

# Research on Capacity Generation, Reconstruction and Optimization of Intelligent Transformation of Marine Ranches in China

Tao Li<sup>1</sup> Mo Zhang<sup>2</sup>✉ Tongtong Li<sup>3</sup>✉

<sup>1</sup>Management College, Ocean University of China, 266100, Qingdao, China

<sup>2</sup>School of Accountancy, Shandong University of Finance and Economics, 250014, Jinan, China

<sup>3</sup>School of Marxism, Shandong Jianzhu University, 250014, Jinan, China

✉beethmo@163.com; litongtong19@sdjzu.edu.cn

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## Abstract

Against the backdrop of the accelerated development of the digital economy, the continuous advancement of building a maritime power, and the deep reshaping of the modern fishery system, Marine ranches are shifting from the traditional resource allocation and experience-based management model to a new development form characterized by data perception, intelligent decision-making, collaborative control, and ecological governance. Unlike the digitalization of general industries, Marine ranches have triple attributes of natural ecosystem, fishery production system and regional governance system. Their intelligent transformation is not only related to the improvement of production efficiency, but also to Marine ecological restoration, resource conservation, public supervision and industrial chain collaboration. In this process, digital technology does not automatically translate into transformation performance. What really determines the depth and quality of transformation is whether the organization can complete capability generation, capability reconstruction and capability optimization around technological opportunities. Based on theories related to digital transformation, dynamic capabilities, absorptive capabilities, resource orchestration, and information technology capabilities, this paper constructs a capability analysis framework for the intelligent transformation of China's Marine ranches from the perspective of normative research. The study suggests that the evolution of capabilities in the intelligent transformation of Marine ranches follows a progressive logic of "capability generation-capability reconstruction-capability optimization-performance release". Among them, capability generation is mainly reflected in the organization's perception, connection and learning of technological opportunities, policy signals and market demands; capability reengineering is characterized by process reengineering, resource reorganization and knowledge transformation centered around digital technology adoption, technology absorption and institutionalized embedding; Capability optimization, on the other hand, involves the coupled improvement of production and operation capabilities, organizational synergy capabilities, innovation diffusion capabilities, and ecological governance capabilities. Furthermore, this paper proposes that dynamic capabilities determine transformational direction identification and opportunity capture, resource orchestration capabilities determine whether technological elements and organizational elements can form an efficient combination, and innovation capabilities determine whether digital technologies can be internalized as new institutional arrangements and sustainable value creation mechanisms. Based on this, this paper constructs an overall analytical framework of "external drive-capability generation-capability reconstruction-capability optimization-multi-dimensional performance", and puts forward several research propositions, with the aim of providing theoretical explanations for the research on the intelligent transformation of Marine ranches, and also providing ideas for promoting the modernization of Marine fisheries and building an intelligent Marine industrial system in China's coastal areas.

## Keywords

Marine ranches; Intelligent transformation; Capability generation; Capability refactoring; Capability optimization; Digital technology

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This article is a normative theoretical study, and the relevant arguments draw on absorptive capacity, dynamic capacity, resource orchestration, and digital transformation.

## I. Introduction

Marine ranching is a composite form of Marine development and utilization that integrates the

conservation of Marine biological resources, the development of enhanced fishery, the restoration of Marine ecology and the linkage of coastal industries. In recent years, with the rapid development of digital technologies such as sensors, the Internet of Things, artificial intelligence, satellite remote sensing, edge computing, and digital twins, Marine ranches have gradually established a realistic foundation to shift from experience-based governance to data-based governance, from decentralized operations to systematic collaboration, and from single output to multi-value creation. The significance of digital technology for Marine ranches lies not only in improving local operation tools, but also in promoting a systematic reshaping of production organization methods, resource allocation methods and governance logic. Especially in the context of the complex and changeable Marine environment, the strong biological nature of production objects, significant ecological externalities and long industrial chains, digital technology has the potential to be a key means to solve problems such as information asymmetry, lagging monitoring, rough management and insufficient coordination.

However, the intelligent transformation of Marine ranches in reality is not simply about installing equipment, building platforms or connecting systems. The transformation results of entities equipped with the same sensors, automatic feeding systems, water quality monitoring systems and data platforms often show significant differences: some organizations can continuously improve resource utilization efficiency, ecological governance capacity and market response speed, while others remain at the primary stage of isolated application, repetitive construction and institutional deembedding. This indicates that digital technology itself is not a decisive variable, and whether digital technology can truly translate into organizational performance depends on the level of capacity building around technology within the organization. In other words, the essence of the intelligent transformation is not technology substitution but capability evolution; not single-point innovation, but system reconfiguration.

