam, with a particular emphasis on three provinces and cities whose seaports are planned and oriented toward development as special-grade seaports, namely Thanh Hoa Seaport, Da Nang Seaport, and Khanh Hoa Seaport.

- Temporal scope: The period from 2018 to 2024. Development perspectives are considered up to 2030, with a vision toward 2045.

4. Research Foundations and Methodology

4.1. Research Foundations

- *Theoretical foundation:* The dissertation is grounded in the theoretical framework of Marxism-Leninism and Ho Chi Minh Thought, while thoroughly incorporating the guidelines, policies, and viewpoints of the Communist Party of Vietnam as articulated in Party Congress documents across different periods. In addition, the study selectively inherits and further develops prominent scholarly perspectives of domestic and international researchers that are directly relevant to the research issues.

- *Practical foundation:* The practical development of logistics services at seaports in Central Vietnam during the period 2018-2024, including achievements and limitations, together with domestic and international experiences.

4.2. Research Methodology

The dissertation employs the principal scientific research methods of Political Economy, including: *First,* scientific abstraction; *Second,* analysis and synthesis; *Third,* the combination of logical and historical methods; and *Fourth,* comparative analysis. These methods are applied flexibly to analyze theoretical issues and to process empirical data objectively, consistent with the characteristics of the research topic.

5. Scientific and Practical Significance of the Research Topic

The dissertation has the following scientific and practical significance:

5.1. Theoretical Significance

The study contributes to supplementing and further clarifying the characteristics of logistics services at seaports in the context of digital transformation. It systematizes and develops an analytical framework comprising content dimensions and evaluation criteria for seaport logistics services under digital transformation conditions, and formulates a set of criteria for assessing the quality of seaport logistics services in this context.

5.2. Practical Significance

The dissertation systematizes experiences from several countries and territories, thereby deriving lessons of reference value for Central Vietnam. It provides a comprehensive assessment of the development of logistics services at seaports in Central Vietnam during the period 2018-2024, clarifying achievements attained, identifying existing limitations, and highlighting challenges arising in the process of digital transformation. On that basis, the study proposes perspectives and solutions to promote the development of logistics services at seaports in Central Vietnam in an effective and sustainable manner under digital transformation conditions. The research contributes to the improvement of mechanisms and policies for economic development in general and seaport logistics in particular in Central Vietnam. In addition, the research findings may serve as reference materials for teaching and training purposes at educational institutions.

6. Structure of the Dissertation

In addition to the introduction, conclusion, the list of the author's published works related to the dissertation, references, and appendices, the dissertation is structured into 4 chapters comprising 10 sections:

Chapter 1: Overview of research related to the topic

Chapter 2: Theoretical foundations and practical experiences of logistics services at seaports in the context of digital transformation

Chapter 3: The current state of logistics services at seaports in Central Vietnam in the context of digital transformation

Chapter 4: Perspectives and solutions for improving the quality of logistics services at seaports in Central Vietnam in the context of digital transformation

Chapter 1
OVERVIEW OF RESEARCH RELATED TO THE DISSERTATION TOPIC

1.1. OVERVIEW OF STUDIES RELATED TO LOGISTICS SERVICES AT SEAPORTS IN THE CONTEXT OF DIGITAL TRANSFORMATION

1.1.1. Studies on Logistics Services and Logistics Services at Seaports

International studies consistently affirm that logistics constitutes a key driving force for economic development by reducing costs and enhancing the efficiency of goods circulation. Grant et al. (2006) emphasize the role of logistics in economic linkage and value creation, aligning closely with the objectives of ASEAN integration. Banomyong (2008) identifies four criteria for assessing logistics competitiveness: infrastructure, institutional and policy frameworks, the capacity of service providers, and the capabilities of logistics service users. Zhang and Lu (2013) further expand this framework by incorporating factors such as human resources, geographical location, market demand, and innovation capacity. Existing research highlights major determinants of logistics service performance, including transport infrastructure, geographical location, supportive policies, human resource quality, and technological capability. Blancas et al. (2014) demonstrate that an efficient transport-logistics system enhances supply chain reliability, reduces delays, attracts investment, and supports the development of seaport infrastructure and multimodal connectivity. Montwiłł (2014) conceptualizes seaports as integrated logistics hubs that play a crucial role in sustainable distribution systems and urban development. Christopher (2016) underscores that effective supply chain management enables firms to reduce costs and increase value, reflecting trends toward omnichannel operations and modern logistics services. In the seaport sector, studies applying the Port Service Quality (PSQ) model (Thai Van Vinh, 2016) indicate that its four components all exert positive effects on customer satisfaction. Munim and Schramm (2018) show that seaport infrastructure quality and logistics efficiency directly contribute to economic growth, particularly in developing economies. Research on Hai Phong Port (Vu Phuong Thao, 2020) highlights the critical importance of delivery time and cargo condition. Several studies identify five decisive factors determining the quality of seaport logistics services (Le Duc Nha, 2020), emphasize the pivotal role of connectivity in enhancing port competitiveness (Dinh Phi Ho, 2024), and point to the increasingly intense competitive dynamics within Vietnam's seaport system (Quach Thi Ha, 2024).

1.1.2. Studies on Digital Transformation and Logistics Services at Seaports in the Context of Digital Transformation

Digital transformation (Wamba et al., 2017; Schwertner, 2017) is understood as the process of integrating digital technologies into business operations while simultaneously restructuring business models and processes in order to enhance efficiency and competitive advantage. Reis et al. (2018) analyze digital transformation across three dimensions - technological, organizational, and social - emphasizing requirements related to digital culture and skills, information technology infrastructure, and innovation ecosystems. Several theoretical frameworks (Sayabek et al., 2020) identify stages ranging from digitization to digital reinvention and stress the necessity of an appropriate implementation roadmap. Key success factors commonly identified include leadership capacity, organizational innovation capability, infrastructure, human resources, and information technology integration (Swen & Reinhard, 2020; Nguyen Thanh Nga et al., 2024). Technologies such as artificial intelligence, the Internet of Things, blockchain, digital twins, transportation and fleet management systems (TMS/FMS), and cloud computing are widely regarded as major drivers for improving the efficiency of logistics and seaport operations. However, their implementation continues to face significant barriers, including high investment costs, shortages of digital human resources, organizational culture constraints, regulatory limitations, and insufficient integration capabilities (World Bank, 2021; and related studies). In Vietnam, although Central Vietnam enjoys locational advantages, it remains constrained by weak linkages, underdeveloped infrastructure, and limited human resources, underscoring the need to improve policies, infrastructure, and accelerate digital transformation to effectively exploit regional potential.

1.2. OVERVIEW OF AGREED FINDINGS, SCIENTIFIC GAPS, AND ISSUES ADDRESSED BY THE DISSERTATION

1.2.1. Established Findings and Inheritable Contributions

Existing studies indicate that logistics services - particularly at seaports - have attracted substantial scholarly attention in the context of digital transformation, supported by systematic research, robust theoretical foundations, and diverse empirical evidence. Many studies extend their analysis to digital technologies (such as AI, IoT, and big data), technical infrastructure, supply chain management, and smart logistics systems, thereby elucidating the relationship between digital transformation and operational efficiency. A synthesis of the literature reveals four major areas of consensus: (1) clarification of concepts, contents, influencing factors, and evaluation criteria for digital transformation in logistics; (2) recognition of digital transformation as a crucial driver of logistics service development; (3) identification of opportunities, challenges, and barriers in applying digital transformation within port enterprises; and (4) initial assessments of current conditions alongside proposed orientations and solutions to enhance seaport service efficiency. These studies constitute valuable reference materials, providing both scientific foundations and practical guidance for the dissertation entitled "*Logistics Services at Seaports in Central Vietnam in the Context of Digital Transformation.*"

1.2.2. Scientific Gaps

Existing studies largely remain at the level of general theoretical analysis of digital transformation and logistics, with no systematic and in-depth research focusing specifically on logistics services at seaports in Central Vietnam in the context of digital transformation. Most studies provide only broad overviews of practical conditions and development requirements, while this research direction remains relatively new. Evaluation criteria for logistics services at seaports in Central Vietnam have not been comprehensively addressed. Assessments of service development are still largely general in nature and lack specialized, in-depth analysis. Moreover, there is an absence of studies proposing a coherent system of orientations and specific solutions for the State, enterprises, human resources, and training institutions to meet the requirements of digital transformation in the development of logistics services.

1.2.3. Research Issues Addressed by the Dissertation

The dissertation focuses on the following key issues: (1) clarifying the theoretical foundations of seaport logistics services in the context of digital transformation, including concepts, contents, evaluation criteria, and influencing factors; (2) analyzing relevant stakeholders and their roles within the seaport logistics system in Central Vietnam; (3) examining international and domestic experiences to derive lessons applicable to Central Vietnam; (4) assessing the current state of logistics services at seaports in Central Vietnam, identifying achievements, limitations, and underlying causes in the context of digital transformation; and (5) Determining the conditions for digital transformation and, on that basis, proposing solutions to improve the quality of logistics services at seaports in Central Vietnam.

Chapter 1 Summary

Chapter 1 systematizes existing studies into major thematic groups, including logistics services, seaport logistics, digital transformation, and seaport logistics in the context of digital transformation. On this basis, the dissertation synthesizes key findings that have been published, while identifying persisting research gaps. This review provides an essential scientific foundation for inheriting and extending previous studies, as well as for defining the research direction of the topic "Logistics Services at Seaports in Central Vietnam in the Context of Digital Transformation." It thereby affirms the novelty, necessity, and theoretical and practical significance of the research.

