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Research on Optimization of Waste Material Recycling Logistics of Hubei Province Based on "Internet +"

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***Abstract*—Recycling and utilization of waste materials is an environmental protection idea proposed by the modernization of the country, also it's another circular economy industry under the national macro-control. The recycling and utilization of waste materials is researched in this paper. Based on the analysis of the problems and drawbacks of waste material recycling logistics in Hubei Province, with the integration of supply and demand network concepts with relevant logistics enterprises in cities, this paper puts forward a flexible consortium structure model of waste material recycling logistics in urban and rural communities based on the internet, so as to optimize the efficiency of recycling waste materials, and meanwhile, to realize the economic, ecological and social benefits brought by waste materials recycling.**

Keywords*— *Internet; waste materials; recycling logistics; reverse logistics

I. INTRODUCTION

This century is an important period of strategic development opportunities for our country. At the same time, we are also facing a grim situation of resources and environment. It is an important task for our country to improve the utilization rate of resources, alleviate the pressure of resource shortage and environmental pollution, vigorously develop the resource regeneration industry and achieve the goal of sustainable economic development. At present, a large number of garbage and waste materials are produced in urban and rural areas of China every day. Because of the lack of effective treatment, they are piled up like mountains, occupying more than 2 million mu of land each year and polluting the river basin by about 20 million mu. Garbage is wealth in the wrong place [1]. To do a good job in recycling, classifying and recycling of garbage and waste materials can create tremendous economic, ecological and social benefits for us [2]. Recycling and utilization of renewable resources is an important part of comprehensive utilization of resources and environmental protection industry. It is also an important measure to rationally utilize resources, protect the environment and promote sustainable economic development. In the key action of the State Council's Guiding Opinions on actively promoting the "Internet +" action, which was released in 2015, the Internet + green ecosystem was defined [3]. It was proposed to improve the waste resource recycling system and establish an online waste trading system. Therefore, it is particularly important to study the optimization of new waste logistics recovery logistics [4].

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II. DEFINITION OF WASTE MATERIALS

Waste materials, which are old (idle) or abandoned, can be recycled as renewable resources. Material of little value remaining in the course of daily production and life, including: obsolete, scrap, second-hand, inventory, materials produced by production and life. For example, scrap metals, waste paper, and recycled plastics and so on, and even a considerable part of the waste household appliances can be reused and used as a renewable resource [5]. Recycling logistics of waste materials refers to the physical displacement of goods which lose their original use value in economic activities and are collected, classified, processed, packaged, transported and stored according to actual needs and sent to special places. It belongs to a branch of reverse logistics [6].

III. THE DEVELOPMENT STATUS OF WASTE MATERIAL RECYCLING LOGISTICS IN HUBEI PROVINCE

At present, the state also shows an attitude of attaching importance to the waste material recycling industry. In recent years, more than ten laws and policies have been issued to regulate and support the development of waste material recycling logistics. Nevertheless, there are still some problems in waste material recycling in Hubei Province [7].

A. Serious shortage of harmless treatment facilities for waste materials

In the past ten years, most of the wastes disposal sites invested in are mainly sanitary landfills, and less incineration and composting are used. And most of the waste material disposal sites are simple, do not meet the national waste material disposal standards, it is difficult to meet the requirements of harmless treatment, harmless treatment rate is very low. More than 80% of the existing waste material disposal sites in Hubei Province do not have any anti-seepage measures; more than 90% do not have leach-ate collection and treatment facilities, which has caused serious pollution to the surrounding groundwater, surface water and soil [8]. And now the recycling efficiency of waste is relatively low. It's so simple that it's not up to national standards.

B. prominent

With the rapid expansion of the city, many waste material disposal sites in Hubei Province have changed from suburbs

to urban areas, and even some waste material disposal sites have changed into residential land. The security problem is more prominent. According to the survey, more than one-third of urban garbage in Hubei Province is related to packaging waste materials, and plastic packaging waste materials are the main source of packaging waste materials. Among all the municipal solid waste, the plastic packaging bags and disposable plastic lunch boxes are undoubtedly the most extensive and strong reflections.