Existing research has accumulated a lot of results from perspectives such as digital transformation, information technology capabilities, dynamic capabilities, organizational learning, and business process reengineering, but discussions on the particular context of Marine ranches are still clearly insufficient. First, the existing research has mostly focused on mature industries such as manufacturing, retail, and platform enterprises, and has paid insufficient attention to the evolution of digital capabilities in natural resource-based industries, especially in the Marine fishery scenario. Second, some studies focus on the antecedents of technology adoption, while others

focus on the performance consequences, but fail to reveal the intermediate mechanism of how digital technology transforms into sustained performance through capability generation and reconstruction. Third, Marine ranches are characterized by the coexistence of ecological, economic and public governance goals, and their performance encompasses not only financial performance but also ecological and social performance. There are interpretive boundaries to simply borrowing general enterprise digital transformation theories.

Based on this, this paper takes Chinese Marine ranches as the research object and, without relying on specific cases, answers three questions from the perspective of capabilities: First, how are the key capabilities required for the intelligent transformation of Marine ranches generated; Second, how can these capabilities be restructured in the process of digital technology adoption, absorption and institutionalization; Third, how can capacity optimization further drive the formation of multi-dimensional economic, social and ecological performance. This paper attempts to integrate dynamic capability theory, absorptive capacity theory, resource orchestration theory and digital technology capability research to construct an analytical framework that can explain the entire process of the intelligent transformation of Marine ranches.

## 2. Literature Review and insufficient research

### 2.1 Research on Digital technology-driven Intelligent Transformation of industries

Digital transformation research generally holds that the impact of digital technology has gone beyond merely improving information processing efficiency, and has delved into reshaping business models, organizational boundaries, ways of value creation, and governance mechanisms. The research points out that digital transformation is a continuous, contextualized, and cross-level strategic update process, with the core feature being the continuous adjustment of structure, processes, and cognition triggered by the embedding of digital technology in the organization. Unlike traditional informationization, intelligent transformation places more emphasis on the comprehensive utilization of real-time data, algorithmic decision-making, automated execution, and cross-agent collaboration, emphasizing the transition from tool introduction to organizational change.

But from the existing literature, there are still two obvious tendencies around the intelligent transformation of industries: one is to view digitalization as an exogenous technological shock and focus on examining its impact on outcome variables such as enterprise performance, innovation efficiency, and supply chain collaboration; the transformation

is perceived as a phased project management issue, with a focus on information system deployment, digital platform construction and business process reengineering. The above research provides an important basis for understanding the diffusion of digital technologies, but often weakens the mediating role of organizational capabilities. In fact, in complex industrial environments, digital technology cannot function independently of organizational capabilities; Technology can only be transformed into a real organizational advantage through knowledge absorption, process reengineering, institutional adaptation and subject synergy.

## **2.2 Research on Intelligentization of Marine ranches and Digitalization of modern fisheries**

Research on Marine ranches and smart fisheries has increased significantly in recent years. The main topics include environmental monitoring, underwater perception, intelligent equipment, remote control, digital twins, Marine ecological assessment and collaborative governance. Research shows that digital technology can enhance the ability to identify the Marine environment, fish behavior, aquaculture facility status and risk events, providing conditions for Marine ranches to achieve precise feeding, disease early warning, aquaculture density regulation, ecological carrying capacity assessment and full-process traceability. At the same time, smart fisheries research suggests that Marine production activities have strong spatial dispersion, natural uncertainty and complexity of equipment operation and maintenance, which means that the introduction of digital technology requires a higher level of organizational coordination, knowledge integration and institutional guarantee.

However, existing research on Marine ranches has remained more at the technical application level and the functional description level, with limited discussion of the deep structural variable of capacity. For example, many studies focus on what kind of monitoring and control functions a certain type of technology can achieve, but less on the question of why organizations can integrate scattered equipment, data, and personnel into sustainable intelligent systems? Why do some entities manage to embed technology into their day-to-day operations and form regular governance, while others remain in a project-based, demonstrative and fragmented state for a long time? All these questions point to the capability mechanism.