Chapter 2
THEORETICAL FOUNDATIONS AND PRACTICAL EXPERIENCES OF LOGISTICS SERVICES AT SEAPORTS IN THE CONTEXT OF DIGITAL TRANSFORMATION

2.1. CONCEPTS AND CHARACTERISTICS OF LOGISTICS SERVICES AT SEAPORTS IN THE CONTEXT OF DIGITAL TRANSFORMATION

2.1.1. Concepts of Logistics Services at Seaports in the Context of Digital Transformation

2.1.1.1. Services

Building on the perspectives of Karl Marx (2021), Dumoulin and Flipo (1991), Kotler and Keller (2007), and Lovelock et al. (2001), the dissertation defines services as a special type of commodity—an intangible good distinct from conventional godos - that cannot be stored, and whose production and consumption occur simultaneously. Services provide operational mechanisms that meet customer needs and expectations, thereby generating profits in business activities. To ensure customer satisfaction and foster loyalty and trust, service providers must improve service quality, fulfill their commitments, and build credibility with customers.

2.1.1.2. Logistics Services

Based on Karl Marx's theoretical insights that improvements in transportation and favorable locations enable productive resources to participate more effectively in competition, and drawing on definitions proposed by Du Duc Thanh (2004), Anisya S. Thomas and Laura Rock Kopczak (2005), Ballou (1992), the United Nations (2002), the 2005 Vietnamese Commercial Law, as well as Greg Moser (2023) and Abby Jenkins (2024), the dissertation conceptualizes: Logistics services are an intangible type of commodity that facilitates the flow of goods from input factors to the distribution of final products to customers, with the aim of optimizing production and circulation processes, meeting customer requirements and safeguarding their interests, minimizing costs, and enhancing the competitive efficiency of both enterprises and the overall economy.

2.1.1.3. Digital Transformation

From the perspective of Political Economy, digital transformation is understood as a comprehensive and profound process of changing the modes of operation of organizations, enterprises, and society as a whole on the basis of digital technologies. This process goes beyond the mere adoption of new technologies; it entails the strategic use of digital technologies to reshape business models, operational processes,

organizational culture, and customer experience.

2.1.1.4. Logistics Services at Seaports in the Context of Digital Transformation

Based on the previously identified and defined conceptual tools, the dissertation formulates a central concept from the perspective of Political Economy as follows:

Logistics services at seaports in the context of digital transformation constitute a type of intangible commodity that is supplied and consumed by stakeholders within seaport areas, in the course of innovating modes of organization and governance to meet consumer needs, to optimize production and circulation processes on the basis of digital technologies.

The development of logistics services requires stakeholders to continuously establish advanced systems to ensure effective service monitoring, traceability, and the management of shipment and inventory information. Digital transformation plays a pivotal role in enhancing customer experience for logistics service enterprises, particularly in terms of information transparency, cargo traceability, and documentation control.

2.1.2. Characteristics of Logistics Services at Seaports in the Context of Digital Transformation

First, digital transformation necessitates the synchronized implementation of modern technological solutions.

Numerous scholars have analyzed and clarified the characteristics of several key technologies currently applied in practice. These aspects are summarized in Table 2.1.

Table 2.1. Fundamental Characteristics and Impacts of Selected Technologies in the Context of Digital Transformation on Logistics Services at Seaports

Technologies	Characteristics	Impacts on Logistics Services
Blockchain (Orji, Kusi-Sarpong, Huang, & Vazquez-Brust, 2020; Zhang & Liu, 2023)	Decentralization; enhanced cybersecurity; the establishment of smart business plans and contracts; continuous and real-time information sharing; and transparent, standardized data.	Provision of integrated data management systems; continuous, uninterrupted real-time information sharing; prevention of data tampering; and enhanced transparency and reliability.
Internet of Things (IoT) (Kumar, Tyagi, & Sachdeva, 2023)	Real-time data collection; rapid, standardized connectivity and information exchange.	Application of the Internet of Things (IoT) to improve operational efficiency and automate decision-making processes.
Artificial Intelligence (AI) (Chien, Dauzère-Pérès, Huh, Jang, & Morrison, 2020; Tsolakis, Zissis, Papaefthimiou, & Korfiatis, 2022)	Support for analytical learning, research, and decision-making processes.	Automation combined with advanced analytics to optimize forecasting and operational planning.
Robotics (Atzeni, Vignali, Tebaldi, & Bottani, 2021; Liu, Hua, Cheng, Choi, & Dong, 2023)	Automation and execution of physically intensive and repetitive tasks.	Efficient execution of repetitive tasks, increasing accuracy and consistency in operational activities.
Cloud Computing (Zhang & Liu, 2023)	Scalability and capacity for large-scale, virtually unlimited data storage.	Enabling continuous collaboration and effective data integration among stakeholders while optimizing data accessibility.

Source: Compiled by the author

Second, the process of resource optimization in digital transformation depends not only on corporate management but is also closely associated with the roles of other stakeholders within the broader economic ecosystem.

Third, as organizational structures of enterprises become more complex, proactively implementing digital transformation within seaport logistics enterprises has become an urgent requirement.

Fourth, the requirements for sustainable development and carbon emission reduction in the logistics sector are becoming increasingly evident.

2.2. CONTENTS, EVALUATION CRITERIA, AND INFLUENCING FACTORS OF LOGISTICS SERVICES AT SEAPORTS IN THE CONTEXT OF DIGITAL TRANSFORMATION

2.2.1. Contents of Logistics Services at Seaports in the Context of Digital Transformation

2.2.1.1. Maritime Transport Services

Maritime transport refers to the process of moving goods by sea using maritime transport means to meet the requirements of trade, storage, and production-business activities. As such, transport plays an essential role within the logistics chain. In maritime transport, two main types of services are commonly identified: unimodal transport and multimodal transport.

2.2.1.2. Warehousing and Cargo Storage Services

This involves the systematic organization, preservation, and storage of raw materials, fuels, semi-finished goods, and finished products, while performing preparatory handling activities to meet customer supply requirements with optimal service quality and reasonable costs. At the same time, these services provide updated information on the condition, storage status, and location of goods in warehouses, thereby enhancing transparency and efficiency in supply chain management.

2.2.1.3. Cargo Handling Services

According to Decision No. 2106/QĐ-BGTVT of the Ministry of Transport on the promulgation of regulations on *cargo handling, delivery, and preservation at Vietnamese seaports, cargo handling services at seaports are defined as services responsible for carrying out activities related to lifting, moving, loading, unloading, and transporting goods at seaports in accordance with prescribed sequences, procedures, plans, and handling technologies.*

2.2.1.4. Customs Clearance Services

These constitute essential services at seaports, not only holding strategic significance in ensuring safety, speed, and legal compliance in maritime transport activities, but also accounting for a substantial proportion of revenue in the structure of port operating enterprises and logistics service providers.

2.2.2. Evaluation Criteria for Logistics Services at Seaports in the Context of Digital Transformation

Based on existing theoretical frameworks, the dissertation constructs a set of criteria to evaluate the degree of service diversification and the effectiveness of logistics service types at seaports in the context of digital transformation, as presented in Table 2.2.

Table 2.2. Evaluation Criteria for Logistics Services at Seaports in the Context of Digital Transformation

Criteria Groups	Component Criteria	Evaluation Contents
1. Degree of Digitalization of Logistics Services	***1.1. Proportion of enterprises applying digital technologies in operations***	- Percentage of enterprises using TMS, WMS, EDI, blockchain, IoT, and AI systems. - Comparison with regional and ASEAN average levels.
	1.2. Degree of technological integration across the service chain	- Degree of digital linkage across stages of the logistics chain, including transport, warehousing, seaports, customs, and customers. - Proportion of transactions conducted entirely via digital platforms (%).
	1.3. Application of regional/port-level/enterprise-level digital logistics platforms	- Presence or absence of digital platforms. - Applied platforms such as Port Community Systems (PCS), Maritime Single Window (MSW), electronic customs declaration systems, and real-time tracking systems.
2. Operational Efficiency of Logistics Service Types	***2.1. Operational efficiency indicators of logistics services***	- Cargo throughput via seaports (tons/TEUs) and service-based revenue. - Growth rate of logistics revenue (% per year).
	2.2. Ratio of logistics costs to GDP or logistics costs relative to the value of goods	- Percentage of logistics costs relative to GDP or total import-export turnover. - Comparison with domestic and international benchmarks (e.g., OECD, World Bank).
	2.3. Average processing and cargo distribution time	- Average time (hours/days) required for customs clearance, cargo handling, and delivery.

		- Comparison between periods before and after the application of digital technologies. - Benchmarking against international standards (e.g., UNCTAD, World Bank Logistics Performance Index - LPI).
3. Capacity for Infrastructure and Supply Chain Connectivity	***3.1. Multimodal connectivity***	- Degree of connectivity between seaport logistics and road, rail, air, and inland waterway transport. - Percentage of cargo transported via multimodal connections.
	3.2. Data and system interoperability	-. Degree of data connectivity among ports, enterprises, and regulatory authorities. - Existence or absence of shared data systems (e.g., National Single Window, ASEAN Single Window).
4. Strategy, Planning, and Human Resources	***4.1. Supporting strategies and planning frameworks***	- Level of policy completeness and alignment with digital transformation trends. - Presence or absence of incentive mechanisms to encourage investment in digitalizing logistics services.
	4.2. Digital logistics human resources	- Proportion of human resources trained in digital skills (%). - Number of training programs and applied research initiatives related to digital logistics.
	4.3. International cooperation and standardization	- Degree of participation in international smart logistics and smart port networks. - Level of adoption of international standards (ISO, FIATA, UN/CEFACT).