C. *The industrialization development of waste material recovery logistics in Hubei Province is slow*

The environmental sanitation department is not only the administrative department of garbage disposal, but also the service department of garbage collection, transportation and disposal. Due to the inadequate reform of the system, the supervision system for the harmless disposal of garbage is imperfect, the charging system for garbage disposal is difficult to implement, and monopoly operation is widespread [9]. The competitive construction and operation pattern of waste material recycling logistics in Shandong Province has not yet been formed, and the industrialization development process is slow, because of the diversification of investment subjects, the entrepreneurship of operation subjects and the modernization of operation management.

D. *The level of disposal of waste materials varies greatly from region to region.*

Because of the different economic strength, municipal solid waste treatment projects at prefecture level pay more attention to capital investment and introduce advanced technology. Its treatment level has reached the advanced level in China, but the treatment level of county-level cities and counties is uneven, and the treatment technology cannot meet the technical requirements.

E. *Low resource utilization and huge economic losses*

According to the statistics of the environmental protection department, the direct economic loss caused by the pollution of environment by waste packaging materials in Hubei province is more than 4 billion yuan every year, and the waste value of resources caused by the utilization of waste packaging materials but not fully recycled is as high as 10 billion yuan every year. About 70% of the packaging products produced or sold in the province are discarded at will after one-time use every year.

In addition to the above points, there are still some problems in the recycling of waste materials in Hubei Province, such as low recycling price, selective recycling of manufacturer (such as high frequency and high value goods recycling), unclear recycling time, low recycling standard of individual workshops, and difficulty in recycling and picking technology[10].

IV. "INTERNET +" FLEXIBLE WASTE RECYCLING LOGISTICS FLEXIBLE JOINT STRUCTURE MODEL

A. *Operating Model of Waste Material Recycling Logistics in Hubei Province*

According to the current waste material recycling market in Hubei Province, there are three main types of waste material recycling logistics model. They are the self-recycling mode, the joint-venture recycling mode and the third-party recycling mode for which the manufacturer is responsible [11]. The characteristics of the recovery patterns are compared and summarized as shown in Table 1.

TABLE I. RECOVERY MODEL ANALYSIS TABLE

Recovery mode / Evaluating indicator	Manufacturer Recycling Model		Production Enterprise Recycling Model	Third party recycling model	
	Self-support	joint operation		Partial Responsibility	fully Responsibility
Logistics cost	highest	higher	media	lower	low
Economics of scale	low	higher	media	higher	lower
Promoting product design	good	media	media	media	poor
financial risk	big	bigger	media	media	low
information feedback	timely	timely	have a contract to get	have a contract to get	hard to get
Orphan Products	unable to take into account	able to take into account	able to take into account	able to take into account	able to take into account
Product identity	advantageous	advantageous	advantageous	media	unfavorable
Supply Chain Control Capability	very strong	media	media	stronger	weak
Trade secrets	protect	easy to leak	protect	protect	easy to leak
Appropriate Manufacturer Size	big	all of the right size	big	all of the right size	all of the right size
Suitable for product type	products of high value, strong professionalism and large quantity of waste	similar products with little difference	Nissan's supplies	wide scope	wide scope

B. *Optimization model of waste material recycling logistics based on "Internet + "*

In view of the present situation of development in Hubei Province, the game model of government, enterprises and citizens is constructed. The problems existing in the development of waste material recovery logistics and waste electronic products logistics in urban communities of Hubei

Province are discussed [12]. Combining with the relevant logistics enterprises in cities and integrating the concept of supply and demand network, the main related enterprises in the united city, such as third party logistics enterprises, warehousing enterprises and waste disposal, are put forward. The framework model of the flexible consortium of waste material recovery logistics which is participated by enterprises and enterprises' self-supporting logistics organizations is shown in figure 1.

