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A Multi-case Study of Green Port-adjacent Industrial Cluster Development Based on Grounded Theory

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Abstract: This paper adopts a multi-case analysis approach, selecting the port-adjacent industrial clusters in Ningbo, China, Rotterdam, Netherlands, and Tokyo Bay, Japan, as exemplary cases for study. It collects multi-source data and information from academic literature, official channels, news reports, and social media. By applying the three-level coding process of Grounded Theory, it delves into successful practices of these cases in constructing and developing green port-adjacent industrial clusters, and extracts the valuable experiences of them. Based on this, a series of strategic conclusions aimed at promoting the development of green port-adjacent industrial clusters are summarized, providing useful references and insights for the formation and development pathways of port-adjacent industrial clusters in other regions.

Keywords: Green and low-carbon, Port-adjacent industry, Industrial cluster, Industrial development, Grounded Theory, Case analysis.

1. Introduction and Literature Review

With the rapid development of the global economy, port-adjacent economy, as a typical export-oriented economy, has gradually become an important force in driving local and even national economic development by leveraging its powerful industrial agglomeration function and regional economic characteristics [1]. Centered on the port, the port-adjacent economy achieves comprehensive regional economic development by fostering the growth of various industries. The vigorous development of port-adjacent industrial clusters serves as a crucial support and driving force for this economic model. By integrating resources from the port and its surrounding areas, it forms an efficient and collaborative industrial ecosystem, injecting continuous momentum into the prosperity of the port-adjacent economy. Within the port-adjacent industrial clusters, industries such as port-adjacent manufacturing, port logistics, and port-adjacent commerce are interdependent and mutually reinforcing, jointly constructing a diversified and efficient industrial system. This system not only enhances the overall competitiveness of the port-adjacent economy but also injects new growth points into the local economy [2].

In this process, the development of green port-adjacent industrial clusters is crucial. It not only emphasizes the enhancement of economic benefits but also focuses on the ecological environment protection and sustainable development [3]. By introducing advanced environmental protection concepts and technological means, green port-adjacent industrial clusters have effectively reduced environmental pollution and resource consumption while promoting industrial development, achieving a harmonious unity between economic and ecological benefits.

Currently, relevant research is mainly divided into two aspects: the development of port-adjacent industrial clusters and the development of green industries. There is abundant research on the development of port-adjacent industrial clusters. For example, Han and Wang [4] analyzed the current status and issues of China's modern marine industrial clusters and proposed corresponding optimization pathways. Yang [5] analyzed the current status of the development of port-adjacent industrial clusters in the southern Sichuan economic zone. He then pointed out the existing problems from various aspects such as market system support, cluster cooperation and division of labor, and port cluster industry construction, and proposed corresponding countermeasures to address these issues. Yun et al. [6] analyzed the development of the Dashan Port marine industrial cluster. Feng et al. [7] constructed a spatial layout model for port-adjacent industries based on multi-objective planning and systematic layout design methods. Taking the port-adjacent industrial zone of Yancheng Binhai Port in Jiangsu Province as an example, they calculated the optimal layout plan for it. Other scholars [8-10] have explored the degree of correlation and coupling between port logistics and port-adjacent industries. Although these studies have explored relevant topics related to the development of port-adjacent industries, they have not yet addressed the aspect of green and sustainable development. Regarding the development of green industries, Liu [11] studied the theoretical logic, bottlenecks, and implementation pathways for the development of the seed industry under the guidance of green development. Xing et al. [12] analyzed the measurement of agricultural green development level and the path for improving coupling coordination in the Hexi region. Ma et al. [13] constructed a benchmark regression model based on panel data from 30 provinces in China from 2015 to 2022 to examine and analyze the promotional effect of digital economy development on the green development of the logistics industry. From the perspective of green development, Guan and Fang [14] utilized the undesirable output DEA-SBM model to measure the green transformation efficiency of the flooring industry in Jiangsu Province. These studies have promoted the green development of some industries, but they have not covered industrial clusters or port-adjacent industries, and therefore cannot provide guidance for the green development of port-adjacent industrial clusters. Currently, the closest research is conducted by Luo et al. [15], who analyzed the current status and trends of Maoming's port-adjacent industries from the perspective of green development. They elaborated on specific measures to

accelerate the green rise of the port-adjacent industries in three aspects: open cooperation, industrial clustering, and technological innovation. However, the research object is specific and narrow, failing to provide extensive experience and recommendations based on multiple cases.