Source: Developed by the author

2.2.3. Factors Affecting Logistics Services at Seaports in the Context of Digital Transformation

2.2.3.1. Natural Condition Factors

Natural conditions, including geographical location as well as climate and weather patterns, directly affect the operational efficiency of logistics services at seaports, particularly in the context of digital transformation, where operational systems increasingly depend on real-time data and the stability of supply chains.

2.2.3.2. Strategic and Planning Factors for the Development of Seaport Logistics Services

Strategies and planning not only establish the legal framework that ensures transparency and coherence in logistics activities but also guide the process of digital transformation within the sector. At the same time, international commitments and free trade agreements generate both incentives and reform pressures, requiring seaport logistics services to comply with global standards in data transparency, process digitalization, and adherence to international norms. Accordingly, the State plays a pivotal role, exerting a direct influence on logistics services at seaports through the formulation of institutional frameworks in general and specific development strategies and plans in particular.

2.2.3.3. Infrastructure and Digital Technology Factors

Digital technology platforms such as the Internet of Things (IoT), artificial intelligence (AI), blockchain, big data, cloud computing, as well as smart port management systems, warehouse management systems (WMS), transport management systems (TMS), and electronic customs systems, have become essential tools for optimizing operations, reducing costs, and enhancing transparency. In addition, information security, data standardization, and interoperability among technological platforms constitute decisive factors in the formation of a comprehensive digital logistics ecosystem.

2.2.3.4. Economic and Market Factors

According to theories of business cycles and market dynamics, and under the influence of supply-demand mechanisms, economic and market demand serve as a key driver for the development of logistics services at seaports. In the context of digital transformation, market dynamics generate strong demand for the digitalization of processes to meet requirements for speed, flexibility, and traceability of goods. Consequently, economic and market factors function as the primary driving force determining the pace of digital transformation and the degree of quality enhancement in seaport logistics services, while simultaneously exerting pressure for reform and service digitalization.

2.2.3.5. Environmental and Sustainable Development Factors

Theories of sustainable development and green economy converge on the view that environmental considerations are increasingly becoming both a pressure and a standard for the logistics sector. In a global context that prioritizes greenhouse gas emission reduction and climate change mitigation, seaport logistics must simultaneously integrate two core requirements: digitalization and greening.

2.2.3.6. Human Resources and Governance Factors

Human capital and governance capacity play a decisive role in determining the feasibility and effectiveness of digital transformation strategies. In the digital transformation era, human resources in seaport logistics services must not only possess expertise in traditional operations but also demonstrate competencies in digital technologies, data analytics, and digital supply chain management.

2.3. EXPERIENCE IN ENHANCING THE QUALITY OF LOGISTICS SERVICES AT SEAPORTS IN THE CONTEXT OF DIGITAL TRANSFORMATION AND IMPLICATIONS FOR CENTRAL VIETNAMESE SEAPORTS

2.3.1. Experience in Enhancing the Quality of Logistics Services at Seaports in the Context of Digital Transformation

2.3.1.1. Experience from Seaports in Eastern China

From practical efforts to improve service quality, several key lessons can be drawn from seaports in Eastern China: (1) development of digital infrastructure and smart ports; (2) integration of "single-window" mechanisms and digitalization of administrative procedures; (3) application of automation, artificial intelligence, and satellite-based positioning; (4) development of integrated logistics and digital supply chains; (5) supportive policies and legal frameworks; (6) human resource training and innovation incentives; and (7) the integration of digitalization with sustainable development.

2.3.1.2. Experience of Singapore

Singapore is widely regarded as a global benchmark in logistics and seaport development, attributable to the following experiences: (1) leveraging geostrategic advantages in conjunction with the planning of the Tuas Mega Port; (2) promoting comprehensive digital transformation and automation; (3) digitalization of logistics procedures and integration with e-commerce platforms; (4) building an integrated and sustainable logistics ecosystem; (5) strong emphasis on maritime cybersecurity and information security; and (6) improving operational efficiency and optimizing logistics cash flows.

2.3.1.3. Experience from Seaports in Southern and Western Malaysia

Practical experience from seaports in Southern and Western Malaysia highlights several lessons: (1) strategic positioning through public-private partnerships and international integration; (2) leadership in digital transformation and operational automation; (3) infrastructure expansion planning aligned with digitalization strategies; (4) integration of ESG strategies into seaport logistics development; (5) development of digital logistics ecosystems and "single-window" systems; and (6) supportive policies for logistics enterprises and SMEs in the digital era.

2.3.1.4. Experience from Southern Vietnam

Based on an analysis of operational practices and adaptive capacity in the context of digital transformation, key experiences from Southern Vietnam include: (1) strategic positioning of digital transformation in alignment with the role of a national logistics hub; (2) comprehensive digitalization of operational and management processes; (3) digital connectivity with customs authorities and other stakeholders in the logistics chain; (4) application of emerging technologies such as IoT, AI, and big data; (5) cybersecurity governance and digital customer services; and (6) orientation toward smart port development and green logistics.

2.3.2. Lessons for Central Vietnamese Seaports

First, develop digital infrastructure in conjunction with the construction of smart and green ports.

Second, accelerate the implementation of "single-window" mechanisms and the digitalization of administrative procedures.

Third, integrate digital supply chains and promote multimodal logistics services.

Fourth, strengthen public-private partnerships and international integration.

Fifth, place greater emphasis on training human resources for digital logistics services.

Sixth, ensure cybersecurity and enhance digital customer services.

Seventh, strategically position development pathways in line with regional potential and functional roles.

Chapter 2 Summary

Logistics services at seaports in Central Vietnam are experiencing rapid development in the context of digital transformation, emerging as a key driver of regional socio-economic growth. Chapter 2 of the

dissertation presents the theoretical foundations of seaport logistics in the digital transformation era and examines practical experiences from selected regions, including Eastern China, Singapore, Malaysia, and Southern Vietnam. These experiences demonstrate that enhancing the quality of logistics services requires a coordinated approach encompassing digital infrastructure, procedural digitalization, supply chain integration, public-private cooperation, digital human resource development, cybersecurity assurance, strategic positioning, and a commitment to sustainable development. Effective application of these lessons will enable Central Vietnam to modernize its seaport system and strengthen its role within national and international logistics networks.

Chapter 3
CURRENT SITUATION OF LOGISTICS SERVICES AT SEAPORTS IN CENTRAL VIETNAM IN THE CONTEXT OF DIGITAL TRANSFORMATION

3.1. OPPORTUNITIES AND CONSTRAINTS OF LOGISTICS SERVICES AT SEAPORTS IN CENTRAL VIETNAM IN THE CONTEXT OF DIGITAL TRANSFORMATION

3.1.1. Opportunities

First, geographical advantages: The region comprises 11 provinces located along the strategic North-South transport axis and the East-West Economic Corridor, while also serving as a maritime gateway to international shipping routes.

Second, climatic and weather advantages: Central Vietnam features two distinct seasons - rainy and dry. The clear seasonal differentiation between the North Central and South Central sub-regions enables enterprises to proactively plan and organize logistics operations.

Third, socio-economic potential: The region possesses significant advantages in the marine economy, supported by an extensive system of islands, economic zones, and large fishing grounds, along with national policy orientations prioritizing the sustainable development of the maritime economy. In addition, the level of information and communication technology (ICT) capacity in several localities is relatively high. Notably, Da Nang and Thua Thien-Hue rank among national leaders in ICT and digital transformation indices, providing a favorable foundation for the digitalization of logistics services.

Table 3.1. Readiness Index for the Development and Application of Information and Communication Technologies in Selected Central Vietnamese Provinces

No.	Province/City	Technical Infrastructure Index	Human Resource Infrastructure Index	ICT Application Index	ICT Index	Ranking		
						2022	2020	2019
1	Da Nang	0,97	0,77	0,99	0,9094	1	1	1
2	Thanh Hoa	0,49	0,66	0,44	0,5307	15	50	45
3	Khanh Hoa	0,64	0,45	0,39	0,4911	24	18	17

Source: Compiled by the author from the Vietnam ICT Development and Application Readiness Index Report 2022.

In the context of digital transformation, several provinces and cities in the Central region record relatively high rankings in digital government, digital economy, and digital society.

Table 3.2. Rankings of Digital Transformation Levels in Selected Central Provinces/Cities, 2023

DTI Ranking	Province/City	Digital Government Ranking	Digital Economy Ranking	Digital Society Ranking
1	Da Nang	1	1	1
11	Thanh Hoa	9	8	8
30	Khanh Hoa	46	27	22

Source: Ministry of Information and Communications

Fourth, transport infrastructure potential: The Central region possesses a dense system of seaports, including several deep-water ports, which are organized into two strategic port groups serving the North-South axis and the East-West Economic Corridor. This configuration enhances transshipment capacity and supports the development of regional logistics services.

3.1.2. Constraints

First, financial constraints in implementing the digital transformation of logistics services at

seaports in the Central region.

Second, limitations in transport infrastructure connectivity linking the Central-region seaports.

Third, shortcomings in the technological infrastructure required for the digital transformation of seaport logistics services.

Fourth, constraints related to the digital transformation of human resources.

3.2. CURRENT STATUS OF LOGISTICS SERVICES AT SEAPORTS IN CENTRAL VIETNAM, 2018-2024

3.2.1. Maritime Transport Services

3.2.1.1. Level of Digitalization of Maritime Transport Services

Maritime transport services occupy a central position in the logistics chain of the Central region. During the period 2018-2024, most seaports in Central Vietnam have formulated and implemented investment plans for infrastructure and digital technologies in port operations and management.