## **2.3 Main deficiencies in the research from the perspective of ability**

From the perspective of capability research, the dynamic capability theory emphasizes an organization's ability to perceive opportunities, seize opportunities, and reconstruct the resource base in a rapidly changing environment; Absorptive capacity theory emphasizes

the ability to identify the value of external knowledge, absorb it and commercialize it; Resource orchestration theory emphasizes management actions in the process of resource acquisition, allocation, integration, and release; Information technology capability studies focus on the relationship between IT infrastructure, IT manpower, IT management and performance. These theories all provide inspiration for understanding the intelligent transformation of Marine ranches.

But there are still three shortcomings in the existing achievements. First, there is a lack of contextualized interpretation of natural resource-based and ecological-targeted industries. Capacity building in Marine ranches is not only about market competition, but also about responding to multiple requirements such as ecological restoration, public regulation and regional coordination. Secondly, there is a lack of stratified discussions on the process of capacity evolution. Many studies directly view capability as a static variable without distinguishing the stage characteristics of capability from germination to formation, from formation to reconstruction, and from reconstruction to optimization. Thirdly, there is a lack of coupling analysis with the phased embedding process of digital technology. Technology adoption, technology absorption, and technology institutionalization correspond to different organizational requirements, and it is difficult to explain the differences in the depth of transformation without incorporating capability changes into this process. Therefore, it is necessary to construct a theoretical analysis framework centered on capability generation, capability reconfiguration, and capability optimization based on the industrial characteristics of Marine ranches.

## **3. Theoretical Basis and Definition of Core Concepts**

### **3.1 Dynamic Capability Theory**

Dynamic capability theory holds that in a rapidly changing environment, a company's sustained competitive advantage does not come solely from the stock of existing resources, but from the ability to perceive changes, seize opportunities, and restructure resources. For Marine ranches, environmental changes include not only technological advancements, market demand upgrades and policy orientation adjustments, but also climate fluctuations, ecological risks and changes in maritime governance rules. This means that the intelligent transformation of Marine ranches is primarily not a matter of equipment, but rather a matter of whether the organization has the ability to identify changes and respond strategically. Dynamic capability theory provides the basis for explaining why Marine ranches are undergoing an intelligent transformation and why they can continue to advance the transformation in an uncertain environment.

### 3.2 Absorptive capacity theory

The absorptive capacity theory emphasizes that organizations need to have the ability to identify the value of external knowledge, digest and absorb it, and translate it into business applications. Key knowledge in the intelligent transformation of Marine ranches often comes from equipment suppliers, research institutions, platform service providers, government departments, and industrial chain partners. Because of the highly specialized, interdisciplinary and scenario-dependent nature of this knowledge, organizations must have a strong absorption capacity to transform external digital technologies and expertise into localized, operational and institutionalized governance capabilities. The ability to absorb shows us that technology is not something that can be used immediately; rather, it needs to be transformed into value through organizational learning, knowledge translation, and continuous iteration.

### 3.3 Resource Orchestration theory

The resource orchestration theory further explains that resources themselves do not automatically create value; value formation depends on the structuring, compositing, and leveraging of resources by managers. The intelligent transformation of Marine ranches involves a variety of resources such as Marine space, ecological resources, monitoring equipment, communication networks, data platforms, professional talents, government rules and market channels. They are heterogeneous, scattered and updated at different speeds, and only through effective orchestration can a stable operating system be formed. Resource orchestration theory helps explain why some organizations are able to combine technology, capital, organization and external networks to form a transformation loop, while others are trapped in equipment idleness, data silos and process disconnections.

### 3.4 Research on Digital Technology Capabilities and Information Technology Value

Information technology capabilities research indicates that IT infrastructure, human resources, and management mechanisms together form the key foundation for organizations to create value through digital technology. Digital technology capabilities do not equal the amount of technology owned, but rather the comprehensive ability of an organization to integrate, deploy, and update digital resources. From the perspective of Marine ranches, digital technology capabilities include environmental awareness capabilities, data governance capabilities, system connection capabilities, algorithm application capabilities, platform collaboration capabilities, and technical operation and maintenance capabilities, etc. Its value lies not only in enhancing productivity,

but also in changing the timeliness, precision and traceability of organizational decision-making.

