

Digital Transformation and Improving the Effectiveness of State Management of Marine Economic Development: International Experience and Implications for Vietnam

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ABSTRACT: In the context of the Fourth Industrial Revolution, digital transformation has become an inevitable trend, profoundly impacting public administration and marine economic development. The study analyzes the relationship between digital transformation and the effectiveness of state management of the marine economy in Vietnam. It refers to international experience from the European Union, Singapore, China, and some other countries. The results show that Vietnam has made progress in digitalizing marine management through the vessel monitoring system, fisheries database, and GIS application in marine spatial planning. However, the implementation process still faces many challenges, such as scattered data, unsynchronized digital infrastructure, limited human resources, and inter-sectoral coordination mechanisms. Based on international experience, the study proposes six policy implications for Vietnam, including improving legal institutions, building a national interconnected marine database, investing in digital infrastructure, developing digital human resources, promoting public-private and international cooperation, with increased transparency and accountability. These suggestions contribute to the realization of the goal of sustainable development of the marine economy in the digital age.

KEYWORDS: State management, digital transformation, marine economy, sustainable development, public policy

1. INTRODUCTION

The Fourth Industrial Revolution is taking place strongly, and digital transformation has a profound impact on all areas of economic and social life. For Vietnam, digital transformation is an important driving force to promote growth model innovation, a strategic solution to improve the effectiveness of state management and national competitiveness. In the field of marine economic development, the application of digital technology, big data, artificial intelligence (AI), Internet of Things (IoT), and modern digital platforms is opening up many opportunities to optimize management, improve exploitation efficiency, protect resources, and develop sustainably in the direction of modernization and integration (Do et al., 2022).

Vietnam is a coastal country with more than 3,260 km of coastline. The marine economy and related industries account for an important proportion of the national economic structure, contributing about 47-48% of the GDP of coastal provinces and cities. Resolution No. 36-NQ/TW of 2018 of the Central Executive Committee has set the goal that by 2030, Vietnam must become a strong maritime nation, rich from the sea, emphasizing the central role of state management and the requirement to modernize management methods associated with the national digital transformation process. In reality, state management of the marine economy still has many limitations, such as a lack of institutional synchronization, scattered data, an unmet digital infrastructure, management of human resources that have not kept up with technological development, and inadequate inter-sectoral coordination mechanisms (Nguyen & Le, 2025).

Many developed countries in the world have made great strides in applying digital transformation to marine economic management. The European Union (EU) has built an open ocean data system to integrate, share, and effectively exploit information sources on the sea; Singapore develops a Smart Port model with the ability to manage and coordinate maritime transport based on real-time data; China applies artificial intelligence and big data in marine spatial planning and marine environmental monitoring. The models have demonstrated that digital transformation aims to improve the effectiveness of state management, create conditions for sustainable development of the marine economy, and, at the same time, enhance transparency, accountability, and participation of stakeholders (Bellantuono et al., 2021).

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In that context, the study of the impact of digital transformation on state management in marine economic development in Vietnam aims to find feasible, effective, and practical solutions. The study was conducted to analyze the relationship between digital transformation and the effectiveness of state management in the field of marine economic development, based on referring to and comparing international experience, drawing policy implications that are valuable for Vietnam in the process of building and implementing a strategy for sustainable development of the marine economy (Alvarenga et al., 2020).

The study raised three questions: (1) How does digital transformation affect state management of marine economic development? (2) What international experiences can be referred to improve management efficiency in the context of digitalization? (3) What policy implications are necessary for Vietnam to realize the goal of sustainable development of the marine economy in the digital age? Answering these questions has scientific significance in supplementing theories on public administration in the context of digitalization, and has profound practical significance in providing arguments for policy making for marine economic development in Vietnam in the coming time.

