



The Exploration of Port Industry Ecological Development under the Background of Low- carbon

Authors

Lei Wang
School of Management /Qufu Normal University

walliege@163.com
Rizhao,276826,China

Abstract

This paper talks about the connotation of port industry ecological trend, analyzing and exploring port industry ecological trend development from five aspects, such as enterprise, supply chain, cluster, land-sea and area, and it aims to explore the internal mechanism and development mode of port industry ecological trend. Some correlative strategy of port industry ecological trend development is mentioned and the theoretical framework of port industry ecological trend development is structured in this paper.

Key Words

Low-carbon, Ecological development, Port industry, Exploration

I. INTRODUCTION

The economy of developing country is at a transitional period in the background of economic globalization. The heavy chemical industry which is represented by steel, petrochemical and equipment manufacturing clusters to coastal by making good use of the coastal port advantage, resource, shortening transport distance and saving cost, then forming a competitive port industry cluster gradually. However, the related industry has the characteristics of high input, high energy consumption and high pollution. And this has brought unprecedented pressure to the coastal ecological environment. Today, the countries all over the world advocate developing low-carbon economy and blue ocean economy. Whether we can handle the relationship between port

industry and coastal ecological environment, harmonize the contradiction between port industry and marine industry, form a new situation of continental sea overall planning and industrial ecological development or not, has become a prominent and urgent problem. Therefore, this passage analyzed the ecological development of port industry from the perspective of circular economy, and strives to explore the internal mechanism and development mode of port industry ecological trend.

II. THE CONNOTATION OF PORT INDUSTRY AND ECOLOGICAL TREND

Port industry generally refers to the industry cluster that locates near the port and has advantages on port sources and transportation. Port industry brings the port into the production line, which makes logistics procedure fluent, saves costs extremely and promotes company's competitiveness. According to the consistent division in economic field, port industry includes port direct industry, port symbiosis industry, port dependence industry and port association industry.

Port industry ecological trend aims at realizing the harmony and coordination development of economy, society and ecological on specific port area. It is a process to establish the virtuous-circle industry system through the optimization of industry system, nature system and society system in specific land-sea area, when taking natural ecological system and the tissue framework of industry system into consideration. Compared with traditional industry system model, port industry ecological trend is characterized by ecological feature, circulation, economy and low consumption.

III. THE ANALYSIS OF DEVELOPMENT OF PORT INDUSTRY ECOLOGICAL

From the point of economic growth, port industry, just like industrial economy, follows the traditional and extensive growth path, namely a linear mode: "resource --product + waste". This approach results in more serious non-renewable resource consumption and waste discharge in both speed and scale than any other time before. What's more, the pressure from resources and environment becomes heavier and heavier. It has an essential significance to promote the adjustment of industrial structure, the transition of economic growth mode and the ecologicalization of industry by analyzing the ecological development of port industrial. In fact, the process of port industry ecologicalization is to establish a circular economy system. And it needs analyses from aspects such as microscopic, medium-view and macroscopic. Given the dispersion and sea-land unity of port industry, if we want to promote the development of port industry, we should analyze not only industry, cluster and society but also industrial chain and sea-land overall planning. The port industry ecological development is analyzed from the following five aspects:

A. Production layer of enterprise

Port industry works like a cell to realize port industry ecological trend. According to the

composition of port industry, port manufacturing especially the port heavy chemical enterprise that discharges waste water, waste gas and waste residue during the production procedure, has more influence on environment. To promote port industry ecological development, we have to urge ecological operation of port industry first, which means to realize the minor cycle within the enterprise according to 3R principle. At present, the main problems existing in the process of enterprise inner circulation system building are as follows:

First, the driven factor, the motivation for ecological operation is not enough. Under the condition of market economy, enterprise aims to chase economic benefits, that is to say, minimize the unit output cost. Enterprise should input on capital, technology and talents to realize ecological operation. Although the social benefit is obvious, enterprise may suffer from loss because of the low return rate. The figure below represents the relationship between social benefit and economic benefit of enterprise when constructs ecological operation system. Without certain incentive and guarantee measures, the social benefit and economic benefit will like curve A-C-D-E-B. Although enterprise hopes that the benefit will increase from point A to point B, it is always faced up with a stage of negative benefit, i.e. curve C-D-E. This explains why enterprise lacks initiative. The restriction mechanism and incentives are in need to promote the enterprise to follow a ecological path, i.e. curve A-D₁-B.