Therefore, this paper will employ a multi-case analysis approach, utilizing the port-adjacent industrial clusters in Ningbo, China; Rotterdam, the Netherlands; and Tokyo Bay, Japan, as research cases. By gathering pertinent data and information from a range of sources, including literature databases, official government websites, news reports, social media platforms, and others, and applying the Grounded Theory, this paper aims to synthesize the successful experiences of industrial clustering and green development observed in these cases. Subsequently, it will formulate a series of recommendations for the advancement of green port-adjacent industrial clusters.

2. Research Design

2.1. Research Method

This study adopts the coding method of Grounded Theory proposed by Glaser and Strauss in 1967. Grounded Theory is a methodology that deeply analyzes raw empirical data, gradually abstracts concepts, and constructs theoretical frameworks. The specific processes are illustrated in Figure 1. It not only ensures a close connection with the original data but also fully demonstrates the levels of abstraction in theory, making it an extremely effective research approach for process-oriented issues. By applying Grounded Theory, the core essence of the research question can naturally emerge from social processes and related studies, thereby efficiently extracting profound insights about the real world from objective data.

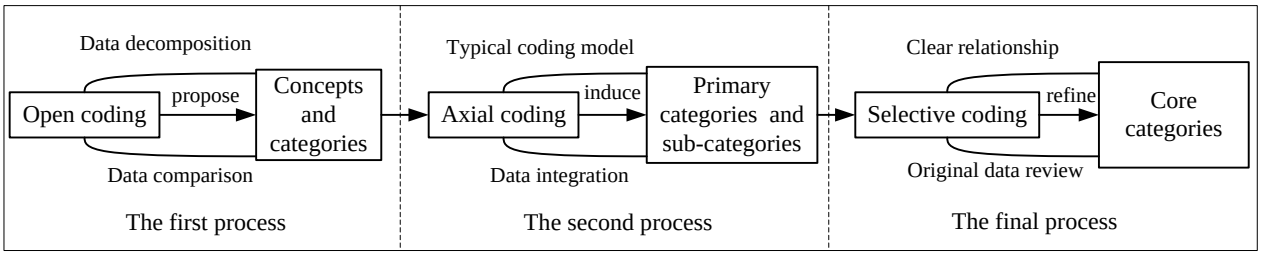

Figure 1. The coding processes of Grounded Theory

The main reasons for adopting Grounded Theory in this paper are as follows:

(1) Data collection for green port-adjacent industrial clusters is difficult, and direct quantitative analysis is challenging to achieve, thus making it suitable to adopt standardized qualitative research methods.

(2) Currently, existing research in this field lacks sufficient multi-case analysis and summarization. The application of Grounded Theory allows for a more comprehensive perspective, which helps to uncover theoretical elements that have not yet been covered.

(3) Given that theoretical research on green port-adjacent industrial clusters is still in its preliminary exploratory stage, starting with specific cases makes it easier to refine and generalize concepts, thereby deeply analyzing the relevant theoretical connotations.

2.2. Case Selection and Data Collection

To obtain the most valuable theoretical content, this study identifies the “Ningbo Port-adjacent Industrial Cluster” in China, the “Rotterdam Port-adjacent Industrial Cluster” in the Netherlands, and the “Tokyo Bay Port-adjacent Industrial Cluster” in Japan as research cases based on their case type, typicality, and representativeness [16]. The characteristics of the selected cases are shown in Table 1.