2. THEORETICAL BASIS AND RESEARCH OVERVIEW

2.1. Theoretical Basis

Concept of state management of the marine economy

State management of the marine economy is the entire organized and powerful activities of the State in formulating, promulgating, organizing implementation, inspecting, and supervising policies and laws to orient, regulate, and promote sustainable development of marine economic activities. State management includes administrative and legal aspects; modern management functions such as strategic planning, inter-sectoral coordination, provision of public services, environmental monitoring, and ensuring security and defense at sea.

Concept of digital transformation in public management

Digital transformation in public management is the process of systematically applying digital technologies (AI, big data, blockchain, IoT, cloud computing) to management activities, aiming to improve efficiency, transparency, decision-making ability, and the level of participation of people and businesses. In the field of marine economy, digital transformation is demonstrated through the construction of ocean databases, satellite ship monitoring systems, smart port management, integration of online logistics services, or digital-based marine spatial planning.

Basic theories

First, the New Public Management Theory (NPM) emphasizes the role of efficiency, competitiveness, technology application, and private sector participation in public service provision. Digital transformation in marine economic management clearly reflects the New Public Management philosophy when the State controls and creates conditions for social actors to participate.

Second, the Digital-era Governance Theory (DEG) argues that modern public management should be based on open data, interconnectivity, and comprehensive digital solutions. In marine economic management, Digital-era Governance is demonstrated through the use of interdisciplinary data platforms on oceanography, environment, exploitation, and maritime transport.

Third, Sustainable Development Theory provides a basis for considering marine economic management to achieve economic growth, ensure environmental balance, social equity, and future generation benefits. Digital transformation becomes an important tool to realize sustainable development, through optimizing exploitation, minimizing environmental risk, and monitoring the efficiency of resource use.

Thus, the theoretical basis for the study is built on the combination of New Public Management, Digital-era Governance, and sustainable development theory, in which digital transformation is considered a driving factor for innovation in the state management model of the marine economy.

2.2. Research Overview

There have been many studies and applications of digital technology in marine management. The European Union (EU) implements the “Blue Growth” policy, emphasizing the role of digital data in the sustainable development of the marine economy. The European Marine Observation and Data Network (EMODnet) system allows the collection, sharing, and exploitation of oceanographic data from many member countries, contributing to decision support in fisheries resource management, marine spatial planning, and environmental monitoring. The European Marine Observation and Data Network has improved transparency, saved research costs, and enhanced cross-border cooperation.

Singapore stands out with its “Smart Port” model, a smart seaport operated based on real-time data. According to the Maritime and Port Authority of Singapore, the application of AI and IoT technology helps ports achieve high operational efficiency, reduce congestion, optimize logistics, and enhance maritime safety monitoring capabilities. The success is achieved thanks to the combination of a flexible legal framework, investment in modern technology, and the development of high-quality human resources.

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China is a country that actively applies digital transformation in Marine Spatial Planning (MSP). The use of big data, remote sensing, and AI has supported Chinese maritime management agencies in closely monitoring resource exploitation activities while minimizing conflicts of interest between sectors. China has invested in building a marine disaster early warning system based on big data, contributing to protecting the safety of residents and coastal infrastructure.

In addition, many studies in Korea, Japan, and the United States have applied digital technology in seaport management, environmental monitoring, and sustainable development of the marine industry. The common point is that these countries consider digital transformation an important pillar to improve the efficiency of state management, while promoting transparency, accountability, and public-private cooperation.

Many studies on marine economic management have focused on aspects including the exploitation and protection of marine resources, sustainable development strategies for the marine economy, and integrated management of marine resources and the environment. However, these studies mainly follow the traditional approach, without an in-depth analysis of the relationship between state management of the marine economy and the digital transformation process (Fyshchuk & Evsyukova, 2020).

Some research mentions the digitalization trend in marine management, the application of remote sensing and GIS in monitoring coastal resources, and the development of digital government in maritime industry management. However, these studies are still fragmented, lacking in systematization, and have not formed a comprehensive analytical framework on the role of digital transformation in improving the effectiveness of state management of marine economic development.