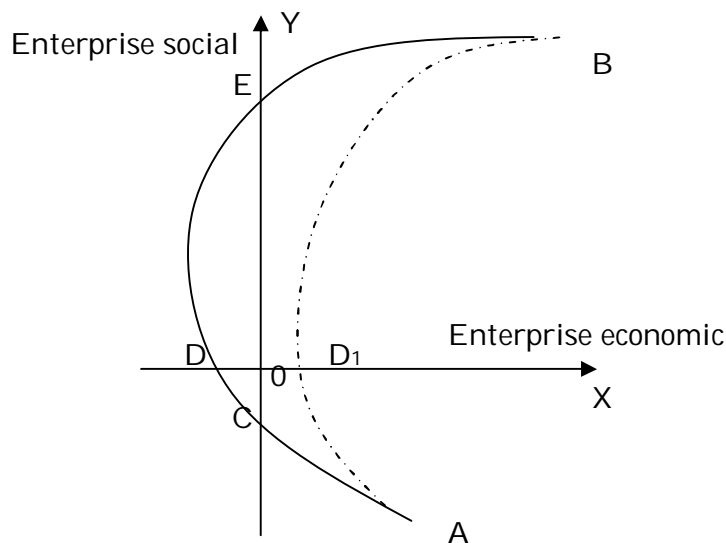


FIGURE I: THE PATH OF ENTERPRISE ECOLOGICAL OPERATION

Second, the scale factor, for individual enterprise, it is economic feasible to recycle the wastes only when wastes amount to a certain scale. But the fact is that the small and medium-sized enterprises "fail" to discharge so many wastes, which means it is not economic feasible to implement inner resources recycling. In that case, special enterprises that are professional on waste collection, classification, processing, and reuse are in need. In this way, we can realize unified treatment of individual enterprise' wastes. Theory and practice have proved that it is not

reliable to rely on enterprise's initiative to undertake social responsibility to save energy and reduce emissions.

Third, the technical factor, the enterprise ecological operation needs technical supports. It is impossible to improve ecological efficiency and decrease consumption without advanced production technology and process. At present, some enterprises lack knowledge of advanced production technology and related equipments, they ignore the investment on ecological technology and lack deep exploitation of resources and waste disposal. All these lead to the result that some advanced technologies have not been widely used yet.

B. Metabolism layer of industry chain

For an individual company, the best choice is to establish internal small loop system first. But many companies fail to do that due to the factors mentioned above, so material waste is inevitable. Therefore, to realize port industrial ecologicalization, it is necessary to build eco-port industrial chain system according to the principle of biological chain. Under the guidance of ecology, ecological economics, industrial ecology and system engineering, eco-industrial chain combines companies according to theories of material cycle and relevant industrial symbiosis to the industrial chains and networks with a complete life cycle of resource utilization. Eco-industrial chain seeks for comprehensive development of resource recycling system by minimizing the negative impacts on the ecological environment, and seeks for efficient resource use by establishing several complete industrial chains that help coordinate energy, raw materials, products and wastes between enterprises.

Traditional industrial chain is built up on the basis of product supply and demand. However, ecological industry chain is connected with the recycling of waste and it has some characteristics of the traditional industrial chain, such as sharing infrastructure resources, reducing transaction costs and so on; However, due to the ecological requirements of the enterprise in the chain coupled with its upstream and downstream companies through the exchange of material, energy, information and value to form an interaction, interdependent, common development entirety. The chain players coordinate with each other in waste emission and utilization efficiently.

There are some problems in the development of eco-industrial chain in port at present. First, the industry chain is short. Many industrial chains involve only two or three metabolic relationships. It is unable to form effective market and social effects. So the ecological effect is not obvious. Second, it is difficult to balance supply and demand. The discordance in industrial chain between the upstream and downstream in usage and emission of resource and waste is increasing, which results in inefficient demand-supply relation, and inhibits the development of real ecological industry chain and recycling eco-industrial chain. Third, the layout of players in industrial chain is unreasonable, because when design the port industry, efficiency and cost are put in the first place. Due to geographical factors, eco-industrial chain is only possible literally but not geographically. Fourth, the leader enterprise in eco-industrial chain dose not execute its

duty. Affected by market scale and policy, leading company lacks initiative to establish ecological industry chain, which results in slow extension and low level eco-industrial chain.