### 3.5 Definition of Core concepts

The intelligent transformation of Marine ranches referred to herein means the continuous process in which the main body of Marine ranches systematically reshapes production monitoring, operation control, resource allocation, business decision-making and ecological governance systems by introducing and embedding digital technologies. The core lies not in partial automation, but in the shift of organizational operation logic from experience-driven to data-driven and from decentralized control to collaborative control. Capability generation is the initial set of capabilities formed by the organization around digital technology opportunity identification, external knowledge access, internal learning, and experimental exploration; capability reconfiguration is the process by which an organization reorganizes its original resource allocation methods, process structures, job divisions, and decision-making mechanisms in the process of technology adoption and in-depth application; capability optimization is the process of continuously iterating and coupling the existing capability system around production and operation, innovation diffusion, ecological governance, and multi-agent collaboration after the technology is gradually institutionalized.

## 4. Capacity generation mechanisms for the Intelligent Transformation of China's Marine ranches

Capacity generation is the starting point of the intelligent transformation and the prerequisite for subsequent capacity reconstruction and optimization. From the perspective of the development practice of China's Marine ranches, capability generation is not accomplished instantaneously, but gradually emerges under the combined effect of three forces: external drive, internal cognition, and organizational learning.

### 4.1 Technological opportunities, policy signals and market demands jointly trigger the emergence of capabilities

The intelligent transformation of Marine ranches primarily stems from changes in the external environment. Technically, the development of Internet of Things perception, Marine communications, intelligent equipment and data analysis technologies makes it possible for Marine ranches to be remotely monitored in real time and managed precisely; At the policy level, the strengthening of modern Marine fishery construction, Marine ecological protection, digital China and smart ocean has put forward higher requirements for standardization, visualization and

traceability of Marine ranches; At the market level, consumers' growing concern about the quality and safety of aquatic products, brand traceability and green production has also driven Marine ranches to shift from extensive management to digital governance. It is under the combined effect of three types of external pressures and opportunities that the main body of Marine ranches has begun to reevaluate the limitations of traditional production methods, and thus the awareness of intelligent transformation has emerged.

#### **4.2 Organizational cognitive renewal drives capacity generation from the consciousness level to the action level**

Not all entities that feel external pressure can move towards intelligent transformation. The key lies in whether managers and core teams form a common perception of the value of digital technology. If digital technology is still perceived within the organization as an accessory tool, demonstration project, or short-term policy project, then capacity generation often remains at the level of a slogan; Capacity generation enters a substantive stage only when organizations view digital technology as an important means of reconfiguring production logic, enhancing ecological governance, and shaping long-term competitive advantage. This shows that cognitive renewal is the first threshold for capacity generation. The immediate consequence of cognitive updates is that organizations start to proactively allocate their digital resources, as shown by setting digital construction goals, introducing technical personnel, establishing cooperative networks, initiating data collection norms, and conducting pilot applications. These actions may seem scattered, but they actually form the rudiments of initial capabilities.

#### **4.3 The learning mechanism and the trial-and-error mechanism contribute to the accumulation of initial capabilities**

The intelligent transformation of Marine ranches has a strong experimental nature. The Marine environment is complex and changeable, data quality is significantly affected by natural conditions, and equipment operation is constrained by factors such as hydrology, meteorology, corrosion and maintenance costs. Therefore, any technical solution needs to be constantly adjusted in the context. Capacity generation is thus highly dependent on learning mechanisms and trial-and-error mechanisms. Organizations, on the one hand, enhance their understanding of technical principles and application boundaries through training, communication, and collaboration, and on the other hand, gradually form stable rules through small-scale deployments, local integration, and feedback correction.

In this process, initial capabilities are roughly divided into three categories: First, perceptual

capabilities, that is, the ability to identify changes in the Marine environment, the direction of technological development, and changes in market demand; Second, connectivity, the ability to connect technology providers, research institutions, government departments and industrial partners; Third, the ability to learn, the ability to transform scattered information into internal knowledge and continuously iterate application solutions. These three types of capabilities together form the origin of capabilities for the intelligent transformation of Marine ranches.

### **5. The mechanism of capability reconstruction for the Intelligent Transformation of China's Marine ranches**

If capability generation addresses the question of whether transformation can be initiated, then capability reconfiguration addresses the question of whether technology can be truly embedded in the organization. Capability reconfiguration in the intelligent transformation of Marine ranches essentially occurs in three consecutive stages: digital technology adoption, technology absorption, and technology institutionalization.