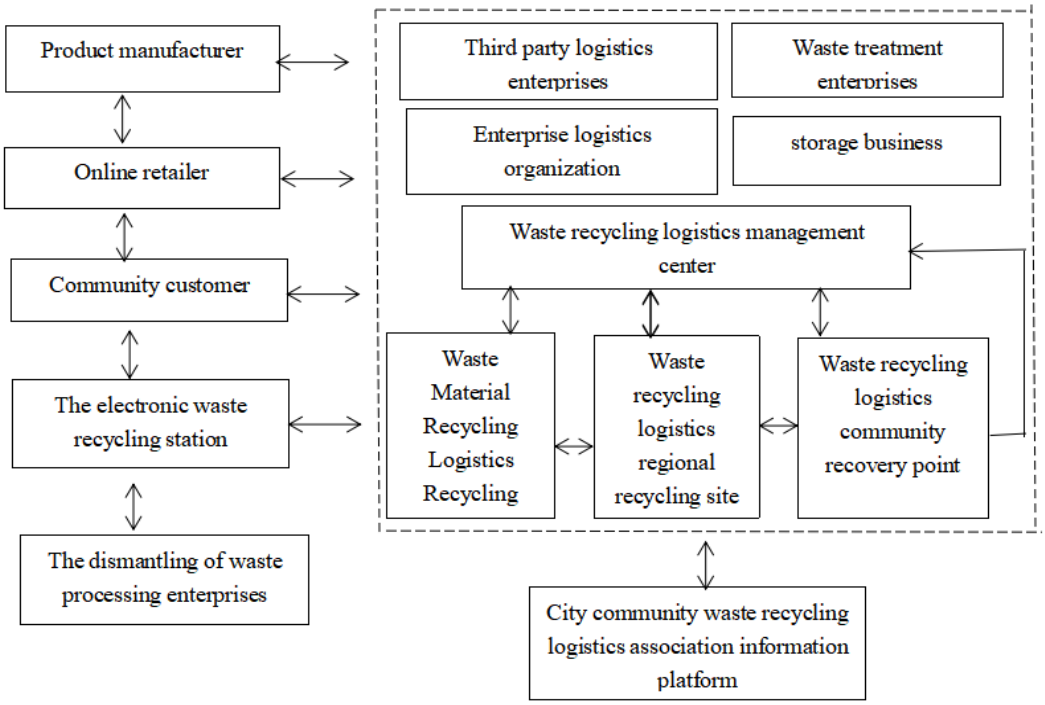

Fig. 1 Flexible Consortium Framework of Waste Material Recycling Logistics in Urban Communities

The consortium includes a waste material recovery logistics management center, a number of waste material recovery logistics recovery centers composed of large warehousing enterprises or large third party logistics enterprises, a number of waste material recovery logistics regional recycling stations composed of medium-sized logistics enterprises, and a large number of community recycling points for waste material recovery logistics, which are responsible for by small logistics enterprises [13]. Besides the logistics management center for waste material recovery, the number of other roles in the consortium can be changed dynamically and directed directly by the logistics management center. The members of the consortium reserve certain storage space and vehicles according to the provisions of the cooperation contract, and the remaining resources can carry out independent business activities as usual. Unified mobilization of the available resources of each member and collaboration to complete the logistics task of waste material recovery can achieve the optimal allocation of resources within the consortium, thus reducing costs and maximizing the utilization of resources.

C. Logistics Operation Process of Waste Material Consortium

The rights, responsibilities and interests of the members of the consortium are defined through contracts, and real-time information exchange is carried out through the unified information platform, and regular fund settlement is carried out. In the aspect of waste material recycling logistics operation, consumers apply for waste material recycling through the network to the waste material recycling station, providing information including waste material types, quantity, customer address and acquisition time [14]. After the confirmation of the waste material management center, a logistics task of waste material recovery is generated and sent to the waste material recovery logistics center in batches [15]. According to the logistics tasks of waste material recovery issued by various waste material management centers, combined with the current available logistics resources of the members of the consortium, the waste material recovery logistics center uses optimization strategy to decompose the logistics tasks of waste material recovery and allocate them to the corresponding waste material recovery logistics center, waste material recovery logistics regional recycling station and waste material recovery logistics community. According to the task sent by the waste material recycling logistics management center, the community recycling point is completed. As shown in figure 2.

