

Research on the Coupling Mechanism of Industrial Chain based on Circular Economy

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Abstract— *Circular economy is a new economic operation mode that emphasizes symbiosis and synergism the formation of an ecological network of resource recycling is its fundamental feature. The article takes the development of ship breaking industry in Sitakunda, Chattogram Division, Bangladesh as a case This paper analyzes on the evolution process and the micro operation law of the circular economy industrial chain, probes into the mechanism of the industrial chain coupling, and advances some countermeasures for promoting the development of the circular economy industrial chain.*

I. INTRODUCTION

1.1 Topic Overview

Circular economy is a new economic operation mode that emphasizes symbiosis and coordination The formation of an ecological network of resource recycling is its fundamental feature. This kind of ecological network can exist not only in large enterprise groups, but also in the industrial chain formed by the cooperation of several enterprises around relevant resources. The difference between circular economy industry chain and ordinary industry chain lies in the circular economy industrial chain puts more emphasis on the interdependence between the enterprises at each node of the industrial chain. If a node in the chain breaks, the whole industrial chain may collapse.

Therefore, the coupling mechanism of the industrial chain is particularly important, and the discovery or increase of value is the key to the coupling of the industrial chain

With the proposal of the Scientific Outlook on Development, the study of circular economy in Bangladesh is a subject of great academic value and realistic urgency The research results are also rich. In the operation of circular economy Scholars made detailed research on its operation mechanism and dynamic mechanism from different perspectives, such as author in [1] used game theory to analyze the cooperation mechanism of circular economy; author in [2] proposed the mechanism of circular economy chain from a macro perspective It is considered that the industrial ecological chain is a necessary condition for the

implementation of circular economy; author in [3] used transaction cost theory to analyze the symbiosis mechanism of enterprises in eco industrial parks; Author in [4] analyzed the possibility of industrial chain composition, and then discussed its realization form and development path; Author [5] analyzed the value chain and management of eco industrial parks; Author [6] analyzed the stability of the circular economy industry chain based on the value chain. The contribution of these documents in the micro field of circular economy It is instructive to further explore the coupling mechanism of circular economy industrial chain. However, in general, there are few studies on the relationship and operation rules among enterprises and industries of circular economy. The analysis of the operation mechanism of circular economy industrial chain is a “one field to be broken through”.

II. THEORETICAL BASIS

Industrial chain is the product of division and cooperation among affiliated enterprises. The basis of division of labor and cooperation is common interests. The premise of obtaining common interests is value appreciation Value chain has become an important perspective to analyze the coupling of industrial chain.

2.1 Industrial Chain and Value Chain

Industrial chain refers to a key product, the relationship between different industrial sectors involved from formation to final consumption. Industrial chain in a narrow sense It is an industry that produces certain products and services with circular use function throughout Various elements are linked to form a “chain”; The extended industrial chain can also be called the industrial ecological network It refers to a network system based on the division of labor within the industry and the relationship between supply and demand, with several enterprises as major nodes and products as small nodes [7].

Michael first developed the value chain. Porter proposed it in 1985. Porter believes that “every enterprise is a collection of activities in the process of designing, producing, selling, sending, and assisting its products. All these activities can be shown by a value chain.” The value creation of an enterprise is formed through a series of activities. These different but interrelated production and

operation activities constitute a dynamic process of value creation, namely the value chain. The value chain is ubiquitous in economic activities. There is an industry value chain between upstream and downstream related enterprises. The connection of each business unit within an enterprise constitutes the enterprise’s value chain. There is also a value chain connection between each business unit within an enterprise Each value activity in the value chain will have an impact on how much value the enterprise can achieve. The value chain provides the value basis for the industrial chain Related enterprises compete and cooperate to improve their position in the value chain.

2.2 Value Chain Characteristics of Circular Economy Industry

The circular economy industry can form a chain It is because of the force that there is an interest space for cooperation This interest space is the value basis of the circular economy industry chain. As the circular economy industrial chain is a value chain formed based on resource conservation and reuse, it has the following characteristics compared with the traditional value chain [8]:

- (1) **The combination of value discovery and value appreciation:** The traditional value chain focuses on value appreciation Focus on profits rather than resource conservation. The value chain of circular economy industry is a process combining value discovery and value appreciation, that is, finding the residual value of resources from waste It starts from the rational allocation and utilization of by-products after natural resources are put into production and the main products are manufactured Realize the transfer of residual value of resources in another industry. Due to technical and conceptual reasons, the potential value of residual resources must be arranged through certain systems Technological innovation and organizational innovation will find out, and the reuse of resource residual value also has a prohibitive cost. When the residual value of resources is lower than its reuse cost People will give up the reuse of residual resources The market link of the industrial chain based on this is often fragile However, this value chain is extremely valuable It realizes the

maximum utilization of resources in the way of full transformation of resource value, and realizes the win-win of economic benefits and environmental benefits.