#### **5.1 Capability Reconfiguration in the Digital technology Adoption phase: From experience-based operation to data access**

The focus of the digital technology adoption phase is to transform previously fragmented, ambiguous, and lagging production information into perceivable, recordable, and comparable data streams. At this point, what the organization needs to restructure is its fundamental operational capabilities. Water quality management, feeding control, facility inspection and risk warning activities, which relied on experience-based judgment in the past, are now being digitally expressed through sensors, video monitoring, automatic control and remote communication. As a result, the operational boundaries of Marine ranches have been redefined: the objects of production are no longer just fish or the facilities themselves, but also data, models and algorithms.

#### **5.2 Capacity Reconfiguration in the Digital technology Absorption phase: From data access to Process Reengineering**

Data access alone does not mean the intelligent transformation is complete. One important reason why the digitalization of a large number of Marine ranches has remained superficial is that the technology has remained at the collection and display level and has not really changed the organizational processes. The technology absorption phase emphasizes the deep coupling of digital technology with the organization's business processes, management

processes, and collaborative processes. At this point, the focus of capability reengineering shifts from basic operational capabilities to resource integration and process reengineering capabilities. On the one hand, organizations need to link data from monitoring, control, logistics, quality traceability, customer feedback, ecosystem assessment and other links to reduce information breakpoints and repetitive work; On the other hand, organizations need to reshape operational rules around the new data structure to adapt departmental boundaries, job responsibilities, and decision-making authorities to the requirements of intelligence. Resource orchestration capabilities are particularly critical at this stage. Because data, equipment, talent, funds, and institutions do not naturally work together, organizations can only form stable digital operation mechanisms through management actions such as selection, allocation, combination, and release.

### **5.3 Capacity Reconfiguration in the Digital Technology Institutionalization Phase: From Process Reengineering to organizational Embedding**

The institutionalization phase means that digital technology is no longer a project tool but an integral part of the organization's stable operation. At this point, the ocean ranch's capacity reconfiguration extends further from the process level to the institutional level and the strategic level. The organization will gradually build a new system of rules around data governance, technology updates, risk control, performance evaluation, and cross-agent collaboration. That is to say, digital technologies are beginning to be incorporated into the organization's regular systems, decision-making logic, and value distribution mechanisms. Innovation is particularly crucial at this stage because institutionalization does not mean rigidity; instead, it requires organizations to constantly transform new technologies, new knowledge, and new demands into replicable and scalable operating rules.

Overall, the capability reconfiguration in the intelligent transformation of Marine ranches has distinct phased coupling characteristics: the adoption stage focuses on opening up channels for data to enter the organization, the absorption stage focuses on transforming technology into processes, and the institutionalization stage focuses on completing the leap of embedding capabilities into the organizational structure. Dynamic capabilities, resource orchestration capabilities, and innovation capabilities play key roles at different stages, but the three are not in a substitutive relationship, but rather in a relay advancement relationship.

## **6. Capability Optimization Paths for the Intelligent Transformation of China's Marine Ranches**

Capacity optimization is the core issue in the deepening stage of the intelligent transformation of Marine ranches. The essence is not simply to expand equipment investment or add technical modules, but to improve the overall operational quality through continuous adjustment and synergistic coupling on the basis of the existing capability system, so that the organization gradually forms a self-reinforcing, self-correcting and self-evolving capability structure.

### **6.1 Production and operation capacity optimization: Shifting from extensive control to precise control**

The optimization of production and operation capabilities is mainly reflected in the dynamic optimization of feeding, inspection, disease early warning, environmental regulation and facility maintenance by using real-time data and intelligent algorithms. Traditional Marine ranches often rely on empirical thresholds for management, but under intelligent conditions, organizations can make more fine-grained decisions based on continuous monitoring data, historical operation records, and scenario simulation results. As a result, production decisions have shifted from post-correction to pre-prediction and process control, and operational efficiency, resource utilization, and risk identification accuracy have all improved simultaneously.