An overview of international studies has shown many successful models in applying digital transformation to marine management, but there have not been many comparative studies and lessons for Vietnam. In Vietnam, research focuses on the aspects of resource management, environment, and marine economic development, while the digital transformation factor is mentioned at the level of technical tools, not yet linked to the theoretical framework of public administration and sustainable development (Tan & Pan, 2003). The current research gap is determining the mechanism for integrating digital transformation into state management, including institutions, digital infrastructure, human resource development, and international cooperation. This research aims to fill the theoretical and practical gap through analyzing the relationship between digital transformation and the effectiveness of state management of marine economic development, and at the same time, drawing policy implications for Vietnam from international experience (Oliinyk, 2024).

3. RESEARCH METHOD

The paper uses a qualitative research approach combined with comparative policy analysis to clarify the role of digital transformation in improving the effectiveness of state management of marine economic development, while drawing valuable international lessons for Vietnam.

The paper analyzes secondary documents by synthesizing and processing data sources from reports of the United Nations (UNDP, UNEP), the World Bank, the Organization for Economic Cooperation and Development (OECD), academic studies, documents, laws and current policies of Vietnam (Law of the Sea 2012, Resolution 36-NQ/TW in 2018, National Digital Transformation Strategy to 2030).

The study uses content analysis to systematize and generalize the main arguments related to digital transformation and state management in the marine economy. The study identifies key trends, opportunities, and challenges in the digitalization process of marine economic management.

Applying a comparative analysis method between Vietnam and several typical countries and territories, such as the European Union (EMODnet, Blue Growth), Singapore (Smart Port), and China (Marine Spatial Planning applying AI and big data). The selection of these cases aims to ensure diversity in governance models, economic development level, and digital transformation application strategies.

The analysis results are synthesized to provide policy implications for Vietnam, with an orientation that is both based on a scientific basis and consistent with national practice, thereby contributing to the policy-making process and state management of marine economic development in the context of digital transformation.

4. CURRENT STATUS OF STATE MANAGEMENT OF MARINE ECONOMIC DEVELOPMENT IN VIETNAM IN THE CONTEXT OF DIGITAL TRANSFORMATION

4.1. Current Legal Framework and Policies

Over the past years, Vietnam has issued many important legal documents and strategies to orient the development of the marine economy in line with modern state management requirements. The 2012 Law of the Sea of Vietnam is a fundamental legal document, affirming national sovereignty, sovereign rights and jurisdiction at sea, and clearly defining the functions of state management of resources, environment, security, defense, and marine economic activities. The Law of the Sea has created an important legal basis for the implementation of activities to exploit, protect, and sustainably use marine resources, associated with the obligation to protect the environment and develop the national economy (Tuyen et al., 2025).

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Resolution No. 36-NQ/TW dated October 22, 2018, of the 12th Party Central Committee on “Vietnam’s sustainable marine economic development strategy to 2030, with a vision to 2045” has identified the strategic goal of turning Vietnam into a strong maritime nation, rich from the sea. The Resolution emphasizes the need to innovate management methods, modernize infrastructure, apply science and technology, and use digital technology in exploiting and protecting the sea. It is considered an important shift in management thinking, demonstrating the connection between the marine economic development goal and the national digital transformation process.

Many related programs, projects, and policies have been issued, including the National Digital Transformation Strategy to 2030, the Green Growth Strategy, and plans for the development of the maritime, fisheries, and marine tourism industries. However, the documents still lack coherence and synchronization in implementation, leading to low management efficiency.

4.2. Applying Digital Transformation in Marine Economic Management

In recent years, Vietnam has initially applied digital technologies to state management in the field of marine economy, focusing on several important areas

First, vessel management and maritime safety. The Vessel Monitoring System (VMS) was deployed as required by the Fisheries Law 2017, allowing authorities to monitor the activities of tens of thousands of fishing vessels at sea via satellite signals. This helps limit illegal fishing and, at the same time, improve the ability to rescue and search at sea. In the maritime sector, some major ports such as Hai Phong and Cai Mep - Thi Vai have applied electronic seaport management software, supporting customs procedures and logistics.