Table 1. Cases and their characteristics

Cases	Characteristics
Ningbo Port-adjacent Industrial Cluster	A. Large industrial scale and influence in China: One of the steel and chemical industry clusters with significant influence. B. Strong industrial agglomeration effect: It has gathered numerous steel and chemical enterprises, which possess strong capabilities in technological innovation and research and development. C. Sustainable development and environmental protection measures: It has achieved certain results in terms of environmental protection measures, energy conservation, and emission reduction.
Rotterdam Port-adjacent Industrial Cluster	A. Significant international influence and rich successful experience: Its port-adjacent industrial cluster is mature and large-scale, possessing extremely high international influence. B. A model of green development: By adopting a unique “platform + recycled resources” development approach, it mimics the circular path of natural ecosystems, achieving closed-loop material circulation and multi-level energy utilization. This provides an example for material and energy integration among enterprises. C. Comprehensive industrial structure and ecosystem: Specialized industrial clusters have formed in various fields such as petrochemicals, shipbuilding, steel production, and food processing. These clusters cooperate closely, generating significant economic scale effects.
Tokyo Bay Port-adjacent Industrial Cluster	A. A massive industrial cluster: It is one of the world’s largest industrial zones, gathering industries such as petrochemicals, steel, automobiles, shipbuilding, and logistics. B. Demonstrating green and low-carbon practices: By introducing advanced environmental protection technologies, optimizing industrial structure, and improving resource utilization efficiency, it has achieved a virtuous cycle of economic development and environmental protection. C. Remarkable innovation and technology research and development achievements: As one of Japan’s technology hubs, it boasts numerous universities and institutions, providing powerful talent and technical support for industrial development.

Using relevant keywords associated with the three industrial clusters mentioned above, such as combining terms like “Ningbo”, “port-adjacent”, “industrial cluster”, “industrial agglomeration”, “industrial chain”, “port industry”, “green and low-carbon”, “steel and chemicals”, and so forth for data collection on the Ningbo Port-adjacent

Industrial Cluster, we conducted searches on domestic and international journal literature retrieval platforms such as CNKI and Web of Science, government official websites, news reports, consulting agency data reports, and major domestic and international social media websites. After cleaning, refining, and improving the collected data and materials, we ultimately obtained the data and information presented in Table 2. And Table 3 shows the partial reports of the cases.

Table 2. Data acquisition status of the cases (Units: copies)

Sources / Cases	Literature retrieval platforms	Official websites and news reports	Consulting reports and major social media websites
Ningbo Port-adjacent Industrial Cluster	86	89 (including 17 videos)	47
Rotterdam Port-adjacent Industrial Cluster	103	136 (including 22 videos)	56
Tokyo Bay Port-adjacent Industrial Cluster	91	75 (including 11 videos)	33

Table 3. The partial reports of the cases

Cases	Data title
Ningbo Port-adjacent Industrial Cluster	➢ Ningbo: Gathering "Chains" into "Clusters" to Create a Smart Manufacturing Innovation Hub. ➢ Economic Development and Pollution Reduction and Carbon Reduction Go Hand in Hand; This Port-Adjacent Industrial Zone Achieves Both "Green" and "Wealth". ➢ How Ningbo is Striving to Build a World-Class Green Petrochemical Industry Cluster. ➢ "Enhancing Greenness and Adding Value", the Low-Carbon Path of This Major Industrial City. ➢ 130 Billion! Ningbo is Powering Up Its Fund Cluster, and a Trillion-Yuan-Scale New Industry is on the Horizon.
Rotterdam Port-adjacent Industrial Cluster	➢ International Experience and Insights on the Clustering of Port Industries. ➢ Port of Rotterdam: Outlook for 2030. ➢ Global City Observation | Urban Innovation in Rotterdam: Actions Speak Louder than Words. ➢ Management Representatives from World Port Organizations Gather in Ningbo to Discuss the "New Era of Ports". ➢ Port of Rotterdam, Netherlands • Digital Transformation of Ports.
Tokyo Bay Port-adjacent Industrial Cluster	➢ Tokyo Bay Area Theme Series (I): Division of Labor and Collaboration Among Port Clusters. ➢ Bay Area Observation ⑨ | Tokyo Bay Area: Experiences and Lessons from the Transformation into a World-Class "Industrial Bay Area". ➢ Taking "Tokyo Bay" as an Example: Asia is Building Urban Creative Clusters. ➢ A Model of Industrial Intensification in Tokyo Bay: Six Major Ports Transitioning from Competition to Complementarity. ➢ The Greater Tokyo Bay Area: The Heartland of Japan's Economy.