Table 3.3. Statistics on the Adoption of Electronic Port (E-Port) Systems at Seaports in Central Vietnam

No.	Port	Use of the Electronic Port (EPort) System
1	Thanh Hoa	Used
2	Da Nang	Used
3	Khanh Hoa	Used

Source: Compiled by the author

. In addition to the E-Port electronic port system, the Smartgate intelligent container gate currently operated at Da Nang Port is among the most advanced systems in Vietnam, incorporating multiple functional modules (*see Table 3.4).*

Table 3.4. Subsystems and Functions of the E-Port Software and the Smartgate Intelligent Container Gate System at Da Nang Port

No.	Subsystems	Functions
1	Subsystem 1	"Connecting shipping lines to transmit delivery orders and manage electronic delivery orders (eDO)."
3	Subsystem 2	"Freight forwarders/logistics firms split bills on the EPort system from the Master Bill of Lading to the House Bill of Lading."
3	Subsystem 3	"Import-export companies and transport enterprises use the EPort system to register services, complete customs clearance, conduct electronic payments, and issue electronic invoices."
4	Subsystem 4	"Transport companies manage and dispatch vehicles for container pick-up and delivery."
5	Subsystem 5	"Mobile application for drivers to receive and deliver containers."
6	Subsystem 6	"Container handover at the smart container gate (Smartgate)."
7	Subsystem 7	"System administration, account provisioning, and customer support during the deployment and operation of the EPort system and Smartgate."

Source: Compiled by the author

Da Nang Port has deployed an AI-based container recognition system using cameras and ACCR algorithms, combined with RPA to automate order processing, reducing clearance time from approximately 10 minutes to only 1 minute. To strengthen investment in digital means of production, Nghi Son Port is developing a vessel traffic management system for port entry and exit based on AIS (Automatic Identification System) connected to the Maritime Administration. For Cam Ranh Port, in 2024, the Khanh Hoa Provincial People's Committee issued Plan No. 9334/KH-UBND, which prioritizes the application of technology and digital transformation in logistics service development; however, in practice, the large-scale and integrated implementation of electronic port systems remains limited, and the port is currently in the phase of upgrading and attracting information technology investment.

Overall, the level of digital transformation among seaports in the Central region remains uneven. According to the Vietnam Logistics Report 2024, 90.5% of surveyed logistics service enterprises are still at the early stages of digitalization, including Level 1 (computerization) and Level 2 (connectivity) (*see Table 3.5).*

Table 3.5. Levels of Digital Transformation of Logistics Service Enterprises in Vietnam

Levels of Digital Transformation	Description	Proportion of enterprises
Level 1 - Computerization	Basic application of information technology,	-

Levels of Digital Transformation	Description	Proportion of enterprises
	including word processing, email, and Excel.	
Level 2 - Connectivity	Internal systems are interconnected, with the application of management software.	73,5%
Level 3 - Visualization	Real-time management systems are in place (e.g., tracking systems, EPort).	5,0%
Level 4 - Transparency	End-to-end data transparency across the entire chain, with multi-stakeholder integration.	2,2%
Level 5 - Forecasting	Application of AI and data analytics for forecasting and prediction.	1,9%
Level 6 - Adaptability	Systems capable of automated decision-making and adaptive responses to changes.	0,4%

Source: Vietnam Logistics Report 2024

3.2.1.2. Operational Efficiency of Maritime Transport Services

(1) Cargo Throughput

During the period 2018-2024, the productivity of maritime transport services in the Central region recorded significant growth, while bill processing time was substantially reduced. This trend reflects the effectiveness of digitalizing operational processes and applying technology across different stages of maritime transport services.

Table 3.6. Cargo Throughput via Seaports in the Central Region, 2020-2024

Unit: Million tons

Year / Port	2020	2021	2022	2023	2024
Nghi Son Port	41,8	42,3	41,3	45,8	56,14
Dang Nang Port	11,4	12,9	12,8	12,2	14,0
Cam Ranh Port	2,1	2,4	2,2	2,2	2,4

Source: Compiled by the author

Nghi Son Port (Thanh Hoa) records the highest cargo throughput within the group. Da Nang Port shows a steady increase in throughput, while Cam Ranh Port maintains a very low level of cargo volume.

(2) Service Processing Time and Costs

The application of digital transformation in maritime transport activities at seaports in the Central region has contributed to reducing both service processing time and costs. Among these ports, Da Nang Port demonstrates the most evident improvements, whereas Nghi Son Port and Cam Ranh Port have not yet shown clear or measurable outcomes.

3.2.1.3. Connectivity of Infrastructure and the Supply Chain in Maritime Transport Services

First, regarding Nghi Son Port, infrastructure connectivity and supply chain integration are promoted in accordance with Resolution No. 107/NQ-HĐND dated July 11, 2018, which adjusted the master plan of the Nghi Son Economic Zone toward 2035 with a vision to 2050, clearly identifying two key functional areas directly linked to logistics service development.

Second, with respect to Da Nang Port, its multimodal transport infrastructure is relatively well developed, enabling the port to function as the logistics hub of Central Vietnam.

Third, for Cam Ranh Port, the port currently serves major domestic shipping routes (Ho Chi Minh City - Cam Ranh - Quy Nhon - Hai Phong) and has begun to expand cooperation with several small- and medium-sized international shipping lines to transship bulk cargo and export clinker and wood chips to Southeast Asian markets, particularly the Philippines and Malaysia.

3.2.1.4. Strategy, Planning, and Human Resources for Maritime Transport Services

First, in terms of strategy and planning

Thanh Hoa Province has defined the development orientation of Nghi Son Port toward 2030 as a national general port and a gateway for the North Central region, with the long-term goal of becoming a regional transshipment hub within Northern ASEAN. In Da Nang, the city has approved a strategy to develop Lien Chieu Port into the largest gateway port in the Central region, moving toward a “smart port” model based on a comprehensive digital management platform. In Khanh Hoa Province, the provincial

strategy emphasizes the application of digital technologies in port management and operations, cargo flow forecasting, maritime security assurance, and optimization of berth capacity.

Second, with regard to human resources

The workforce engaged in logistics services at Central Vietnam's seaports has increased in both quantity and quality, gradually meeting the requirements of digital transformation.

Table 3.7. Number of employees in selected logistics service enterprises at Central Vietnam's seaports, 2018-2024

Unit: persons

No.	Enterprises	2018	2019	2020	2021	2022	2023	2024
1	PTSC Thanh Hoa Technical Services Joint Stock Company	445	461	446	437	464	723	723
2	Da Nang Port Joint Stock Company	653	674	702	728	778	774	798
3	Cam Ranh Port Joint Stock Company	185	189	191	191	181	170	168

Source: Compiled by the author

In terms of human resource quality, Da Nang records a relatively high proportion of highly qualified personnel: employees holding master's degrees account for 5%, engineers 9%, and bachelor's degree holders 19%. A similar pattern is observed at Cam Ranh Port, where 51 out of 170 employees possess university and postgraduate qualifications, representing approximately 30% of the firm's human resources by educational level.

3.2.2. Warehousing and Cargo Storage Services

3.2.2.1. Level of Digitalization in Warehousing and Cargo Storage Services

(1) Nghi Son Port (Thanh Hoa)

+ 2018-2020: Nghi Son Port began adopting electronic warehouse management systems, gradually replacing paper-based records with digitized data.

+ 2020-2024: All enterprises engaged in warehousing, storage, and port operations in the area were connected and exchanged electronic data via the Automated Cargo Management and Supervision System (VASSCM), enabling real-time monitoring of cargo entering and leaving the port.

(2) Da Nang Port: Da Nang Port is a pioneer in the digital transformation of warehousing services in the Central region, particularly through the Electronic Port (EPort) software. The EPort-CFS (Container Freight Station) system allows customers to book space, track shipments, make declarations, and complete online payments for less-than-container-load (LCL) warehousing services, thereby enhancing transparency and significantly accelerating import-export processes.

(3) Cam Ranh Port (Khanh Hoa): Digitalization at Cam Ranh Port has progressed more slowly than at Da Nang. However, since 2021, the port has implemented an integrated warehouse management system linked with VASSCM and established online connectivity with Customs authorities. Digital platforms are used for container tracking, shipment monitoring, inventory reporting, and electronic document storage. In addition, the port participates in the regional vSOC monitoring system to ensure cybersecurity in warehousing and cargo handling operations.

3.2.2.2. Operational Efficiency of Warehousing and Cargo Storage Services

The operational efficiency of warehousing and cargo storage services in the context of digital transformation is presented in Table 3.8.

Table 3.8. Operational Efficiency of Warehousing and Cargo Storage Services

Operational Efficiency	Nghi Son Port	Da Nang Port	Cam Ranh Port
Service Quality	- The automated warehouse management system helps reduce storage costs and minimizes discrepancies between physical cargo and system records. - Stored goods, particularly bulk cargo and construction materials, are monitored more accurately through the integration of camera systems	- Throughput via CFS warehouses has increased steadily, reaching over 250,000 tons per year in 2023 - more than 1.5 times higher than in 2018. - Automation in cargo management has reduced pressure on frontline labor, allowing the port to focus more on coordination and warehouse	The implementation of warehouse management software has improved the operational efficiency of warehousing activities.

	and cargo location software.	space optimization. - Synchronized data enables faster and more accurate reporting, cargo traceability, and periodic inventory checks.	
Processing Time	The automated warehouse management system has reduced documentation processing time by approximately 30-40% compared to the pre-2018 period.	The implementation of EPort has shortened warehouse-related administrative procedures by an average of 25-30%.	Digital warehouse management has reduced the average cargo dwell time from 3.5 days in 2019 to 2.2 days in 2024.
Limitations	The professionalism of cargo handover and receiving processes at some enterprises remains limited due to delays in synchronizing management systems.	Not significant.	However, warehouse utilization has not yet reached designed capacity (approximately 70-75%), mainly due to the relatively low scale of import-export cargo flows.