At each waste material recycling station, terminal recycling and registration are carried out in the community; vehicles from the regional recycling station are dispatched to return products from the community recycling point for registration, sorting (or temporary storage) and then transported to the task-designated recycling center; the waste material recycling logistics recycling centers verify, register, temporarily store the goods sent from the recycling station and sort them according to the destination.

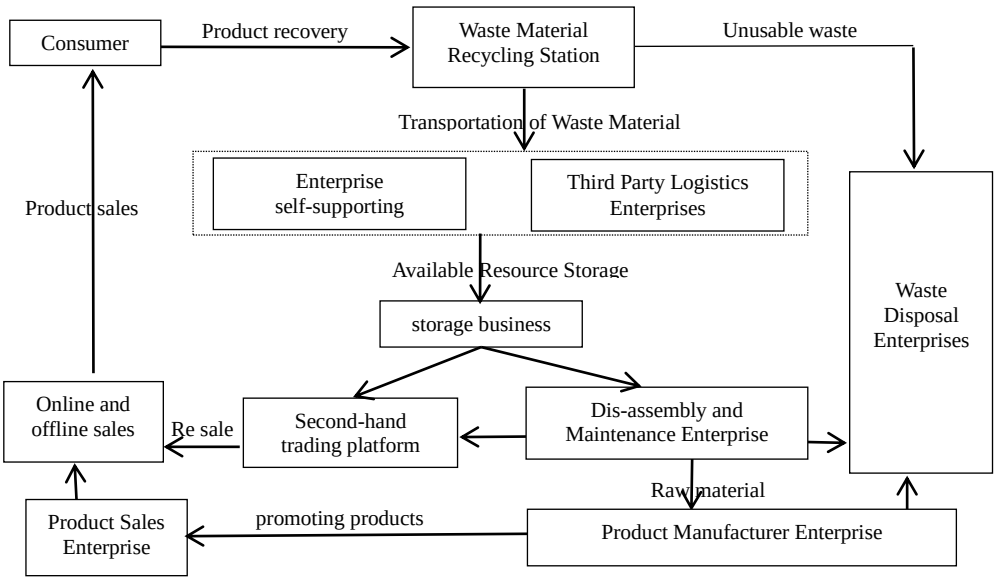

Fig. 2 Flow chart of operation mode of waste material recovery

Loading and transporting to the warehouse designated is by the online retailer or the warehouse designated by the manufacturer. The waste material recycling logistics management center can also call the idle vehicles of the product manufacturer or the online retailer to carry out the final transportation work according to the agreement.

D. Specific Contents of Operation Model of Waste Material Consortium

1) Information Platform of Waste Material Recycling Management Center

The information platform of waste material recycling management center is the core of the whole consortium information platform. It not only needs to manage the waste material recycling logistics service business between online sellers and producers of products and waste material recycling network, but also needs to optimize and decompose the logistics task of waste material recycling in batches, and to carry out the dynamic change of available resources in the consortium. Task allocation, temporary coordination and command of unexpected situations in recycling logistics activities, emergency dispatch of on-the-road vehicles equipped with good vehicle information system, etc. The platform needs to have the ability of real-time acquisition, processing and transmission of massive data, as well as intelligent decision support capabilities [16]. Its structure is shown in figure 3 below.