3. Coding Analysis of Data

3.1. Open Coding

Based on the analysis processes outlined in Figure 1, open coding is the first process in Grounded Theory. It primarily involves reading and analyzing raw materials, extracting key concepts from the context of the text, and categorizing them to form initial categories. In this study, through detailed reading and analysis of the data collected, fragment coding and key concept extraction were conducted based on the semantics within the text. With the research theme in mind, repeated deliberation, comparison, and classification were performed, ultimately leading to the identification of 22 initial categories. Table 4 presents 10 representative categories as examples to illustrate the coding process.

3.2. Axial Coding

Axial coding is the second process in Grounded Theory. It builds upon open coding by further refining and elevating the logical connections among the categories initially identified from the raw data, thereby constructing and forming more concise and hierarchical primary categories. In this study, through in-depth analysis and refinement of the 22 initial categories presented in Section 3.1, they were ultimately integrated into 9 primary categories, as specifically shown in Table 5.

3.3. Selective Coding

Selective coding is the final process in Grounded Theory. It further refines and summarizes the core category based on open coding and axial coding, and clarifies the relationships between all primary and sub-categories and the core category. In this study, analysis was conducted around the core category of "the formation and development of green port-adjacent industrial clusters", revealing that the nine primary categories, including green and low-carbon system and practices, green advocacy and public participation, natural resources, human resources and social resources, as well as industrial composition and scale, all constitute the foundation or content that drives the "formation and development of green port-adjacent industrial clusters". Therefore, this study constructs a system model for the formation and development of green port-adjacent industrial clusters (see Figure 2). This model not only demonstrates the juxtaposition or serial relationships among the primary categories but also provides insights into the operational mechanism of the system for the formation and development of green port-adjacent industrial clusters.

Table 4. Initial categories

Initial categories	Representative original sentences (key concepts)
Construction of a green system	A-2-a5: With promoting the establishment of the "green manufacturing" system as the starting point (green system). A-3-a13: Establish a joint prevention and control mechanism for solid waste in Qingzhi Chemical Industry Park, and set up an "enterprise-level" early warning and prevention system (early warning system). C-3-a12: Develop a positive list of industrial entry thresholds to control the entry of polluting industries from the source (entry list).
Low-carbon technologies and facilities	A-3-a4: Encourage enterprises to increase investment in technological renovations (technological renovation). A-2-a5: Implemented various integrated energy renovation projects, including rooftop distributed photovoltaics and new energy charging stations (renovation). B-2-a13: Construct a concrete park that can function as a rainwater reservoir during rainfall (construction). C-3-a13: High-level sports and cultural facilities, coastal environments surrounded by water and greenery, and low-carbon, intelligent infrastructure (facilities).
Human resources	A-2-a1: To strengthen industries, talents must be "gathered" (talent guarantee). A-2-a17: In this process, scientists, enterprises, and the government are all indispensable (talent). B-3-a15: Facing a shortage of talents (talent gap). C-3-19a: Providing a large number of job opportunities and attracting a large workforce (workforce).
Government policy	A -2-a17: Targeted support policies are provided in different fields (policies). B -3-a16: A sound investment environment and preferential tax policies (taxation). C-2-a1: Continuous policy guidance is the guarantee for industrial development (policies). C-3-a13: The government's "invisible hand" has played a crucial role in the cultivation of Japan's marine emerging industries (government).
Supporting service	A-2-a1: Providing full-process services from research and development, production, transformation to sales (support services). A-2-a2: Ningbo Eco-industrial Park offers services such as customized factory buildings and construction agency, then enterprises can lease customized factory buildings and move in with just their bags (services). B-2-a2: Providing transaction services, value-added technical services, and information support (services and support).
Infrastructure Construction	B -2-a2: The infrastructure is complete, with docks, yards, warehouses, roads, and environmental protection facilities all in place (infrastructure). B-3-a19: Infrastructure construction such as logistics supply chains and pipelines (infrastructure). C-2-a3: Not only are there a large number of industrial zones and port facilities, but business districts, high-end residential areas, and other regions such as Odaiba and Toyosu have also been developed (facilities). C-3-a33: Building convenient transportation infrastructure (infrastructure).
Core industries	A-1-a23: Heavy and chemical industries are an important part of port-adjacent industries (chemical industry-led). B-2-a3: The chemical and petrochemical industries in the port-adjacent and riverside industrial belt are particularly prominent (petrochemicals). C-2-a1: A heavy industrial zone dominated by steel and petrochemicals (heavy industry).
Ecological model and industrial chain	A-2-a2: Exploring the "industry + leading enterprise + capital + bank" model (ecological model). A-4-a4: Promoting innovation to "complement the chain", forming clusters to "strengthen the chain", and gathering "chains" into "clusters" (chain complementation). B-3-a13: Thus forming a complete new industrial chain. B-3-a19: Building a full-chain innovation and entrepreneurship ecosystem (ecosystem). C-3-a3: Creating a large number of civilian manufacturing enterprises, giving birth to numerous industrial towns, and forming local industrial chains (industrial chain).
Supply chain collaboration	A-3-a7: From raw materials to components, and then to upstream, midstream, and downstream of complete vehicle manufacturing (supply chain). B-3-a12: To further realize integrated supply chain processes (supply chain). C-3-a9: Achieving seamless connection between engineering chains and supply chains (supply chain). C-2-a6: Actively integrating into overseas supply chains and participating in global procurement (supply chain).
Upgrade industries	A-2-a3: Leveraging advanced and applicable technologies such as digital intelligence and green technology to promote the transformation and upgrading of traditional industries like shipbuilding and repair, and aquatic product processing (industrial transformation). A-3-a24: Promoting major industrial upgrades through new-type industrialization (new industrialization). C-3-a9: Upgrading the industrial structure towards "high-end" levels (industrial upgrading). C-2-a13: Driving the optimization and upgrading of the industrial structure (industrial optimization).