- (2) **Ecological network value chain:** The traditional economy is a linear economy. The circular economy is closed. The value chain of circular economy is composed of various links to discover and utilize potential value. The activity of value discovery runs through the whole process of material flow, so the form of material flow in circular economy is nonlinear. It may appear in the form of “ring”, “chain”, “net”, etc.
- (3) **The value chain is longer:** The circular economy production mode itself has lengthened the industrial chain and deepened the development of resource value. In this process, the originally abandoned by-products have been recycled, treated, and processed as production links are added, the value chain is extended accordingly. The same resources create greater value.
- (4) **The dependence degree is higher:** The traditional value chain is mainly the input of raw materials and semi-finished products, which are generally standardized and market-oriented. Easy to obtain through market transactions. The relationship between the trading partner or the node enterprises in the chain can be loose, and the degree of dependence is low; The circular economy industrial chain is mainly the reinvestment of abandoned by-products, standardization and low degree of marketization. The connection between node enterprises in the chain is unique and close, and the degree of dependence is higher.
- (5) **The value chain structure is characterized by network:** Traditional value chains are usually linear. That is to say, the value transmission and appreciation of a certain product in a pipeline way; Under the circular economy model, the value of resources will be more fully utilized. The same resources are used by multiple industries or

repeatedly. The material cycle brings about production detours, and the multiple development of resources leads to the subdivision of the use value of resources, and the value chain crosses many times. Therefore, the shape of the circular economy value chain may be characterized by network and ring.

2.3 Coupling Mechanism

The core of circular economy is resource conservation and environmental friendliness. The goal of any economic activity is to maximize profits. For the four dimensions of the industrial chain, the value chain is the leading factor, the enterprise chain is the carrier, and the product chain is interlinked and the value chain is realized through the spatial distribution of the enterprise chain [9].

- (1) **Driven by the deep utilization of resources:** The formation of the circular economy industry chain is closely around the development and utilization of resources, including the reduction of the use of resources, the full use of resources and the recycling of resources. Enterprises are connected to form an industrial network chain based on the relationship of resource utilization. Each enterprise on a node is a link in the comprehensive and circular utilization of a certain type of resource. Wastes from a certain link (enterprise) are likely to become the resources needed for the production of the next link (enterprise). Enterprise networking is to maximize the utilization of resources. In the circular economy industry chain, waste value discovery and reuse technology and enterprises are very important. With the embedding of these technology nodes, the coupling force of the industry chain is stronger and the structure is more stable.
- (2) **Ecological drive:** The circular economy is essentially an ecological economy. It is an economic circular activity with “resources - products - renewable resources” as the closed-loop feedback under the control of ecological laws. Change “resources - products - pollution and waste” This single linear traditional

economic model. There is a symbiotic relationship between the various elements within the ecosystem. Circular economy industry is an ecological industry or an industry with eco-friendly characteristics. Systemic symbiosis requires that the economic activities of the industry conform to the ecological law. In an eco-industrial system, each production process is not isolated, but is related to each other through material flow, energy flow and information flow. Wastes from one production process are used as raw materials for another production process. This interdependence and symbiosis restrict industrial activities, thus affecting changes in industrial costs and benefits. The ecological drive requires that all enterprises in the circular economy industry chain should pay attention to the 3R C reduction, reuse and recycling principles of environmental protection and resources. When these requirements conflict with the economic interests of enterprises, the price formation mechanism should be reconstructed, With the assistance of other systems, environmental protection will become an urgent need of every enterprise. Waste reprocessing will also become a profitable market. The economic relationship between traditional industries and environmental protection industries will be formed. Under the effect of industrial agglomeration, enterprises engaged in waste reuse and pollution treatment will automatically join the existing industrial chain and become a new link.