Source: Compiled by the author

3.2.2.3. Connectivity of Infrastructure and Supply Chains

(1) Nghi Son Port: The warehousing system is directly integrated with the Nghi Son Economic Zone, facilitating efficient linkage between production and export supply chains. *(2) Da Nang Port:* The CFS warehouses, bonded warehouses, and cold storage facilities are organized in close integration with Hoa Nhon ICD and Lien Chieu Industrial Park, contributing to the formation of an inter-regional supply network. *(3) Cam Ranh Port:* The port leverages the proximity of warehouses to Suoi Dau Industrial Park and Cam Ranh Airport, enabling rapid cargo circulation.

3.2.2.4. Strategy, Planning, and Human Resources

(1) Nghi Son Port: Warehousing enterprises focus on upgrading digital operating procedures and training personnel in the operation of VASSCM systems and surveillance technologies.

(2) Da Nang Port: The port cooperates with the University of Da Nang and training institutes to develop digital logistics and automated warehouse management skills. Its human resource management system is standardized under the "Smart Port" model, with specialized teams of operational engineers, cybersecurity staff, and data analysts.

(3) Cam Ranh Port: Planning is aligned with the orientation of developing a national general port, with an emphasis on logistics services for tourism, fisheries, and light industry.

3.2.3. Cargo Handling Services

3.2.3.1. Level of Digitalization in Cargo Handling Services

(1) Deployment of the EPort platform and Smartgate container gates

(2) Process automation through Robotic Process Automation (RPA)

(3) Application of artificial intelligence in berth operations

(4) Digitalization of dispatching chains and vehicle connectivity

3.2.3.2. Operational Efficiency of Cargo Handling Services

(1) Service quality: At Da Nang Port, eTractor saved approximately VND 4 billion over three years, eCPS saved VND 6.6 billion per year, and RPA reduced administrative labor costs by at least 20-25%. Nghi Son and Cam Ranh Ports have achieved comparable outcomes through EPort implementation, shortening administrative procedures by 50-60% and enhancing the capacity to serve larger vessels and logistics clients.

(2) Handling productivity and processing time: Data integration among EPort, RPA, and eCPS enables end-to-end connectivity across operational chains - from berth scheduling to order processing - thereby significantly reducing vessel waiting time.

3.2.3.3. Infrastructure and Supply Chain Connectivity

Nghi Son Port (Thanh Hoa): Direct connectivity to National Highway 1A, the North-South Expressway, and the Nghi Son Economic Zone-Hanoi railway facilitates efficient cargo distribution to the Nghi Son and Hoang Long industrial zones and the broader North Central region. Da Nang Port: Serving as the Central region's international transshipment hub, the port connects directly to the East-West Economic

Corridor through Laos and Thailand, alongside regional logistics infrastructure including Kim Lien freight station, Da Nang International Airport, and the La Son-Tuy Loan-Cam Lo expressway network. Cam Ranh Port (Khanh Hoa): The port benefits from road connectivity via National Highway 1A and the Nha Trang-Cam Lam section of the North-South Expressway, and can be linked with Van Phong International Transshipment Port, forming a strategic logistics port cluster for the SouthCentral region.

3.2.3.4. Strategy, Planning, and Human Resources

(1) Strategy and planning for cargo handling services

In Thanh Hoa, the development strategy for the Nghi Son Port area clearly identifies investment in upgrading cargo-handling equipment as one of the three core priorities aimed at establishing a multifunctional deep-water port. The master plan toward 2030 continues to expand general cargo berths and develop a digitalized container terminal connected to electronic dispatching systems and e-Port software. The application of the "Digital Twin" platform (digital simulation of port operations) is currently under study to optimize handling productivity. *In Da Nang,* cargo handling services are oriented toward comprehensive modernization within the Lien Chieu Port Project, designated as the Central region's international gateway port. The city has proposed the construction of container berths equipped with remotely controlled automated STS and RTG cranes. *In Khanh Hoa,* planning focuses on investment in specialized cranes and handling systems, the application of automation, and a transition toward environmentally friendly equipment using clean energy.

(2) Human resources for cargo handling services

Seaports in the Central region have significantly reduced manual labor in cargo handling through automation while upgrading the digital competencies of technical personnel. Operators of EPort, RPA, eCPS, and TOS systems are trained in data analytics, cybersecurity, and digital operations management. However, there remains a shortage of high-skilled human resources, particularly in AI, IoT, and smart port system programming. This constitutes a major challenge to ensuring the sustainability of the digital transformation process.

3.2.4. Customs Clearance Services

3.2.4.1. Level of Digitalization in Customs Clearance Services

At Nghi Son Port (Thanh Hoa), since 2019, the EPort system has been integrated with VNACCS/VCIS. Da Nang Port is among the pioneers in deploying electronic EPort systems with comprehensive connectivity to the National Single Window and electronic payment platforms such as Napas and Momo. At Cam Ranh Port (Khanh Hoa), since 2020, there has been strong investment in digital infrastructure, including transmission networks, server systems, Big Data platforms, and internal management systems (Fast Business Online).

3.2.4.2. Operational Efficiency of Customs Clearance Services

The application of digital transformation technologies has generated clear efficiency gains in customs clearance at Central-region seaports, including: (1) shortened customs clearance time (according to internal statistics); (2) reduced logistics costs; (3) enhanced transparency and reduced procedural risks; (4) increased clearance productivity; and (5) strengthened regional competitiveness.

3.2.4.3. Infrastructure and Supply Chain Connectivity

+ *Technological connectivity:* EPort systems at Da Nang, Nghi Son, and Cam Ranh Ports are interconnected online with the General Department of Vietnam Customs, the National Single Window portal, and electronic payment systems.

+ *Supporting technical infrastructure:* Da Nang Port has deployed digital call centers and ERP systems for human resource and customer data management. Nghi Son Port is moving toward data integration with industrial zones and export-import enterprises within the province. Cam Ranh Port has invested in high-speed internet systems, full-area Wi-Fi coverage, and upgraded server rooms and centralized data centers.

3.2.4.4. Strategy, Planning, and Human Resources

+ *Strategy and planning:* Central-region seaports aim to fully digitalize customs brokerage and clearance services in alignment with Vietnam's Customs Development Strategy to 2030 (Decision No. 628/QĐ-TTg, 2022), under the orientation of *"Smart Customs - Green Logistics - Digital Connectivity*."

+ *Human resources:* Da Nang Port is a leading case in implementing the VIMC E-learning program, with over 70% of staff completing online courses on management in the industry 4.0 era, customer experience, and problem-solving skills. At Cam Ranh and Nghi Son Ports, human resource restructuring has been undertaken toward leaner and highly specialized structures, prioritizing training in ERP systems, Fast Business Online software, and EPort operations.

3.3. ASSESSMENT OF THE CURRENT STATUS OF LOGISTICS SERVICES AT SEAPORTS IN CENTRAL VIETNAM, 2018-2024

3.3.1. Achieved Results

3.3.1.1. Maritime Transport Services

(1) Level of digitalization in maritime transport services

Based on the digital transformation level assessment framework presented in the Vietnam Logistics Report, the degree of digital transformation of seaports in Central Vietnam can be evaluated as shown in Table 3.9.

Table 3.9. Assessment of digital transformation levels of seaports in Central Vietnam, 2018-2024

Port	Level of Digital Transformation	Assessment Basis
Da Nang Port	Level 3 - Visualization, progressing toward Level 4	- Implementation of the EPort platform and online operational management systems. - Connectivity with the National Single Window (NSW) and online public services. - Digitization of records and container control through camera-based monitoring systems.
Nghi Son Port	Level 2 - Connectivity, with signs of transition to Level 3	- Availability of internal operational management software. - Partial digital linkage of certain logistics services, though not yet fully synchronized with customs authorities and port administrations. - Lack of comprehensive visual monitoring and real-time supervision systems.
Cam Ranh Port	Levels 1-2, predominantly at Level 1	- A significant number of procedures are still conducted manually. - Limited and insufficient investment in the large-scale deployment of EPort systems and integration with the National Single Window (NSW).

Source: Evaluated by the author

Among the three ports, Da Nang Port exhibits the highest level of digital transformation. Nghi Son Port demonstrates considerable development potential thanks to its large scale and strategic location; however, it currently remains at the connectivity level. Cam Ranh Port is still at the initial stage of digital transformation.

(2) Operational efficiency of maritime transport services

+ In terms of revenue:

Overall revenue generated by logistics service enterprises at central Vietnamese seaports has shown continuous growth over the period under review.

Table 3.10. Annual realized revenue of central Vietnamese seaports, 2018-2024

Unit: billion VND

Year	2018	2019	2020	2021	2022	2023	2024
Nghi Son Port	1.125,08	902,59	629,15	745,37	953,59	1.038,16	1.202,64
Da Nang Port	718,09	854,44	938,25	1.112,36	1.238,29	1.289,77	1.493,03
Cam Ranh Port	159,55	159,96	138,42	194,94	151,88	143,51	177,53

Source: Compiled by the author

According to the revenue data in Table 3.10, Da Nang Port recorded the strongest growth among the three ports. Nghi Son Port, although having the highest revenue at the beginning of 2018, experienced a sharp decline during 2018-2020. However, from 2021 onwards, the port's business showed signs of strong recovery. Cam Ranh Port maintained stable revenue, albeit at a low level.

+ Customer experience:

During 2020-2024, seaports in Thanh Hoa, Da Nang, and Khanh Hoa focused on developing centralized customer databases, enabling internal departments to access, monitor, and analyze customer information synchronously. At the same time, enterprises diversified communication and interaction channels such as websites, email, SMS, chatbots, Facebook, Zalo, and YouTube, laying the groundwork for an integrated omni-channel customer engagement model and enhancing professionalism and interaction efficiency.