Second, monitoring seafood exploitation and protecting resources. The Ministry of Agriculture and Environment has deployed a national fisheries database system, combined with remote sensing and GIS technology, to monitor fishing areas. Some coastal localities have piloted the application of electronic seafood logging management software, helping to reduce fraud and increase transparency in the seafood supply chain.

Third, marine spatial planning. Vietnam has initially applied GIS technology, remote sensing, and digital data to build marine spatial planning maps, serving the allocation and coordination of economic sectors such as oil and gas, fisheries, tourism, transportation, and marine conservation. Vietnam is building an integrated database system on marine resources and environment, considering this as the foundation for digital management in the future. Digital transformation applications show that Vietnam is gradually penetrating marine economic management activities, contributing to improving management efficiency, minimizing risks, and improving transparency.

4.3. Limitations and Challenges

Despite some initial results, the application of digital transformation in marine economic management in Vietnam still faces many limitations

First, data is still scattered and lacks connectivity. Ministries and sectors such as the Ministry of Agriculture and Environment, the Ministry of Construction, and the Ministry of Science and Technology have their own data systems, but there is no mechanism for integration, sharing, and synchronous exploitation. This leads to duplication, waste, and difficulties in inter-sectoral coordination.

Second, digital infrastructure has not met requirements. Monitoring systems, electronic databases, and digital platforms are only at the pilot or local scale in some localities, and have not yet formed a highly connected national network. Telecommunications infrastructure in many coastal and island areas is still weak, affecting the ability to apply modern technology.

Third, human resources are limited. The majority of state management staff for the marine economy come from the fields of natural resources, fisheries, and maritime, but they lack digital skills, knowledge of big data analysis, artificial intelligence, and cybersecurity. This makes the implementation of digital transformation difficult, especially in the system operation and maintenance phase.

Fourth, the inter-sectoral coordination mechanism is still weak. Marine economic management is related to many fields (natural resources, environment, maritime, fisheries, tourism, and defense), requiring close coordination between ministries, sectors, and localities. However, the current mechanism is still overlapping and lacks clarity on responsibilities, leading to the application of digital technology not achieving the desired results.

4.4. Opportunities in the Context of Digital Transformation

Vietnam has many opportunities to apply digital transformation to the state management of marine economic development:

First, developing digital seaports and smart logistics. With the global trend of e-commerce and logistics, Vietnam has the potential to build smart seaports based on real-time data, connecting the global supply chain. This is an opportunity to improve competitiveness, reduce costs and transportation time, and increase foreign investment attraction (Huynh et al., 2025).

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Second, apply AI and IoT in marine environmental management. The use of IoT sensors combined with artificial intelligence allows monitoring of seawater quality, early detection of pollution, oil spills, or ecological changes. This helps management agencies have a scientific basis to make timely decisions, minimizing negative impacts on the marine ecosystem.

Third, increase transparency and accountability. Digital transformation allows data, processes, and management results to be made public on online platforms, creating conditions for people, businesses, and social organizations to participate in monitoring. Digital transformation helps increase social trust, helping to prevent corruption and waste in marine resource management.

Fourth, international integration and cooperation. Participation in regional and global marine data networks will help Vietnam access advanced technology, share information and management experience, thereby improving its capacity to forecast, respond to natural disasters, and develop sustainably (Luu, 2024).

State management of marine economic development in Vietnam in the context of digital transformation has made remarkable initial steps, demonstrated by the issuance of strategic policies, the deployment of several digital technology applications in vessel management, seafood monitoring, and marine spatial planning. However, limitations in data, infrastructure, human resources, and inter-sectoral coordination mechanisms remain major barriers, making management effectiveness not commensurate with potential and practical requirements.