C. The symbiosis layer of cluster

According to the viewpoint of ecology, the port industry cluster ecology is within the range of the port area and focuses on energy use and waste disposal. Different industrial chains, related departments, technical services departments, basic services departments, research institutions and intermediaries exchange knowledge, information, conduct technology diffusion, circulate materials and energy. Finally, these departments organize a self-organizing and self-regulating functional unit.

Port industry ecology should play not only the role of eco-industrial chain but also the role to analyze the coupling of different industrial chains from the aspect of cluster. So it can make full use of resources, eliminate environmental damage and coordinate the development of natural, social and economy. Port enterprise cluster ecology is a gradual process during which the characteristics of anti- ecology decrease and ecological characteristics increase. Theoretically, the port industrial cluster system not only has to form material recycling feedback system through material producers, but has to guarantee all enterprises and the entire ecological chains can develop in a more enriched and improved way by providing intangible technical support and business services. Technical and institutional innovation and social service play a vital role during the process of improvement and development, as shown in Figure 2.

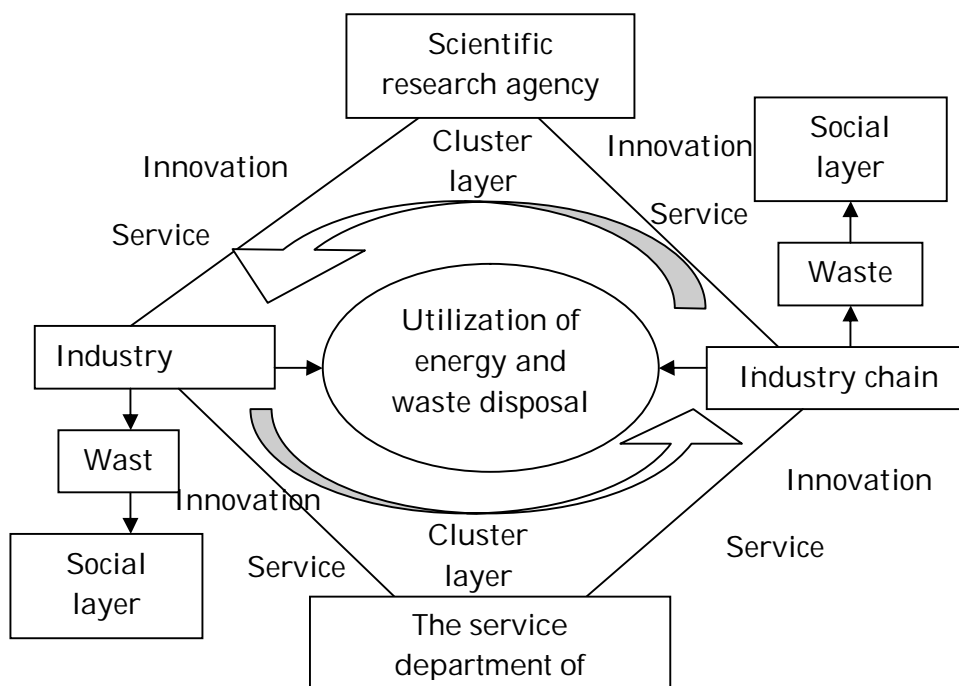


FIGURE II: THE SCHEMATIC DIAGRAM OF THE ECOLOGICAL CLUSTER OF PORT INDUSTRY

At present, the main problems in developing eco-port industry cluster are listed as follows: First, the industry concentration is low. The industrial correlation degree among different port industry clusters is low. Furthermore, various kinds of industries within a cluster lead to various kinds of wastes, and this inhibits ecological symbiosis among industry chains. A complete isolate line-ecological structure does not exist in the process of port area-ecological development, if any, it just exists temporarily. In practice, we need realize the recycling of all kinds of by-products and secondary resources according to the design theories such as "link-adding" (production link, revenue-adding link, consumption-reducing link and compound link), "unlink" "processing link" in metabolic chain.