The digital customer experience for maritime transport services through the EPort electronic port system at Da Nang Port was relatively stable. Specifically, all digital experience indicators achieved a 100% success rate, as shown in Table 3.11.

Table 3.11. Digital customer experience results for maritime transport services via the EPort system at Da Nang Port, 2023

No.	Categories	Unit of Measurement	Quantity	Proportion
1	Shipping lines using electronic delivery orders (eDO)	%	36/36	100%
2	Forwarder/logistics companies	Company	760	100%
3	Container transport companies	Company	374	100%
4	Number of customers using mobile applications (APP) for cargo handling and dispatching instructions to drivers	%	374	100%
5	Number of transport company drivers using the app for container handling	%	374	100%

Source: Compiled by the author from the 2023 Annual Report of Da Nang Port Joint Stock Company

(3) Infrastructure and Supply Chain Connectivity

During the 2021-2024 period, seaports in Central Vietnam exhibited a clear shift toward sustainable development and regional integration, particularly in digital transformation, collaboration, and logistics service chain connectivity. Given the complex security and defense developments in the East Sea, ports such as Da Nang (near the Hoang Sa fishing grounds) and Cam Ranh, Khanh Hoa (near the Truong Sa fishing grounds) have acquired additional national strategic significance. An efficient maritime logistics system has supported vessels and fishermen to remain at sea for extended periods, maintaining a civilian presence in sovereign waters, thereby reinforcing national security and affirming Vietnam's territorial sovereignty.

(4) Strategy, Planning, and Human Resources

First, Strategy and Planning:

Since 2021, Nghi Son (Thanh Hoa), Da Nang, and Cam Ranh (Khanh Hoa) ports have issued digital transformation strategies for 2021-2025, with a vision toward 2030, emphasizing: enhancing management and operational capacity based on digital platforms; investing in modern logistics infrastructure and technology; establishing and annually consolidating Digital Transformation Steering Committees.

Second, Human Resources:

Nghi Son Port is in the process of restructuring its workforce and gradually training digital personnel to operate smart management systems and logistics management software. Da Nang Port focuses on developing a skilled handling workforce, collaborating with Tan Cang STC to train staff on advanced equipment operation (QCC cranes, RTG cranes, automated cranes). This has enabled the workforce to master modern technology and equipment, moving toward a "green port - smart port" model. Cam Ranh Port emphasizes improving the quality and specialization of human resources, particularly managers, technicians, and customer service staff.

3.3.1.2. Warehousing and Cargo Storage Services

(1) Level of Digitalization

At Nghi Son Port, since 2020, all warehousing enterprises have adopted Warehouse Management Software (WMS), connected online to Customs via the Automated Cargo Monitoring System (VASSCM).

At Da Nang Port, the CFS warehouse, bonded warehouse, cold storage, and container yard are centrally managed through EPort-CFS and WMS integrated with ERP. Warehouse data is synchronized across the port, logistics enterprises, customs, and customers, establishing the first "Digital Port-Warehouse-Customs" model in Central Vietnam.

(2) Operational Efficiency

+ Productivity and Service Quality: Da Nang Port achieves the highest efficiency by fully integrating the EPort-CFS platform, converting warehouse operations from manual to fully electronic processes, increasing handling productivity by over 30% compared to 2018-2020. Nghi Son Port has developed an automated warehouse management system but still relies heavily on individual enterprise operation capabilities, with incomplete data connectivity. Cam Ranh Port is at the initial stage of automation but has improved storage accuracy, particularly for exported seafood.

+ Time and Operational Flexibility: Digital technology applications reduce cargo handling time by 25-40% at all three ports, alleviating congestion and accelerating container turnover.

+ Economic Efficiency and Costs: All ports report a 10-20% reduction in warehouse operation costs, mainly due to automation and reduced manual labor requirements.

(3) Infrastructure and Supply Chain Connectivity

Table 3.12. Assessment of Infrastructure and Supply Chain Connectivity for Warehousing and Cargo Storage Services at Central Vietnam Ports, 2018-2024

Criteria	Nghi Son Port	Da Nang Port	Cam Ranh Port
Linkage with industrial zones/production centers	Strong (directly linked to Nghi Son Economic Zone)	Strong (linked to Hoa Khanh, Lien Chieu, Chu Lai, Phu Bai industrial zones)	Trung bình (gắn KCN Suối Dầu)
Warehouse system and hinterland ICDs	No ICD, centralized warehouses within the EZ	Has ICD Hoa Nhon, regional scale	No official ICD
Digital connectivity within the supply chain	Yes, via VASSCM and customs connectivity	Comprehensive (EPort - CFS - electronic customs)	Basic level of digital integration
Level of regional logistics integration	Medium-High	Highest in Central Vietnam	Medium
Potential for expanding connectivity	High (linked to Thanh Hoa - Nghe An industrial corridor)	Very high (Lien Chieu Port expansion)	High (linked to the South Central Vietnam corridor)

Source: Compiled by the author

The state of warehousing and cargo storage from 2018 to 2024 at Central Vietnam's seaports indicates that Da Nang Port achieved the highest level of infrastructure and supply chain connectivity, supported by its multimodal logistics infrastructure, a fully developed ICD system, and an integrated data platform linking all actors in the chain. Cam Ranh Port benefits from a strategic location and favorable transport access, but its logistics infrastructure remains underdeveloped, with a short and fragmented supply chain. Nevertheless, it represents a significant potential, given that the southcentral region is targeted for regional logistics development by 2030.

(4) Strategy, planning, and human resources:

The 2018-2024 period laid the strategic foundation and initiated the development of human resources for digital transformation in warehousing at Central Vietnam ports. Da Nang leads in strategy, planning, and standardized training programs. Nghi Son benefits from production-logistics connectivity but requires further development of ICD facilities and specialized personnel. Cam Ranh shows strong potential but lacks IT-logistics expertise and supporting infrastructure. To fully harness the benefits of digital transformation, coordinated policies are needed, encompassing strategic planning, training support, education, enterprise cooperation models, and incentives for logistics infrastructure investment.

3.3.1.3. Cargo Handling Services

(1) Level of digitalization

Da Nang Port achieved the highest level, approaching the "Smart Port" model recommended by ESCAP and UNCTAD, through the full integration of multiple digital platforms (EPort, Smartgate, eCPS, eTractor, RPA). Nghi Son Port has initiated EPort implementation and online data management, but automation remains limited, mainly in administrative and vehicle coordination functions. Cam Ranh Port is at a basic level of digitalization, deploying EPort and an electronic container management system, yet integration of AI and RPA is still minimal due to a smaller operational scale and insufficient cargo volume to justify full automation optimization.

(2) Operational efficiency

The 2018-2024 period marked a significant improvement in cargo handling efficiency at Central Vietnam's ports. Through digital technology adoption, ports achieved higher productivity, reduced costs, enhanced safety and service quality, shortened procedural times, and improved vessel and equipment turnaround. These improvements also stimulated the broader logistics and ancillary industries in the Central region, progressively moving toward a smart port model.

(3) Infrastructure and supply chain connectivity

+ Multimodal transport integration: All ports are connected to road, rail, and air networks, facilitating both domestic and international cargo flows.

+ Data integration and supply chain digitalization: The EPort-Smartgate-TOS system is linked to e-customs, creating a unified information-sharing platform.

+ Smart logistics network development: Ports, enterprises, and regulatory authorities are progressively operating on a digital platform, reducing time, costs, and operational errors.

(4) Strategy, planning, and human resources

The strategy and planning of cargo handling services in Central Vietnam ports have been shaped with a digital and environmentally friendly orientation. Da Nang leads technologically; Nghi Son and Cam Ranh leverage strategic locations and are investing in equipment to expand capacity. However, the main challenge

lies not in equipment but in the digital workforce - there is a shortage of high-skilled personnel and a supporting training ecosystem, alongside financial and system integration risks. Transitioning from a "digitized port" to a "sustainably operated smart port" requires a coordinated action plan: standardized data, investment roadmap, funding models, and structured training programs with clear KPIs, alongside mechanisms to attract high-tech talent.

3.3.1.4. Customs Clearance Services

(1) Level of digitalization

Overall, the digitalization of customs clearance services at the three representative Central Vietnam ports has advanced from Level 1-2 (partial process digitization) before 2018 to Level 3-4 (full process digitization, data integration, and high automation) during 2021-2024. Da Nang Port currently leads the region in completeness, while Nghi Son and Cam Ranh are expanding connectivity to other logistics services such as transport, warehousing, and electronic payment.

(2) Operational efficiency

First, significantly reduced clearance time. *Second,* lower logistics costs and improved port operational efficiency. *Third*, enhanced transparency and reduced procedural risks. *Fourth*, increased customs throughput and data processing capacity. *Fifth*, strengthened regional competitiveness and integration capability.

Digital customer experience results for customs clearance services via the EPort system at Da Nang Port are stable, with all customer experience indicators achieving 100%, see Table 3.13.

Table 3.13. Digital customer experience results for customs clearance services via EPort at Da Nang Port, 2023

No.	Category	Unit of Measurement	Quantity	Proportion
1	Number of customers making online (cashless) payments via Momo e-wallet and Napas payment system	%	374	100%
2	Number of customers completing electronic customs clearance on EPort	%	374	100%

Source: Author's synthesis from the 2023 Annual Report of Da Nang Port Joint Stock Company

(3) Infrastructure and Supply Chain Connectivity

First, technical and technological infrastructure connectivity: Central Vietnam's seaports, particularly Da Nang, Nghi Son, and Cam Ranh, have proactively invested in technological infrastructure to ensure real-time, secure, and synchronized data exchange with customs authorities and third-party logistics actors.