- (3) **Benefit driven:** The formation of circular economy value chain is based on the premise that its profit is greater than zero, which is also the economic power for the sustainable development of circular economy. The value chain is a highly integrated and interdependent system. Once the economic value chain is formed, it means the integration of economic value, social value, and ecological value. When the operation of the value chain is in a value-added state, the circular economy is sustainable development. The reason

for the formation of the industrial chain is the realization and creation of industrial value. It is to create industrial value maximization. If the recycling of waste products and wastes into useful resources is much more expensive than the purchase of added resources, the enterprises on the chain link cannot realize value increase and profit, and the circular economy industry chain cannot develop.

The coupling benefit of the circular economy industrial chain is not only reflected in the value creation (value added) at the level of cooperative enterprises, but also in the “cluster value” of the whole chain (network). For example, due to the coupling effect of the industrial chain, enterprises gain economies of scale and scope through division of labor and cooperation and resource complementarity, forming a regional common brand and improving the competitiveness of the entire industry, which ultimately promotes the improvement of the interests of cooperative enterprises.

III. RESULTS AND ANALYSIS

3.1 Case Study

Bhatiari is a place situated at Bhatiari Union in Sitakunda, Chittagong. It is a famous ship dismantling area in Chittagong. The place is surrounded by several lakes and hills, with rich coastline resources the water transportation is convenient. The 10000 ton ship can directly enter Bhatiari through the Bay of Bengal. Ship scrapping industry is praised as “smokeless metallurgical industry” by world metallurgical industry experts. According to data, ship scrapping can reduce gas pollution by 86%, water pollution by 76%, water consumption by 40%, and mining waste by 97%. Ship scrapping industry is a resource friendly industry and a typical embodiment of circular economy.

Driven by Sitakunda Shipbreaking Co., Ltd., a leading enterprise in Bangladesh’s shipbreaking industry, more than 100 private enterprises in Sitakunda Town’s shipbreaking industry have developed rapidly. These enterprises use waste ship materials to produce various small flat steel, square steel, round steel, steel furniture and hardware products There are more than 6000 employees, with an annual output value of more than 2 billion USD; More than

1000 people provide logistics, transportation, catering and other services for these enterprises. At present, Sitakunda Town has basically formed a waste ship dismantling industry. The industrial cluster with the recycling and deep processing of dismantling materials as the industrial chain as shown in Figure 1 and Figure 2. Through ship

dismantling and its industrial chain, Sitakunda Town provides tens of millions of USD of tax for the country every year. It solves the labor employment of 10000 people, and ship dismantling has become the pillar industry of the town.