We should promote the coupling link of the industrial chain link which is centered on port logistics in order to form a crossing ecological industry network. Second, the division mechanism of port industry is not perfect and the technical force is scattered, so it is difficult to dispose resources, and the role of cluster system can not play a full role. Because of this, each internal department can not make full use of the by-products that come from upstream, and it is difficult to have a mutual infiltration among different industry chains and dispose the waste from upstream. So we should establish a cooperation platform, on which the enterprises can operate efficiently, and we should build a platform that every company has an effective division and cooperation. With this platform as the carrier, the ecological benefits as the premise, take the economic efficiency as the core, rational planning, full information sharing, to achieve the enterprise symbiotic objective. The carrier to promote port industry ecological cluster is e alongshore-sea industrial park.

D. The coupling layout of sea and continental

The rapid development of port industry has great influences on marine ecological environment. Currently, the land-sourced pollutants discharged into the sea remains serious problems. And exhaustion of fisheries resources, reduced marine species, islands deterioration of ecological environment, the weakening of coastal resilience, and sudden marine environmental disasters all threat the sustainable development of coastal areas. Therefore, it is the important link that builds a harmonious integration of land and sea ecosystems to promote the development of port industry ecological trend. In the land and sea coupling level, there mainly exist the following several aspects: First, the marine industry and land industry don't have strong docking capability. Although the marine industry is an important part of the port industry, the current development of marine industry is still relatively extensive, mainly in farming, fishing and tourism and other related fields, high value-added processing of marine fisheries are developing relatively slow and marine resources as a basis for the development of two or three industry is still in its early growth phase, a smaller proportion of marine high-tech industries, and low level of industrialization is a very prominent problem. Second, the other port industry is now invading the marine industry related resources, and producing negative effect on the marine industry. On the one hand, the coastal area reclamation is developing to the direction of high speed, large area

and wide range. "Ask land from sea" eases the development of land resource "bottleneck" of the risk at the same time. The lack of proper planning and excessive reclamation activities implemented will have a negative impact, resulting in local waters degradation of marine ecological system and even the loss of near shore. And it can even have effect on marine fisheries resources, destruct natural shoreline and increase pollution of the marine environment. On the other hand, the phenomenon of land-based pollution remains a serious impact on marine ecological system. It concludes conventional sewage pollution also includes various types of sudden catastrophic event marine pollution.

E. Regional ecosphere

From the whole social aspect, the final purpose of eco-industrial port is to promote the construction of the port regional ecological system, harmonize the development of man and nature, and finally establish an ecotype society. The following several aspects are the main problems in ecotype society: First, to promote the development of the related system of ecological port area, and the relevant laws and regulations of the development of regional ecological is not perfect. The development of circular economy started late in China, and we lack corresponding laws and regulations. As a new mode of economic development circular economy is a system engineering which is a set of economic, technology and society, and it needs the support of law, regulations and systems. The paid use system and incentive mechanism of the ecological environment is the fundamental guarantee to develop economy, it includes elements of the ecological environment system of pricing, production responsibility extension system, consumer responsibility system, the government responsibility system, resource recycling incentive mechanism, incentive mechanism of the economical use of resources, ecological technology support mechanism, the relevant tax system and pollution compensation, these systems need to be established and improved in China. Second, a complete free market economy system can not achieve the development of circular economy. The history of the modern economic development proved this, the role of government macro-control is more and more important and essential with the development of the market economy. At present, the majority of small and medium-sized enterprises are in the state of free competition, and the market is like a pair of invisible hands to play a leading role. Under the free market economy, many asymmetry problems exist in the market, that is to say, the role of the market is in a blind area and it is impossible to realize the development of circular economy simply relying on the role of the market, and the operation of the market will not be useful if the treatment of environmental pollution and waste is not under the constraint of the market. Third, the society has not yet established the consumption value system of ecotype social life. Social mobilization mechanism is single, and the participation consciousness and ability of public is not strong. The public and non-governmental organizations are the strong power in the development of circular economy. Because of the information mechanism is not clear, it is difficult to obtain the information resources of the development of circular economy, so the public lack the awareness of the importance of the development of circular economy, green conception, environmental awareness and the awareness of social

participation. At the same time, the intermediate link is lost because of the lack of large masses of environmental protection organization, so it is difficult to achieve the desired effect simply relying on the promotion of the government. Fourth, the mechanism of the government promotion is inordinate. The government is the leading and the driving strength to develop the circular economy. Under the development of the circular economy, because the main point of benefit is different. In the development of circular economy strategy, some governments pay attention to the growth of GDP in the pressure of the economic growth and stressful employment ignoring the environmental benefits, and their attitudes are so negative that the actual effect of the development of circular economy is not good.