In the future, Vietnam has many opportunities to take advantage of digital transformation achievements to build a modern, transparent, and sustainable marine economic management system. The core issue is the need for a synchronous legal framework, investment in digital infrastructure, training of high-quality human resources and strengthening international cooperation. This will be an important premise for Vietnam to successfully achieve the goal of "a strong maritime nation, rich from the sea" in the digital age.



Diagram 1. Framework for analyzing the impact of digital transformation on state management of the marine economy

Diagram 1 shows that digital transformation is an input factor, directly affecting the state management mechanism, thereby creating sustainable economic, social, and environmental results in marine economic development.

5. INTERNATIONAL EXPERIENCE

Many countries and regions have successfully implemented digital transformation application models in the state management of marine economic development. These experiences have brought about outstanding management efficiency, providing important lessons for Vietnam in the process of building policies and implementing modern marine management.

The European Union (EU) is one of the pioneering regions in combining marine economic management with digital transformation. The "Blue Growth" program, implemented since 2012, has identified sustainable development of the marine economy as a strategic pillar of the EU. An important highlight is the European Marine Observation and Data Network (EMODnet), which allows the collection, standardization, and sharing of oceanographic data from member states. EMODnet not only supports policy making but also serves research activities, environmental protection, and marine industry development. The adoption of an open data system has saved hundreds of millions of euros in survey costs, while improving transparency and cross-border coordination. This is proof that digital data-driven governance can bring great efficiency to regional maritime management.

Singapore is a typical model in developing smart seaports. With a strategic position in the global logistics chain, Singapore has invested in building a Smart Port system, applying AI, IoT, and real-time data to seaport management. The Maritime and Port Authority of Singapore (MPA) has deployed an integrated electronic platform that automates customs procedures, monitors cargo flows, and optimizes vessel schedules. As a result, PSA Port has become one of the most efficient container shipping ports in the world, with outstanding productivity and high safety levels. The success comes from the close combination of a flexible legal framework, long-term investment strategy, and the development of high-quality digital human resources (Erh, 2023).

China also stands out with its strategy of applying digital technology to marine spatial planning and management (MSP). The Chinese government has deployed a marine monitoring system based on big data, remote sensing, and AI, allowing for monitoring of resource exploitation activities, controlling pollution, and minimizing conflicts of interest between marine economic sectors. In addition, China has also built an early warning system for marine disasters using big data, helping to minimize damage caused by

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storms, tsunamis, and climate change. The applications have improved the state's management capacity and supported the formulation of sustainable marine development policies (Zhang et al., 2024).

Some other countries have notable experiences. South Korea has developed the e-Navigation system to manage maritime activities based on digital data, enhancing maritime safety and minimizing accidents. Japan applies IoT in monitoring aquatic resources and developing sustainable marine tourism. The United States implements Ocean Data Portal programs, focusing on building open databases for research, planning, and ocean conservation. These models all emphasize the role of digital data, advanced technology, and multi-sectoral, multinational cooperation in marine economic management.

International experience shows that digital transformation is not only a supporting tool but also a central factor, shaping a new method of state management in the field of marine economy. Vietnam can completely learn, adjust, and apply appropriately to domestic conditions to improve management efficiency, successfully implementing the goal of sustainable development of the marine economy by 2030 and the vision to 2045.

6. POLICY IMPLICATIONS FOR VIETNAM

Digital transformation is a trend that plays a key role in improving the effectiveness of state management of marine economic development. For Vietnam, where the marine economy is identified as an important driving force for national growth, integrating digital transformation into management is an objective requirement and a strategic solution. To realize the goal of "a strong maritime nation, rich from the sea" in the context of digitalization, Vietnam should focus on the following policy implications

First, perfecting the synchronous institutions and legal framework for digital management in the marine economy. Vietnam should review, supplement, and update the current legal system to suit the digital transformation trend. In addition to the 2012 Law of the Sea and Resolution 36-NQ/TW, specialized decrees and circulars should be issued on license plate data management, inter-sectoral information sharing, data security, and application of new technologies in seaport, seafood, and environmental management. This legal framework should facilitate data integration, ensure access to information for stakeholders, and be linked to a transparent control and accountability mechanism.