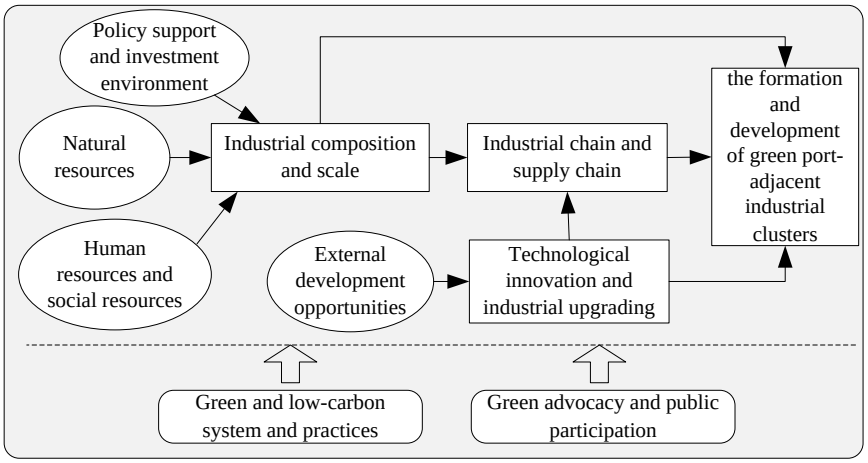

Figure 2. The formation and development of green port-adjacent industrial clusters system model