IV. FRAMEWORK OF PORT INDUSTRY ECOLOGICAL DEVELOPMENT

According to the above analysis, the ecological system of port industry needs to be constructed according to the range from small to large and the minimization principle of the interlayer exchange of material and energy, then construct an economic system. Now we will discuss from the above five aspects in the following.

A. Enterprise level: pay attention to the science and technology innovation

Studying on the composition of port industry and analyzing the ecological construction of enterprise is important. So we should study on the characteristics of enterprise from the level of technology and the characteristics of enterprise "three wastes". According to the principle of energy reduction to design the small circulation of enterprises, and promote the cleaner production and resources cyclic utilization in enterprise, then create a recycling enterprise. We must guide the enterprise to study, introduce and digest, and we also need to extend the production technology of clean, to improve the level of enterprise environmental management, and to reduce energy consumption, material consumption, water consumption of the unit production and pollutant emissions. We need to clean the production, and strive to build a small circular system of port ecological. We should put the development of recycling economic into the overall development planning of enterprise, establish and improve the long-acting investment mechanism of the development of recycling economic from a long, strategic perspective. Finally, we should strengthen the internal management of enterprise, set up some full-time organizations to save energy resources, clean production, and manage environment. And we should ensure company's goal, responsibility, and assessment index system. In these aspects, the enterprise should analyze from productive level and the production operation system:

The product level: in the product level, we should have ecological evaluation and design of the product, and norm the quality and ecological standard of product. In the process of the development and design of product, we should reduce the environmental impact which is from products. We evaluate the product in a mode of "from the cradle to the grave", seeking to the chance and methods to improve the environmental impact of products, so this can provide technical support for ecological design of products. We should scan the whole life cycle of the

products from the perspective of sustainable development, and have a systemic analysis and evaluation according to the perspective of life cycle in the period of product development, in order to eliminate the negative and potential impact on the environment, then we strive to form a process "from the cradle regeneration". Ecological design should consider ecological performance and economic performance of environment, and consider all stages of developing and using, and we should research and choose the product which has a small effect on environment in life cycle.

Production operation system layer: First, it is to improve the manufacturing process and reduce resource consumption. Enterprises ecological production technology depends on the degree of level in resource utilization of integration and process optimization. The reform of the manufacturing process, the development of new technology, the use of resources and energy in high utilization, efficiency and high conversion rate of raw materials, few pollutants produced in new processes and few pollutants and the waste of resources in the manufacturing process, making the waste can be recycled and finally the waste can be decomposed then maximize realize less waste or no waste production. Re-examine the production technology and manufacturing processes, then to carry out clean production and to reduce waste production. The development of new green technologies and new processes in the way of efficiency material conversion, clean, rational use of resources, including the following: the establishment of a new system of environmental resources and unity of cleaner production strategies in the control of methodologies source; zero emissions target management system; establishment in material flow process industries, energy flow, information flow comprehensive optimization of process integration; development of bio-conversion technology, renewable resources and alternative technologies and the establishment of internal matter, energy stratified multistage loop optimization utilization system. Second, using energy-saving equipment or upgrading old equipment. If we want to carry out cleaner production in the production process, we should start from the green manufacturing equipment, that is to say, using energy-saving equipment, researching new equipment or upgrading old equipment to achieve energy saving. Third, to achieve the renewable cycle, we can use recycling and reuse technology. The manufacturing process of the regeneration cycle can be the main application of techniques for disassembly and recycling technologies. Technology of disassembly means is according to the minimum additional cost and maximum utilization of the principles of value if the best disassembly procedures and methods are developed. And by the secondary manufacturing we would recover the characteristics of the products to the state which is close to new, this is not only to extend life of product but also promote recycling of components and materials. Recycling technology is secondary utilization technology in the disassembled components or material of components.