### **6.2 Optimization of organizational synergy capabilities: Shifting from departmental segmentation to system linkage**

The intelligent transformation of Marine ranches is not a task that can be accomplished by a single department. It requires the coordinated operation of multiple functions such as aquaculture, equipment, data, market, ecology and safety. One of the key aspects of capability optimization is to promote cross-departmental collaboration around platformization, process-oriented and rule-based approaches. Internally, it is necessary to achieve unified data metrics, clear responsibility boundaries and closed-loop decision-making linkage; Externally, it is necessary to promote data collaboration and governance collaboration with research institutions, equipment manufacturers, platform service providers, regulatory authorities and market entities. The stronger the synergy, the easier it is to magnify the marginal benefits of technology application.

### **6.3 Innovation diffusion capability optimization: From single-point application to scenario replication**

For the intelligent transformation to have a lasting impact, it is necessary to break through the limitations of local pilot projects and single-point applications and form replicable and scalable innovation diffusion mechanisms. The optimization of innovation diffusion

capabilities in Marine ranches is reflected in two aspects: on the one hand, organizations can summarize, modularize and standardize existing technology application experiences to reduce replication costs; On the other hand, organizations can adapt and re-innovate technical solutions based on different sea conditions, production goals and governance requirements. That is to say, capacity optimization is not simply copying, but maintaining resilience and adaptability in the process of replication.

**6.4 Ecological Governance capacity optimization and performance formation**

Unlike the digital transformation of general industries, the intelligent transformation of Marine ranches must also be oriented towards ecological governance goals. The deep embedding of digital technology enables organizations to identify water quality changes, ecological carrying pressure, facility spillover risks and resource conservation effects at a higher frequency, thus creating a finer balance between ecological protection and economic development. Capacity optimization is important because it can break through the last mile of performance release. This paper argues that the performance formation of the intelligent transformation of Marine ranches involves at least three interlinked paths: the efficiency path, the synergy path, and the ecological path. The three paths work together to form a unity of economic performance, social performance and ecological performance.

**7. Analytical Framework and Research Proposition**

Based on the previous analysis, this paper constructs the overall logic of the intelligent transformation

of China's Marine ranches: external technological opportunities, policy signals and market demands first trigger the transformation drivers; perception, connection and learning capabilities are gradually generated under the influence of organizational cognitive renewal and learning mechanisms; Subsequently, digital technology enters the stage of adoption, absorption, and institutionalization, and the organization reconfigures capabilities around resource allocation, process design, knowledge transformation, and rule embedding; as production and operation capabilities, collaboration capabilities, innovation diffusion capabilities, and ecological governance capabilities continue to be optimized, the intelligent transformation begins to steadily release multi-dimensional performance. The framework essentially reveals a progressive process of external drive, capability generation, capability reconfiguration, capability optimization and performance formation.

To enhance the researchability of the framework, this paper further presents the following proposition: Proposition 1: the superposition of technological opportunities, policy pressures and market demands will significantly promote the generation of initial capabilities for the intelligent transformation of Marine ranches, in which organizational cognitive renewal plays a key transformative role. Proposition 2: At the initial stage of transformation, there is significant complementarity among perception ability, connection ability and learning ability. The higher the level of synergy among the three, the easier it is for the organization to make the leap from transformation intention to transformation action. Proposition 3: Digital technology adoption does not automatically lead to a high-quality transformation. Technology adoption translates into capability

Stages	Core Tasks	Leading ability	Interim results
Capacity generation	Identify technological opportunities, form <u>transformational cognition</u> , and access external knowledge	Perception ability Connection ability learning ability	Form the initial action foundation for the intelligent transformation
Capability reconfiguration	Advance technology adoption, technology absorption, and process <u>reengineering</u>	Dynamic capabilities Resource orchestration capabilities absorption capabilities	Achieve data access, process <u>reengineering</u> , and organizational embedding
Capability optimization	Strengthen operational synergy, innovation diffusion, and ecological governance	Innovation capability Platform Synergy Capability Ecosystem Governance capability	Drive the continuous release of economic, social and ecological performance

Table 1 Capacity Evolution Analysis Framework for the Intelligent Transformation of China's Marine ranches

reconfiguration only when resource orchestration capabilities can effectively coordinate equipment, data, talent, and institutional elements. Proposition 4: The stronger the absorption capacity, the more capable Marine ranches are of transforming external digital technology knowledge into process reengineering and organizational learning outcomes. Proposition 5: The stronger the innovation ability, the more capable ocean ranches are of embedding digital technology outcomes into conventional systems, governance structures, and value creation logic. Proposition 6: When dynamic capabilities, resource orchestration capabilities and innovation capabilities are coupled at a high level, Marine ranches are more likely to achieve simultaneous improvement in economic performance, social performance and ecological performance.