Second, connectivity between customs authorities, ports, and logistics enterprises: The regional logistics supply chain has established a three-tier connection structure: (i) electronic government management, (ii) logistics enterprises, and (iii) port and warehouse systems, aiming for a "single-window, multi-point processing" model.

Third, value chain integration in transport, warehousing, and cargo handling: Positive results have been achieved in linking operations across transport, storage, and cargo delivery.

(4) Strategy, Planning, and Human Resources

+ Strategy and planning: Central Vietnam ports have developed digitalization roadmaps and smart customs strategies, integrating environmental considerations (green logistics), digital connectivity, and customer experience optimization.

+ Human resources: Staff are professionally trained, applying modern technology and data management, with performance policies and KPIs ensuring operational continuity and capacity for improvement.

3.3.2. Limitations

First, operational capacity remains uneven across ports.

Second, the application of digital technologies is still at a basic level.

Third, coordination efficiency and regional connectivity remain limited.

Fourth, infrastructure supporting digital transformation is not yet fully synchronized or developed.

Fifth, investment resources for digital transformation remain constrained, and disbursement progress is slow.

Sixth, there is a shortage of high-quality human resources to support enterprise digital transformation.

3.3.3. Causes of Limitations

3.3.3.1. Objective Causes

First, geopolitical fluctuations and global market instability in 2024 have significantly impacted maritime supply chains.

Second, prolonged drought at the Panama Canal has reduced vessel traffic, coupled with a global trade slowdown and weak domestic demand.

Third, container throughput remains low and unstable.

Fourth, while digital transformation is rapidly advancing globally, Vietnam only began its systematic adoption in 2018, resulting in delays in establishing institutional frameworks and data infrastructure.

3.3.3.2. Subjective Causes

First, local logistics digital transformation plans and strategies remain underdeveloped, lacking measurable targets and tailored implementation mechanisms for each port, leading to low execution efficiency.

Second, awareness of the role and importance of digital transformation is insufficient among both management and enterprises.

Third, data sharing and integration among supply chain actors are limited.

Fourth, infrastructure remains inadequate.

Fifth, resources for service quality improvement are constrained.

Sixth, collaboration between educational institutions and enterprises in digital transformation is weak.

Chapter 3 Summary

During the 2018-2024 period, Central Vietnam's seaports made significant progress in digital transformation, contributing to the modernization of logistics services. All four key service areas recorded improvements: maritime transport applied online management systems to optimize vessel schedules, though international connectivity remains limited; warehousing implemented WMS and ERP systems, enhancing storage efficiency, but digital data infrastructure and skilled human resources remain unsynchronized; cargo handling processes and equipment were digitized, yet technical capacity at certain ports, such as Cam Ranh, still falls short of operational requirements; customs procedures deployed VNACCS/VCIS, EPort, and the National Single Window, reducing clearance times, although automation levels vary across ports. Overall, a digital logistics ecosystem has begun to take shape, but gaps remain in digital infrastructure, data integration, human resources, and regional connectivity. These barriers constrain the efficiency of digital transformation and the competitiveness of the Central Vietnam port cluster, necessitating continued institutional development, workforce enhancement, and investment in digital infrastructure in the coming period.

Chapter 4
PERSPECTIVES AND SOLUTIONS TO ENHANCE LOGISTICS SERVICE QUALITY AT CENTRAL VIETNAM SEAPORTS IN THE CONTEXT OF DIGITAL TRANSFORMATION

4.1. FORECASTED TRENDS, OBJECTIVES, AND PERSPECTIVES FOR ENHANCING LOGISTICS SERVICE QUALITY AT CENTRAL VIETNAM SEAPORTS BY 2030, WITH A VISION TOWARD 2045

4.1.1. Forecast of Logistics Service Development Trends at Central Vietnam Seaports to 2030, Vision to 2045

4.1.1.1. International and Domestic Contexts Affecting Logistics Services in Central Vietnam Seaports under Digital Transformation

First, international context: (1) Global geopolitical instability and the restructuring of global trade; (2) Slow but positive global economic recovery; (3) Emergence of new requirements in global supply chains; (4) Growth of digital economies, digital logistics, and FDI attraction is reshaping capital flows; (5) Deep regional economic integration and the increasing prominence of trade agreements.

Second, domestic context: (1) Post-COVID-19 economic recovery is stimulating logistics demand; (2) Establishment of the Da Nang Free Trade Zone as a new driver for seaport logistics; (3) Development of the national seaport system and fleet provides a foundation for logistics service expansion at seaports.

4.1.1.2. Forecasted Trends

(1) Basis and Forecasting Methods

First, Global Digital Transformation Trends in Logistics and Seaports:

+ Digital transformation in logistics and maritime transport is a global trend, reflected in smart ports, digital logistics, IoT, CPS and robotics, Big Data, AI, Blockchain, Cloud platforms, and green logistics.

+ International standards (IMO regulations, next-generation FTAs, security and safety standards,

environmental protection, data transparency) are expected to continue raising requirements for supply chain digitalization, compelling Vietnamese ports - including Central Vietnam seaports - to accelerate digital transformation to maintain and enhance their positions in global supply chains.

Second, Institutional and Policy Basis:

On 22 December 2024, the Politburo issued Resolution No. 57-NQ/TW on breakthrough development in science, technology, innovation, and national digital transformation. On 24 January 2025, Resolution No. 59-NQ/TW was issued on international integration under the new context. On 30 April 2025, Resolution No. 66-NQ/TW was issued on innovating law-making and enforcement to meet development requirements in the new era. On 4 May 2025, Resolution No. 68-NQ/TW was issued on private sector development. Additionally, regional administrative reorganization and spatial development strategies provide a basis for planning logistics infrastructure.

Third, Approach and Forecasting Methods: Systemic and value-chain approach; Combined qualitative and quantitative forecasting methods.

(2) Forecasted Trends in Digital Transformation of Logistics Services at Central Vietnam Seaports to 2030, Vision to 2045

First, digital transformation will inevitably lead to the emergence of smart port models and the "Automated Port - Smart Warehouse - Autonomous Vehicle" supply chain.

Second, development of integrated digital logistics platforms and interregional digital logistics ecosystems.

Third, logistics management will be driven by big data, artificial intelligence, and core enabling technologies.

Table 4.1 illustrates prominent technologies currently applied or with high potential for application in port logistics operations under digital transformation.

Table 4.1. Selected Prominent Technologies in the Context of Digital Transformation Applied in Logistics Operations at Seaports

No.	Technology	Application
1	IoT Platforms	Smart Containers
		Unmanned Ships
		Echodrone
2	Cyber-Physical Systems (CPS) & Autonomous Robots	Unmanned Ships
		Automated Ships
		Echodrone
		Automated Cargo Handling Systems
		Automated Container Cranes
3	Big Data	Automatic Identification System (AIS)
		Iamport App
		AI Tools - ETA Prediction, Decision Support Systems (DSS), Maritime Risk Forecasting
4	Cloud-Based Support Systems	AI Tools - ETA Prediction, Decision Support Systems (DSS), Maritime Risk Forecasting
5	Blockchain	Blockchain Platforms (Blockfreight và Tmining)

Source: Compiled by the author

Fourth, orientation toward green logistics and sustainable logistics in the digital environment.

(3) Forecasted impacts of strategic Resolutions and administrative boundary adjustments on logistics development at Central Vietnam seaports

In the context of profound digital transformation, the synchronized implementation of key Resolutions - No. 57-NQ/TW, No. 59-NQ/TW, No. 66-NQ/TW, No. 68-NQ/TW - along with the administrative boundary reorganization process, is forecasted to generate both opportunities and challenges for the development of logistics services at seaports in Central Vietnam.

4.1.2. Development objectives for logistics services at Central Vietnam seaports by 2030

General objectives:

First, the develop a synchronized, modern seaport system providing high-quality services to meet socio-economic development demands, ensure national defense and security, maritime safety, and environmental protection, while enhancing the economy's competitive capacity. *Second*, the develop a seaport system at regional and global standards, complying with green port criteria, effectively supporting national

socio-economic development, serving as a strategic pillar and driving force for the maritime economy.

Specific objectives:

To realize the national goal of a synchronized, modern seaport system by 2030, including 36 ports and handling cargo throughput between 1,322 and 1,589 million tons, Central Vietnam's seaports are planned into two main groups: *The Group 1* - North Central Coast ports: Thanh Hoa, Nghe An, Ha Tinh, Quang Tri, and Hue, with a projected cargo throughput of 172-255 million tons by 2030. *The Group 2* - South Central Coast ports: Da Nang (including the Hoang Sa special zone), Quang Ngai, Gia Lai, Dak Lak, Khanh Hoa (including the Truong Sa special zone), and Lam Dong, targeting a cargo throughput of 138-181 million tons by 2030.

4.1.3. Perspectives on enhancing the quality of logistics services at Central Vietnam seaports by 2030, with a vision toward 2045

First, position Vietnam as a maritime power and leverage wealth from the sea.

Second, the plan is to develop Thanh Hoa, Da Nang, and Khanh Hoa seaports as special strategic ports.

Third, improve the efficiency of the seaport system, coastal economic zones, and industrial parks.

Fourth, enhance the business environment and competitiveness of logistics services.

Fifth, direct review and continuous improvement of policies and legal frameworks related to seaport logistics services.

Sixth, consider preferential issuance mechanisms and policies to facilitate the development of Central Vietnam seaport logistics enterprises.

Seventh, invest in synchronized infrastructure with high connectivity among maritime, road, rail, and air transport networks.