B. The level of industry chain: strengthen the industry tie-in

If we want to construct the industry chain of circular economy, we should focus on the introduction of the technology key link, pay attention to the industry chain of enterprise, and strengthen the docking of metabolic chain, then form a recycling ecological chain of waste and by-

products to promote a high link of material flow and energy flow in supply chain. The structure design of port ecological industry chain uses a mode of the development of ecological industry chain which is centered on the leading industry chain (value chain), and expend in a downward vertical extension and horizontal ring. Downward vertical extension is to extend the industrial chain. In addition to stress the first treatment of raw materials by using port advantage, we need to increase the added value of products and stress the benefit of the service increment. The main form is to couple by the chain structure; also it is a one-dimensional chain structure and directly coupled on the port vertical industry. It has a coupling of longitudinal system and the transformation of natural food chain in natural ecosystems to longitudinal input-output chain which is based on manual through the production and technical means in the range of port. There are many vertical industry chains relying on various materials in the port area. Horizontal ring to expand is to make a deep processing of by-product or waste from the ecological industry chain. Finally a crossing chain network of port ecological industry chain is constructed to achieve the coordinated development of social, economic, and the benefits of ecological environment.

C. The level of cluster: highlight the symbiosis of cluster

Port industrial cluster is the product of economic interests under the market mechanism, and it is difficult to form ecological generally. With the development of economic, the driving force for sustainable development of the cluster will gradually become not enough, and it is mainly caused by the following defects: firstly, the traditional cluster development dose not consider the load capacity and suitable density of cluster environment, and blind expansion of the cluster scale also brings great pressure to the environment. Secondly, the cluster of industry chain is too single, the number of producers and consumers is too large, and the number of decomposer is limited. Thirdly, resource utilization rate is low and the waste is serious without introducing the concept of circular economy within the cluster, causing a severe damage to the ecological environment and affecting the sustainable development of the cluster. Finally, the development of cluster dose not considers the relationship of the enterprises symbiosis in the cluster. The individual of clusters lacks strategic vision, and they work by their own free will, causing the benefit in competition is gradually lager than the benefit in coordination in cluster.

The park area of port ecological industry is the effective carrier of the ecological port industry cluster. By promoting the transformation of port industry from the agglomeration of cost to the agglomeration of ecological symbiosis, we need strengthen the sharing of resource integration and the introduction of enterprise called "fill chain". We need form a network of ecological industry between symbiotic enterprises and industrial chains. The establishment of ecological industry cluster can be made with the type of existing transformation, the type of new planning, multi interests driven and supplementary mode network. First, the type of existing transformation is based on the link relationship within the energy, water, raw material utilization status, and the relationship within logistics and energy flow to improve the ecology, strengthen the cooperation between upstream and downstream in enterprises and to extend the

industry chain. Second, according to the concept of circular economy, the new park area will have an overall planning and selection of enterprises, and build a reasonable industry and the chain network of product to achieve the optimal combination of structure of park industry. According to some factors such as the direction of development, industrial structure, supporting facilities, and the surrounding environment, we need have the full implementation of environmental management and collaboration enterprise and make a system of environmental management which is suitable for the authorization and record of project and daily operation. We should promote enterprise to operate in the resources production, product eco-design, waste utilization and other aspects, to achieve a significant reduction in the amount of park pollution or even a "zero emission"; through the improvement, optimization and integration of park infrastructure, to promote focused distribution, centralized management and emissions standards of pollution projects. Third, the type of multi interests driven is the market-oriented models that can strengthen the construction of by-products transaction and promote integrated development of symbiosis industry. Fourth, supplementary mode network is to perfect complement existing industrial symbiosis chain and strengthen linkages between chains, by increasing the number of nodes and size of enterprises to strengthen the professionalism and interdependencies between enterprises, thus forming a more stable industrial symbiosis network.

D. level of sea-land: Embody overall planning of sea-land

The integrated construction of Co-ordinate industrial marine industry and terrestrial integration have the characteristics of coexistence and common prosperity and complementary and mutually. Future development of port industry will be based on the port and co-ordinate the use of sea land, then forming high-end industrial agglomeration of ecology, recycling, efficient and sustainable. On the one hand, it can prevent the marine to affect land, mainly pollution. On the other hand it can prevent the land to affect marine, mainly marine disasters. Thus we emphasize the unified management of land and sea and management which are based on protection. Mutual convergence is required not only on planning but also on coastal zone management. The management of sea, land, port and fisheries should be interrelated, rather than the transport sector think harbor should be built along deepwater coastline. But the fisheries sector is anxious to expand the scale of farming. In addition, the coastal areas should also strengthen regulation and repair. First, strengthen technology research. Second, implement specific projects and protect or restore the remediation. The means of Integrated Coastal Zone Management is sustainability and the goal of it is development. Third, we should strengthen the development of strategic marine industries and accelerate depth adjustment and update in the structure of marine economic.