Second, build a unified and interconnected national database on the sea. A current limitation is that data is scattered across many ministries, sectors, and localities. Therefore, it is necessary to establish a centralized database system that integrates information sources on resources, environment, fisheries, maritime, tourism, and national defense and security. This system should operate on a modern digital platform, allowing real-time updates, and interconnect with national databases on population, land, trade, and logistics. Developing an open database will help improve transparency, support decision-making, and encourage scientific research and innovation (Iman et al., 2022).

Third, invest in digital infrastructure for the marine economy. To successfully transform digitally, Vietnam should prioritize resources for developing coastal and island digital infrastructure, including 5G telecommunications networks, IoT sensor systems, data centers, and cloud computing. The construction of digital seaports and smart logistics is central to improving competitiveness and effectively connecting with the global supply chain. Investment should be increased in marine environmental monitoring systems using AI, remote sensing, and automatic sensors to help provide early warning of environmental incidents and respond promptly to climate change (Lee et al., 2023).

Fourth, develop high-quality digital human resources. Human resources are a decisive factor for the success of the digital transformation process. Vietnam should promote training and fostering of state management officials in digital skills, big data analysis, artificial intelligence, and cybersecurity. At the same time, it is necessary to cooperate with universities, research institutes, and enterprises to develop specialized training programs on license plate management, smart seaports, and ocean technology. Policies to attract domestic and foreign talent should be focused on, aiming to form a team of leading experts capable of leading the innovation process (Tram & Ngoc, 2025).

Fifth, promote public-private cooperation and international integration. Marine economic management associated with digital transformation is a field that requires large resources, while the state budget is limited. Therefore, it is necessary to encourage the participation of the private sector through public-private partnership (PPP) models, especially in the development of smart seaports, digital logistics, and environmental monitoring. In addition, Vietnam should proactively participate in regional and global marine data networks, learn from the experiences of the EU, Singapore, and China, and strengthen bilateral and multilateral cooperation to access advanced technology and mobilize international capital.

Sixth, ensure transparency, accountability, and social participation. One of the great advantages of digital transformation is the ability to publicize data and management processes (Nguyen & Hoang, 2024). Vietnam should build a mechanism that allows people, businesses, and social organizations to participate in monitoring, criticizing, and proposing initiatives through online platforms. Transparency and accountability will improve the quality of management, contribute to preventing corruption and waste, and strengthen trust in the state management apparatus.

The policy implication for Vietnam is to approach digital transformation comprehensively and systematically, from perfecting institutions, building databases, investing in infrastructure, developing human resources, promoting cooperation, to ensuring

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transparency. These are key factors for Vietnam to improve the effectiveness of state management, promote maritime potential and advantages, towards the goal of sustainable development and deep integration in the digital age (Nguyen, 2024).