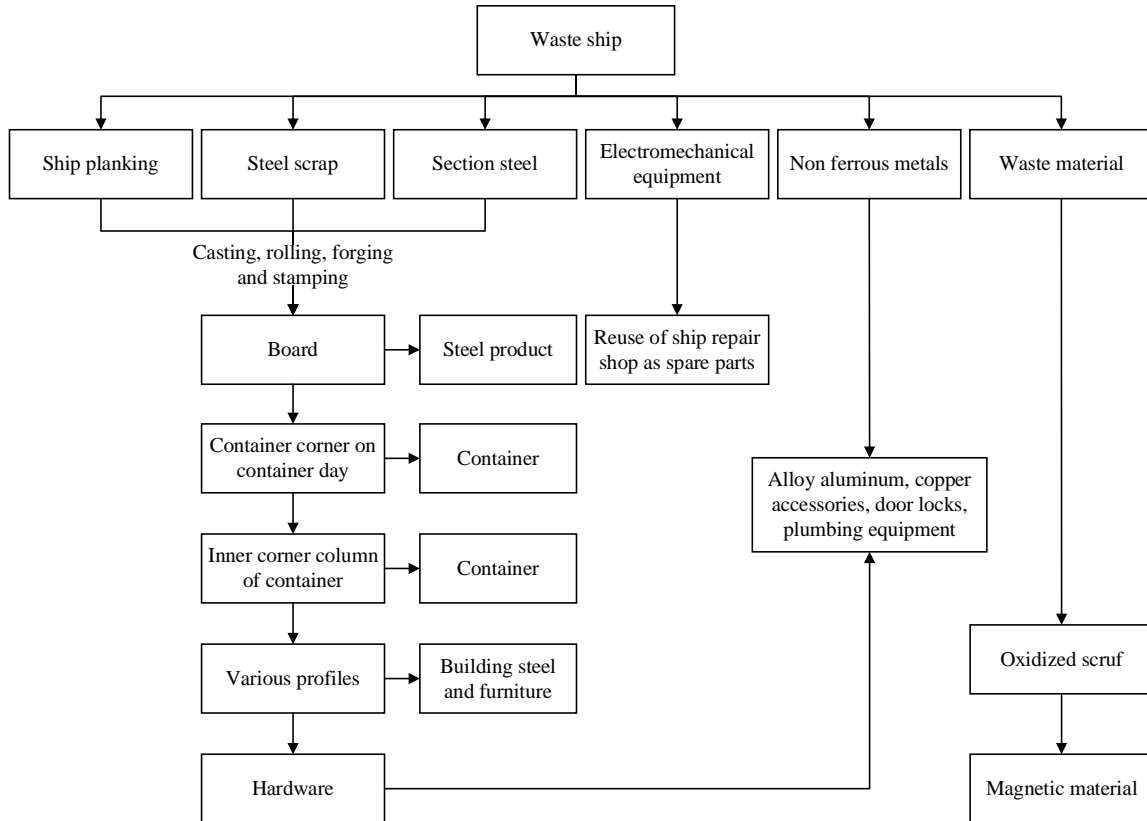


Fig.1: Product chain of Sitakunda ship dismantling industry

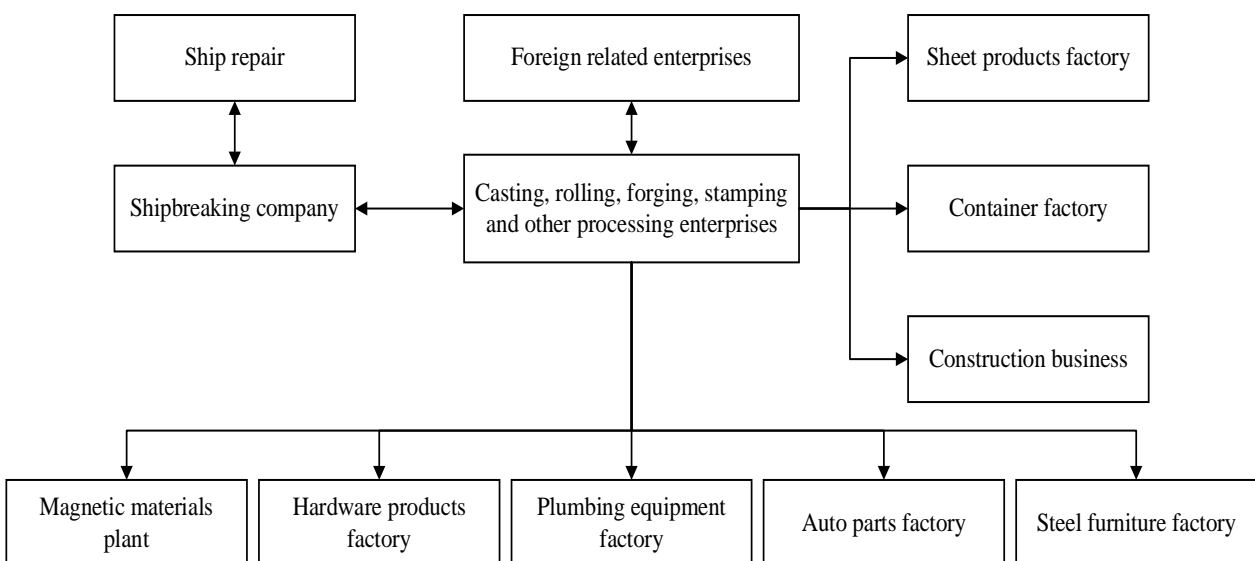


Fig.2: Enterprise chain of Sitakunda ship dismantling industry

3.2 Results Analysis

“A ship is a treasure. It needs a lot of high-quality steel and precious metals to build. It is equipped with advanced machinery and equipment. A retired ship can get a lot of steel, nonferrous metals, available machinery and equipment, and ship accessories after being disassembled. From the proportion of a ship, its ship plate accounts for 47%, 25% is section steel, 20% is scrap steel, 5% is instrumentation and 1% is nonferrous metals, and only 2% is waste. Ship companies have been engaged in ship dismantling business for a long time, but only steel plates were used well in the early stage of ship dismantling. The dismantled scrap steel was not only useless, but also spent a lot of money to deal with it. They did not embark on the road of comprehensive utilization of scrap ship steel resources for deep processing and development of circular economy. Later Through market research and technical innovation, the company has invented new technologies and new processes to refine ship scrapping steel by electric furnace, sand molding, 24-hour continuous injection, computer controlled heat treatment, milling surface processing with special machine tools and continuous protective treatment. A series of high added value products, such as container angle and rolled container inner corner column, have been successfully developed using ship scrapping scrap. Thus, the company has transformed from a single ship dismantling to a comprehensive enterprise integrating ship dismantling, casting box corners and rolling profiles, forming a new industrial chain of “dismantling casting rolling” Walk out a new way to develop enterprises through circular economy. Now the company has 8 box corner continuous casting production lines and 2 profile production lines. The annual output of container corners is 1 million sets, and the inner corner columns of containers can be rolled. The ship’s spherical flat steel, truck’s special flat steel and other special sections are 200000 tons, and the ship is currently dismantled. The market share of box corner and profile products has reached 50%, and the production and sales volume are the first in Bangladesh. The total output value is more than 1 billion USD. The tax paid is tens of millions of USD; In addition to supplying container manufacturers all over the country, the box corners and inner corner columns produced by the company are also exported to foreign markets, generating more than 85

million dollars of foreign exchange directly or indirectly every year; It also sells 50000~60000 tons of thick steel plates every year. Shafts and other steel products to all over the country and abroad.

At first, Sitakunda Shipbreaking Company mainly engaged in ship breaking. The dismantled scrap steel is mainly sold to small steel processing plants nearby because of their small scale. The equipment is simple, the technology and management are backward, and the investment in environmental protection is small. Moreover, the product quality is also low, which seriously restricts the value added of the entire industrial chain. Later, the company gradually realized that environmental protection must be the starting point for better development of the ship dismantling industry chain. Pay attention to the value added of the entire industrial chain. The company adopts