4.2. SOLUTIONS TO ENHANCE THE QUALITY OF LOGISTICS SERVICES AT CENTRAL VIETNAM SEAPORTS IN THE CONTEXT OF DIGITAL TRANSFORMATION

4.2.1. Solutions for State Management Agencies

4.2.1.1. Improve the legal framework for logistics services development at seaports, adapted to the digital transformation context

First, review, systematize, and amend legal documents related to seaport logistics services.

Second, complete legislation on research, application, technology transfer, and digital transformation in logistics.

Third, develop a long-term digital transformation strategy for logistics services at Central Vietnam seaports, aligned with the Vietnam Logistics Development Strategy.

Fourth, to ensure vertical consistency within the legal system.

4.2.1.2. Focus on investment and construction of modern, synchronized digital infrastructure

First, prioritize investment in telecommunications and information technology infrastructure to serve seaport logistics.

Second, integrate telecommunications and IT infrastructure with physical-technical logistics infrastructure at seaports.

Third, mobilize social resources to accelerate investment in logistics services at Central Vietnam seaports.

4.2.1.3 Develop and complete financial and credit policies to enhance capital accessibility and absorption

First, issue preferential policies on taxes and land for logistics service enterprises at Central Vietnam seaports investing in digital transformation.

Second, provide credit and interest rate support.

Third, support logistics technology startups.

4.2.1.4. Promote enterprise technology investment and partnerships with international technology providers

First, establish policies to encourage comprehensive technology investment.

Second, promote strategic cooperation between seaport logistics service enterprises and IT companies.

Third, support Central Vietnam seaport logistics enterprises in connecting with international partners.

4.2.1.5. Improve institutions and organize regional logistics service linkage in Central Vietnam

First, establish a regional shared digital logistics platform.

Second, improve the institutional framework for regional logistics coordination based on digital platforms.

Third, promote the development of local logistics service enterprises through digitalization-based platforms.

4.2.1.6. Strengthen inspection, control, and handling of violations in logistics service management linked to digital transformation

First, establish a centralized digital management platform.

Second, upgrade online public service software systems.

Third, review investment progress and deployment of maritime traffic monitoring and coordination systems (VTS) at Central Vietnam seaports; upgrade the Automatic Identification System (AIS) integrated with satellite AIS (S-AIS) data.

Fourth, deploy automatic vehicle identification and control systems (cameras, RFID, sensors, etc.) to monitor port entry-exit, vehicle flow, and support traffic management and security.

Fifth, apply strict sanctions for violations in logistics service management and operation, particularly in compliance with digital processes and data sharing.

4.2.2. Solutions for Logistics Service Enterprises at Seaports

4.2.2.1. Develop a clear vision, objectives, and digital transformation strategy for the enterprise

First, define a digital transformation vision aligned with regional advantages, such as agro-aquatic logistics, transshipment logistics linking the Central - Central Highlands region and the East - West Economic Corridor, as well as green logistics and flexible-scale digital logistics.

Second, specify phased, feasible objectives (customer experience, internal operations, cost optimization, productivity improvement).

Third, build a digital transformation strategy according to a clear roadmap.

4.2.2.2. Investment and Modernization of Infrastructure and Exploitation Technology

First, prioritize the modernization of container-handling equipment, specialized warehousing systems (including cold storage and export-oriented agro-aquatic product warehouses), and real-time operational monitoring systems to reduce vessel and container turnaround times.

Second, implement specialized management software (WMS, TMS, dispatching systems, and electronic service portals) to enhance transparency and improve customers' ability to track and access information.

Third, gradually integrate ERP systems and connect them with E-Port, EDI, and electronic customs systems to reduce document-processing costs, in line with the characteristics of the region's numerous small and medium-sized logistics enterprises.

Fourth, encourage the adoption of cloud platforms and outsourced services (SaaS) to lower initial investment costs and enhance scalability in accordance with cargo volume demand.

***4.2.2.3.* Build a logistics enterprise network linked with e-commerce and multimodal transport**

First, connect seaport logistics service enterprises - customers, shipping lines - cargo owners, transport units within a digital environment.

Second, deploy EDI and electronic data exchange platforms, learning from Singapore and Japan models in maritime transport and multimodal logistics management.

Third, develop multimodal transport combined with shared-economy models: reduce empty container return rates; increase vehicle utilization, and reduce total logistics costs across the supply chain.

4.2.2.4. Human Resource Management and Digital Enterprise Culture Transformation

First, in recruitment, enterprises should rejuvenate their workforce, prioritize candidates with IT skills, foreign language proficiency, and digital thinking, and incorporate "digital competency" as a recruitment criterion.

Second, in managerial staffing planning: prioritize individuals with digital vision, understanding of corporate culture, willingness to innovate, and readiness to lead digital transformation; ensure strict, transparent selection and planning processes to prevent malpractices.

Third, in management using BSC-KPI: apply balanced scorecards and KPIs linked to digital transformation objectives (processing time, electronic record rate, customer satisfaction, etc.); connect digital transformation results with staff evaluation and reward systems.

4.2.2.5. Training and Development of Internal Human Resources

First, organize regular training for staff on digital system usage (E-Port, TMS, WMS, ERP, electronic customs), data skills, understanding and using analytical reports and dashboards; knowledge on green logistics, carbon management, and international standards.

Second, expand training cooperation with educational institutions, sending staff for short- and long-term courses domestically and internationally.

Third, promote the "learning within the enterprise" model: skilled experts and engineers directly train new employees and interns.

4.2.3. Solutions for Training Logistics Human Resources at Seaports

4.2.3.1. Upgrade Facilities and Training Programs Linked with Digitalization

First, invest in labs and simulation equipment for warehouse management, transportation, cargo handling, and port scheduling for training students and specialists.

Second, update training programs towards Digital Logistics Services - Seaport Logistics Services, integrating content on TOS, PCS, IoT, Big Data, AI, Blockchain, and global supply chain risk management into the curriculum.

Third, key universities such as the University of Da Nang, Hue University, Vinh University, and Quy Nhon University should serve as regional training hubs.

4.2.3.2. Strengthening University-Enterprise Linkages in Training Logistics Human Resources at Central Vietnam Seaports

First, it is necessary to develop co-designed training programs in collaboration with enterprises.

Second, universities and enterprises should coordinate to organize seminars, workshops, and applied research activities; share data and practical case studies from Nghi Son Port, Da Nang Port, Cam Ranh Port, and others.

Third, a sustainable financial mechanism for training should be established, linking training programs to enterprise demand.

Fourth, internship, site visits, and practical experience programs for students and new laborers should be expanded.

4.2.3.3. Enhancing the Quality of Academic Staff and Student Support Systems

Lecturers must be trained and thoroughly master the core digital skill set required for logistics service workers at seaports before instructing specialized students. In addition, universities should strengthen the role of relevant Departments and Centers for Student Support and Enterprise Relations to connect students with enterprises, creating opportunities for internships, employment, and scholarships.

4.2.3.4. Learning from Advanced Training Advisory Models and Promoting Innovative Startups

Study advanced global logistics training models, such as logistics training advisory boards (e.g., Aus4Skills), and develop occupational and skill standards for the sector. In addition, it is necessary to regularly organize competitions and startup programs in digital logistics services in Central Vietnam, fostering a new generation of entrepreneurs and startups in innovative logistics technologies.

4.2.3.5. For Workers Directly Participating in Logistics Services at Seaports

First, workers need to acquire foundational knowledge and a mindset in digital transformation and modern logistics.

Second, develop digital competencies and professional skill sets in accordance with the digital era requirements, targeting core groups of skills: *basic digital skills, advanced digital skills by role, and complementary soft skills.*

Third, workers should build clear career pathways to motivate performance in the context of digital transformation, aligned with skill standards and digital competency levels.

Chapter 4 Summary

Chapter 4 develops a forecast for the development of logistics services at Central Vietnam seaports based on scientific evidence, the national digital transformation policy framework, and Resolutions 57, 59, 66, and 68. The results indicate that digital transformation will serve as the main driving force through 2030, with

a vision toward 2045, highlighting trends such as smart port formation, automation of operations, development of a regionally integrated digital logistics ecosystem, application of big data and AI, shaping digital logistics business models, and promoting green logistics. Based on forecasts and practical limitations across four core service groups, the chapter proposes solutions targeting four main stakeholders: regulatory authorities, enterprises, training institutions, and workers.

CONCLUSION

During the period 2018-2024, logistics services at seaports in Central Vietnam have undergone a comprehensive digital transformation to enhance service quality within the digitalization context. The current state of digital transformation in logistics services at these ports has achieved preliminary results; however, the accomplishments remain disproportionate to the region's potential, local advantages have not been fully leveraged, and the pace of digitalization is still slow. Based on the assessment of logistics services at Central Vietnam's seaports from 2018 to 2024 in the context of digital transformation, the dissertation has accomplished the following key contributions: *First*, it systematized and clarified the main theoretical issues related to logistics services at Central Vietnam's seaports. Notably, the dissertation proposed a conceptual framework for logistics services in the digital transformation context, identifying the requirements for logistics services under digitalization, as well as the roles, contents, evaluation criteria, and influencing factors affecting these services. *Second*, it analyzed and assessed the actual status of logistics services at seaports during 2018-2024, clarifying achievements, limitations, and the underlying causes of these limitations, thereby identifying critical issues that require resolution. *Third*, the dissertation synthesized seven fundamental viewpoints and four groups of development solutions for logistics services at Central Vietnam's seaports toward 2030. The proposed viewpoints and solutions comprehensively address the creation of a conducive political, economic, and social environment, as well as the mobilization of resources and methods to promote logistics service development at these seaports within the digital transformation context.

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