## 8. Management Implications and Policy Recommendations

### 8.1 Focus on capacity building rather than equipment investment as the main line of transformation.

In practice, the intelligent construction of Marine ranches tends to fall into the trap of emphasizing hardware over capabilities. In the future, the intelligent transformation should shift from merely focusing on the number of devices and the scale of platforms to focusing on whether organizations have developed capabilities in data governance, system collaboration, knowledge absorption and institutional innovation. For managers, the criteria for evaluating digital technology projects should not be limited to the number of launches, but rather more about whether they have truly changed the way decisions are made, the process structure, and the efficiency of collaboration.

### 8.2 Reduce the risk of transformation in a phased manner.

The intelligent transformation of Marine ranches is highly uncertain and path-dependent. It is advisable to adopt a progressive approach that involves basic perception, process integration, institutional embedding, and continuous optimization. For entities in the initial stage, priority should be given to addressing issues related to data collection, equipment connectivity and basic operation and maintenance; For entities entering the deepening stage, the focus should be on process reengineering, organizational collaboration, and the establishment of data governance rules; For mature entities, optimization and enhancement should be focused on innovation diffusion, platform ecosystem and multi-value release.

### 8.3 Build a capability support system for cross-subject collaboration.

The intelligent transformation of Marine ranches is

difficult to be accomplished independently by a single entity. The government, research institutions, leading enterprises, platform service providers and financial institutions should jointly build a capacity support system. The government focuses on infrastructure, standards and norms, and the supply of public data services; Research institutions focus on key technology development and knowledge transfer; Enterprises focus on open application scenarios and organizational innovation; Platform service providers focus on system integration and operation and maintenance; Financial institutions focus on providing long-term funding tools that are compatible with digital transformation. Multi-agent collaboration can significantly reduce the cost of transformation trial and error and improve the efficiency of capacity generation and diffusion.

### 8.4 Strengthen the unity of ecological orientation and value orientation.

Marine ranches are different from the general digital transformation scenarios, and their performance should not be measured only by short-term output or financial gains. Future policy design and organizational evaluation should place greater emphasis on the combined value of ecological conservation, risk warning, quality traceability, regional drive and public service. Only by embedding ecological goals into the capacity-building process can the intelligent transformation truly reflect the public and sustainable attributes of Marine ranches.

## 9. Conclusion

This paper conducts a theoretical study on capability issues in the intelligent transformation of offshore ranches in the China Sea, proposing that capability is the core mediating variable connecting digital technology and transformation performance. The intelligent transformation of Marine ranches is not a process in which digital technology simply replaces human experience, but rather a process in which organizations continuously generate, reconstruct and optimize capabilities around technological opportunities. The main conclusions of this paper include: First, capability generation is driven by a combination of technological opportunities, policy signals and market demands, and is gradually formed through organizational cognitive renewal, resource connection and learning trial and error; Second, capability reconfiguration occurs in the three stages of digital technology adoption, absorption, and institutionalization, corresponding respectively to three key leaps: data access, process reengineering, and organizational embedding; Third, capability optimization manifests as the coupled improvement of production and operation capabilities, organizational synergy capabilities, innovation diffusion capabilities,

and ecological governance capabilities, and the ultimate result is the continuous release of multi-dimensional performance in the economic, social, and ecological aspects.

The theoretical contribution of this paper lies in: First, it deepens the process explanation of the intelligent transformation of Marine ranches from the perspective of capabilities, breaking through the limitation of understanding digital transformation as mere technology diffusion; Second, it constructs an overall framework of external drive, capability generation, capability reconfiguration, capability optimization and performance formation, integrating dynamic capability, absorptive capacity, resource orchestration and digital technology capability research into a unified logic; Third, it emphasizes the particularity of giving equal weight to ecological and economic value in the Marine ranch scenario, providing a contextualized supplement to the research on digitalization of natural resource-based industries.

Of course, this paper is a theoretical analysis and has not yet quantitatively tested each proposition. Future research could build on this to construct measurement dimensions, conduct questionnaire surveys, configuration analyses, and multi-stage empirical studies to test the heterogeneous effects of different capability elements in different sea area types, organizational types, and development stages.

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