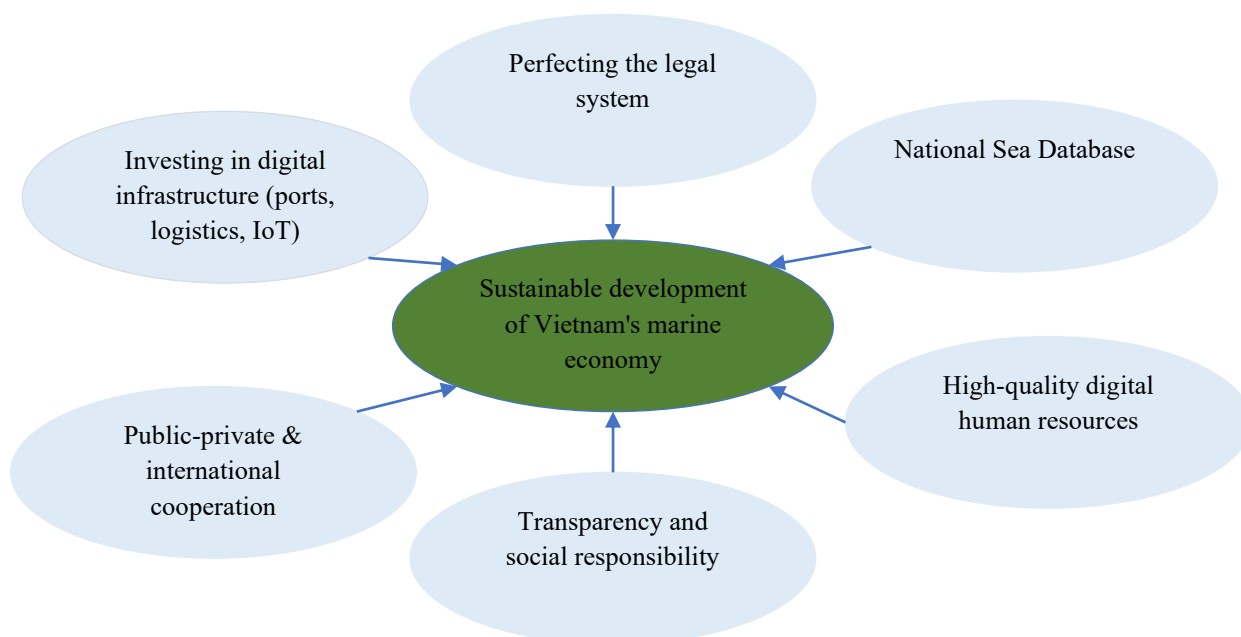


Diagram 2. Policy implications for Vietnam in managing the marine economy in the digital transformation period

Diagram 2 shows that policy implications should be implemented synchronously, creating a “digital policy ecosystem” for marine economic management. Policies are important links that, when combined, will ensure that Vietnam achieves its sustainable development goals.

7. CONCLUSION

Digital transformation has become a trend, profoundly impacting all socio-economic sectors. In Vietnam, where the marine economy is identified as one of the important driving forces of national growth, the integration of digital technology into state management of marine economic development has strategic significance in terms of economics, politics, and security-defense. This study has analyzed the theoretical basis, an overview of international experience, and the implementation status in Vietnam, thereby drawing some important conclusions.

International experience from the European Union, Singapore, China, and some developed countries shows that digital transformation can create a breakthrough in marine management if implemented based on open data platforms, modern digital infrastructure, high-quality human resources, and effective inter-sectoral coordination mechanisms. These are factors that help improve management efficiency, increase transparency, and promote sustainable development.

The current situation in Vietnam shows that there have been important steps, such as the promulgation of the 2012 Law of the Sea, Resolution 36-NQ/TW in 2018, and the implementation of several digital applications in vessel management, seafood monitoring, and marine spatial planning, but digital transformation in marine economic management is still at an early stage. Limitations in distributed data, unsynchronized infrastructure, lack of digital skills in human resources, and weak inter-sectoral coordination mechanisms are major barriers that should be resolved soon.

Vietnam is facing many favorable opportunities, including the trend of developing smart seaports, digital logistics, AI, and IoT applications in environmental monitoring, and increased international cooperation in the field of marine management. If Vietnam makes good use of the opportunities, it can accelerate the process of modernizing state management of the marine economy, while improving its competitiveness and international position.

On that basis, the study proposes six groups of policy implications (i) perfecting institutions and legal frameworks; (ii) building a national interconnected marine database; (iii) investing in digital infrastructure; (iv) developing digital human resources; (v) promoting public-private partnership and international integration; and (vi) enhancing transparency, accountability, and social participation. These are strategic orientations that can help Vietnam overcome limitations, promote advantages, and realize the goal of becoming a strong maritime nation, rich from the sea in the digital age.

Digital transformation is a supporting tool, a central driving force, contributing to improving the effectiveness of state management and promoting sustainable marine economic development. Creatively applying international experience, combined with specific domestic conditions, will help Vietnam build a modern, transparent, and integrated marine management system.

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