Table 5. Primary categories

Primary categories	Sub-categories	The connotation of the category
Green and low-carbon system and practices	Green environmental protection supervision	Supervision methods and practices for pollution prevention and ecological protection in industrial clusters, such as random environmental inspections and regular assessment activities.
	Construction of a green system	Standard construction for green and low-carbon development in industrial clusters, as well as systems for green management.
	Low-carbon technologies and facilities	Technologies, equipment, and facilities that can effectively reduce carbon emissions from production activities in industrial clusters.
Green advocacy and public participation	Publicity and education	Promote green and low-carbon knowledge among the public in industrial clusters, raise environmental awareness, and guide the formation of green and low-carbon lifestyles and production methods.
	Voluntary service	Organize volunteer activities related to green and low-carbon initiatives for the public within industrial clusters.
Natural resources	Port resources	The navigation and berthing conditions for ships in ports, such as shoreline resources and water area resources, serve as important foundations for the formation of industrial clusters.
	Geographical position	The natural geographical location of industrial clusters and ports constitutes an important foundation for the formation of industrial clusters.
Human resources and social resources	Human resources	Attraction and concentration of various types of talent required by all the industries
	Cultural background	The locally existing or cultivated manufacturing and business environment and culture
Policy support and investment environment	Government policy	Supportive policies provided for the development of industrial clusters, such as tax incentives and complementary subsidies.
	Supporting service	Various services that facilitate the establishment of enterprises and projects, such as factory building construction on behalf, transaction services, and information support.
	Infrastructure Construction	The various basic hardware and software systems within the industrial clusters, which assist enterprises in meeting their production, operational, and innovative needs.
Industrial composition and scale	Core industries	The core industries within the clusters, which are characterized by large output value, high agglomeration, and strong radiation capacity.
	Major project	Major engineering projects centered around leading industries aim to propel industrial growth, optimize industrial structures, and enhance competitiveness.
	Auxiliary industries	Auxiliary industries that provide raw materials, intermediate supporting products, as well as logistics, sales, and other services for leading industries.
	Foreign funded enterprises	External financial entities that invest in enterprise projects within the clusters to promote industrial development.
Industrial chain and supply chain	Ecological model and industrial chain	An ecosystem encompassing multiple partners and built around the leading industries, and a complete industrial chain.
	Supply chain collaboration	In the supply chain, multiple enterprises share information, resources, and decision-making. That can improve the supply chain system efficiency.
Technological innovation and industrial upgrading	Enterprise technological innovation	The introduction and development of new technologies, processes, products, and services has the effect of enhancing market competitiveness, reducing costs, and improving production efficiency.
	Upgrade industries	The industries within the cluster are transforming towards the modern industries with high value-added, high technology, and high capital-intensive type.
External development opportunities	Environmental and resource constraints	Environmental regulatory constraints imposed by the government on corporate activities and shortages of corporate resources are constraining factors that hinder development. In such circumstances, enterprises must change or transform.
	Opportunity for change	The critical junctures or conditions that trigger significant changes or transformations in enterprises are non-constraining factors that promote development. Examples include advancements in digitization and the development of e-commerce.

4. Model Elucidation and Series of Conclusions

In the model depicted in Figure 2, the core concept underlying the formation and development of the green port industrial cluster is jointly constituted by the green and low-carbon system and practices, as well as green advocacy and public participation. Natural resources, human resources, social resources, policy support, and investment environment collectively form a solid foundation for the establishment and expansion of the port industry. Among these, natural resources serve as the primary and fundamental prerequisite for attracting industries to locate there; human and social resources are indispensable key factors driving the composition and scale development of the industry; and policy support and investment environment function as incubators, playing a crucial guiding role in the establishment and growth of industries.

As the industrial composition and scale gradually expand, the port industrial park will initially form a clustering effect, and its sustained development will further drive the formation of a complete and efficient industrial chain and supply chain system. Meanwhile, external development opportunities will incentivize enterprises to continuously invest in technological innovation and industrial upgrading. This process will further enhance the completeness of the industrial chain and supply chain, accelerating the vigorous development of the green port industrial cluster. By continuously improving the industrial chain and strengthening collaboration within the

supply chain, the green port industrial cluster will achieve steady and sustainable development. Based on the constructed systematic model for the formation and development of green port-adjacent industrial clusters and the aforementioned elaboration, we have drawn the following series of conclusions:

(1) Establish the core concept of green and low-carbon development.

Adopting green and low-carbon development as the core concept is a critical element and inevitable requirement for building a green port-adjacent industrial cluster. Under this concept, establishing and practicing a green and low-carbon system is essential, which encompasses the implementation of green environmental regulation and supervision, the establishment and enhancement of a green system framework, the research and application of low-carbon technologies, as well as the innovation and promotion of low-carbon facilities and equipment. Meanwhile, actively promoting the dissemination of green ideas and deepening public participation are indispensable aspects for achieving the goals of green and low-carbon development.

(2) Clarify the strengths and weaknesses of natural resources and set targeted development goals.

Conducting an in-depth analysis of a port's resource situation and geographical location is the premise and foundation for establishing its adaptive development goals. By comprehensively reviewing the port's natural resource endowments and accurately grasping the uniqueness and limitations of its geographical location, we can clearly identify the strengths and weaknesses of its natural resources. Based on this assessment, adaptive development goals can be established, laying a solid foundation for the sustainable development of the port.

(3) Establish a favorable business environment and culture to attract talent from all levels.