E. Regional level: Promote the construction of eco-cultural system

Ecological development of port industry is inseparable from the concept of industrial ecology. Establishment of a regional mechanism for the development of ecological culture is the most powerful protection to promote the development of port industrial ecology. In this regard, the

government should strengthen the guidance from the concept, and build eco-cultural system that can promote the development of port industry from the relevant supporting policies, systems and even physical layer level. From the three levels of individuals, businesses, governments to establish regional eco-cultural ideas, make it our core values and consistent principles in guiding our general business. Through the establishment of effective ecological constraints and incentive management system, we can link the mechanism of ecological culture with the relevant laws and regulations, decision management, performance appraisal, investment, personnel appointment and removal and many other aspects, in order to make it related to the index of ecological industry. Give full play to the role of science and technology; improve the specific relevant indicators and transparency of indicators and then strengthen the supervision and guidance. Through the establishment and improvement of various waste materials and water reuse system on material level to promote waste classification of port industry and to construct regional waste classification dismantling and the base of recycling processing. Perfect relevant services supporting measures, sound various intermediary service organizations, inhibit environmental suppress speculation, promote enterprise ecological monitoring system and form the material and cultural foundation of ecological development of the port industry.

V. CONCLUSIONS

Ecological development of the port industry is the necessary requirements of economic and social sustainable development. In the background of transformation of mode, adjustment of structure, benefit for people's livelihood, development of a blue economic, we need to follow the related laws the development of ecological industry and rely on the progress scientific and technological, to analyze and research from enterprise, industry chain, clusters, sea and land, region and other levels. This paper construct the related framework of the development of port-related industrial ecology from the above five aspects. Therefore this can provide a reference guide for a healthy sustainable development of port industry.

REFERENCES

- [1] Wei Feng. (2007). Theory Summary of Industrial Agglomeration, Circular Economy and Relationship between Them [J]. Ecological Economy, 7, 107-110.
- [2] Wenjun Wang.(2009). Exploration on Technical and Economic Paradigm of Low Carbon Economy Development [J].Social Sciences in Yunnan, 4, 114-117
- [3] Haoran Xu, Xiaodi Xu, Zilong Wang, (2009). Diagnosis of government Role in Industry Ecosphere Construction [J].Chinese Public Administration, 290(8), 83-87
- [4] Nannan Dong · Changbiao Zhong. (2009). Research on Developing Recycling Economy to Promote the Coordinated Development of Land Economy and Marine Economy [J].Productivity Research, 17, 95-98
- [5] Xiaoping Wei, Kun Li.(2005). Evolution Game Research of Duplication Dynamics towards Industrial Ecology Linkage' s Building [J].China Industrial Economy, 213(12)

- [6] Kun Li, Jisheng Peng. (2009). Premise of Keystone Enterprise's Function Based on Measurement of Ecology Niche [J], *China Population, Resources and Environment*,19(4),129-133
- [7] Zuo Zhiping, Zhang Bo. (2013) Analysis on Operational Pattern and Stability of Cluster Supply Chain Symbiotic Network [J].*Ecological Economy*,271(9) · 120-124
- [8] Tudor T, Adam E, Bates M (2007) Drivers and Limitations for the Successful Development and Functioning of EIPs (Eco-industrial Parks): A Literature Review [J]. *Ecological Economics*, 61, 199-207.
- [9] Desrochers P (2002) Regional Development and Intert Industry Recycling Linkages: Some Historical Perspectives [J].*Entrepreneurship and Regional Development*, 14, 49-65.

AUTHORS' BIOGRAPHY



MR LEI WANG is currently an associate professor in the School of Management of Qufu Normal University, Rizhao, Shandong province, China. His research interest includes operations management and port logistics management. He has published a few papers in the above areas.