self-construction, merger, integration and other measures. Internalization of some steel processing enterprises into the company. In addition, the government has optimized the industrial organization by controlling the setting and scale of ship breaking plants and steel rolling points. From the practice of ship dismantling industry, the upstream is moderately integrated and centralized, and the downstream end product manufacturing is liberalized. It is the most efficient to form an industrial chain structure with a few large enterprises in the upstream as the center and leading, and many small and medium-sized enterprises in the downstream coexisting. Sitakunda Town has not only become a famous green ship dismantling base at home and abroad, but also has good economic benefits and strong international competitiveness.

IV. CONCLUSIONS

The difference between circular economy industry chain and ordinary industry chain is that circular economy industry chain emphasizes the interdependence between enterprises at each node of the industry chain. It is a huge. Whether the subsystems of a complex system can be coupled and dynamically balanced. It is the key to implement circular economy and achieve the best comprehensive economic benefits. The rupture of a node in the chain may lead to the collapse of the entire industrial chain. Therefore, the coupling mechanism of industrial chain is particularly important. The discovery and increase of value

are the key to the coupling of industrial chain.

The value chain of circular economy industry is a process of value discovery and value appreciation. It realizes the maximum utilization of resources in terms of the full transformation of resource value and realizes the win-win of economic benefits and environmental benefits. Relative to the traditional economic value chain in the structure of circular economy industrial chain, the value chain is longer and enterprises are more dependent on each other, and the nodes of the value chain are crossed and the directions are circuitous. It is characterized by reticulation and ring shape.

From the perspective of coupling mechanism, resources are driven by deep utilization. Ecological drive and interest drive are the three driving forces of circular economy industrial chain coupling, among which interest drive is the key. The coupling benefits of the circular economy industrial chain are not only reflected in the value creation (value-added) at the cooperative enterprise level, but also in the “cluster value” of the whole chain.

The development of circular economy industrial chain will often form corresponding industrial clusters in a certain region. Moreover, industrial chain structure optimization and enterprise innovation are very important to improve the performance of the industrial chain. Therefore, on the basis of market forces, the government should promote it by creating appropriate laws, policies, systems and awareness environments. For example, building eco industrial parks to form an eco-industrial network between enterprises or industries. Connect different enterprises to form a symbiotic combination of industries sharing resources and exchanging by-products and a circular economic network of mutual benefit. Realize the closed circulation system of material and energy flow, and achieve the optimal allocation and utilization of park resources. Reduce the environmental pollution to the lowest level and greatly improve the economic benefits of enterprises in the park.

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