Talent resources are undoubtedly the core element driving the vigorous development of industrial clusters. To facilitate the formation and expansion of industrial clusters, it is necessary to build a superior business ecosystem and an open and inclusive cultural atmosphere, serving as a magnet to attract and gather talent from different fields and levels. Furthermore, a series of talent introduction strategies and programs should be formulated and implemented, providing one-stop, personalized support and services for talent. This will provide a continuous supply of talent support and intellectual security for the sustained development and transformation and upgrading of industrial clusters.

(4) Provide various preferential policies and services, and improve infrastructure construction.

Implement a series of preferential policies aimed at promoting the development of industrial enterprises and projects, covering aspects such as tax incentives and supporting measures. At the same time, to further enhance the attractiveness and operational efficiency of the industrial cluster park, efforts should be made to improve its infrastructure system, including paving and upgrading roads, planning and constructing yards, expanding and optimizing warehouses, etc.

(5) Identify and introduce leading industries and major projects, supplement supporting industries, and attract exogenous investment.

Based on natural resource endowments and development opportunities, accurately position leading industries and meticulously plan and implement investment attraction strategies, focusing on introducing a batch of significant foundational projects to lay a solid foundation for regional economic development. In this process, it is also necessary to fully explore and utilize local resource advantages, reasonably layout and develop supporting industries to strengthen the industrial chain supporting capabilities of the industrial cluster park, forming a good ecosystem of complementary advantages and collaborative development. At the same time, we should actively attract exogenous capital inflows with an open attitude, providing sufficient financial support for project construction and industrial upgrading within the park through diversified financing channels and flexible cooperation models.

(6) Build an ecological model, construct an industrial chain, and strengthen supply chain collaboration.

Construct a development model with an ecosystem approach and promote the bidirectional extension of the industrial chain upstream to raw material supply and downstream to market expansion. At the same time, strengthen the connections between various links in the industrial chain, promoting in-depth collaboration, active interaction, and efficient information sharing among enterprises in the supply chain. In addition, prioritize the sustainable development of this ecosystem by advocating green production, a circular economy, and resource conservation. This will ensure that while extending the industrial chain and optimizing the supply chain, we achieve a harmonious unity of economic, social, and environmental benefits.

(7) Seize development opportunities and encourage enterprises to invest in technological innovation and promote industrial upgrading.

In response to environmental and resource constraints, as well as new opportunities brought about by changes, advocate and fully support enterprises in diving into the wave of technological innovation as the core engine driving industrial upgrading. In this process, encourage enterprises not only to seek breakthroughs in products and services but also to innovate in production processes, management models, and even their entire business models, in order to adapt to changes in the external environment and grasp the pulse of the times.

5. Conclusion

Port-adjacent industries serve as crucial engines for economic development in coastal cities. This paper focuses on the theme of the development of green port-adjacent industrial clusters, selecting the Ningbo Port-adjacent Industrial Cluster in China, the Rotterdam Port-adjacent Industrial Cluster in the Netherlands, and the Tokyo Bay Port-adjacent Industrial Cluster as research cases. By employing Grounded Theory, it analyzes the successful paths taken by these green port-adjacent industrial clusters during their formation and growth, providing experiential insights for the development of port-adjacent industrial clusters in other regions.

Through research, we have developed a systematic model for the formation and development of green port-adjacent industrial clusters. This model reveals nine key factors contributing to the success of the cases and the relationships among these factors. It also clarifies the operational mechanisms underlying the formation and development of these clusters. Then, we summarize seven main conclusions, including establishing the core concept of green and low-carbon development, identifying the strengths and

weaknesses of natural resources, targeting development goals, creating a favorable business environment and culture, and attracting talent at all levels to gather and so on.

Future research can delve into the following two aspects based on this study:

(a) Refining the mechanisms of action of key factors. This study identified nine key factors, including natural resources, policy support, and leading industries. Future research can refine how these factors specifically contribute to the formation and development of green port-adjacent industrial clusters.

(b) Policy simulation and effect prediction. Utilizing methods such as econometrics and system dynamics, future research can build policy simulation models to simulate and predict different policy scenarios, assessing their impact on the development of green port-adjacent industrial clusters.

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