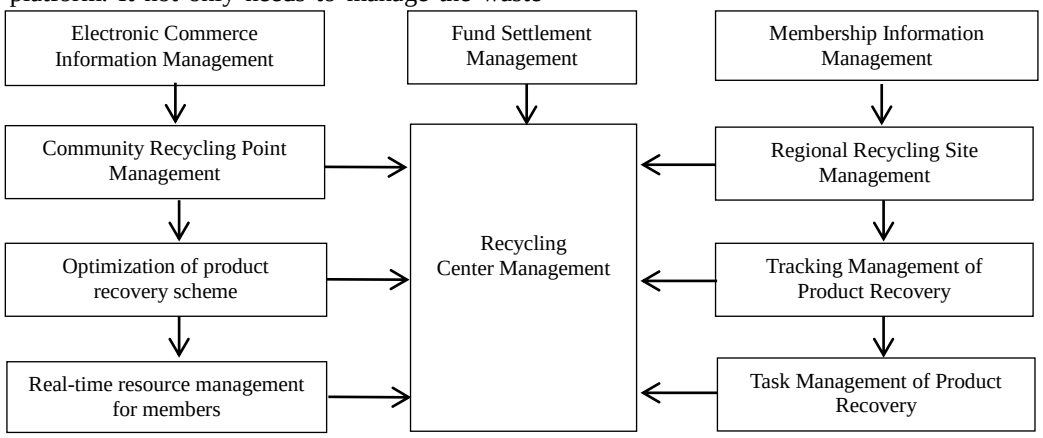

Fig. 3 Composition of Information Platform of Waste Material Recycling Management Center

In the waste material recycling logistics consortium, the waste material recycling logistics center is generally undertaken by large warehousing enterprises and large third-party logistics enterprises, mainly aiming at the logistics task of electronic waste material recycling. The number of recycling centers can be set according to the needs of the city scale and business volume in Hubei Province. The number of recycling centers can be set according to the needs of the city scale and business volume in Hubei Province [17]. The information platform of recycling center mainly provides such services as storage management of recycled products, sorting management of recycled products, transportation management of recycled goods, task management of recycled materials logistics, and settlement management of recycled materials

logistics and tracking management of recycled goods.

Through a unified data interface, the information platform is interconnected with waste material recycling logistics management center, waste material recycling logistics regional recycling station, waste material recycling logistics community recycling point, online vendor information platform and enterprise original information platform to share information. The comprehensive database of waste material recovery logistics includes the background database set corresponding to each transaction processing system.

2) Information Platform for Regional Recycling Station of Waste Material Recycling Logistics

The regional recycling station of waste material recovery logistics is generally undertaken by medium-sized third-party logistics enterprises. In addition to the task of returning waste material recovery logistics, it is also the main node to undertake the task of electronic waste material logistics. In the process of returned waste material recycling logistics, the regional recycling station is an optional link between the recycling center and the community recycling point. The corresponding functions of the information platform include the task management of waste material recycling logistics, the loading management of returned products, the on-the-spot management of returned products, the unloading management of returned products, the instant data communication module and so on, and the recovery of waste material recycling logistics. The central information platform is close, but the storage management, sorting management, transportation management and other related functions are further simplified, and the number is also small.

Regional recycling stations are suitable for large-scale demand of urban area or returned waste materials recycling logistics, providing load buffer for recycling centers; and when the demand of urban area or returned waste materials recycling logistics is small, the role of this layer can be canceled, and vehicles can be directly allocated from the recycling logistics center to the community recycling station to recover products in batches.

3) Community Recycling Point Information Platform for Waste Material Recycling Logistics

Waste material recycling logistics community recycling point is located in the front of waste material recycling logistics recycling. It is generally undertaken by small logistics enterprises in cooperation with large community property companies. It is responsible for the door-to-door recycling of returned products or waste electronic products in the community or surrounding small and medium-sized communities. It can better solve the problem of decentralization of community customers and the normal working hours of logistics enterprises and community customers [18]. There is a problem of inconsistent product recovery time. The main functions of the community recycling point information platform of waste material recovery logistics include task management of waste material recovery logistics, information registration of returned products, tracking management of returned products, information registration of waste electronic products, tracking management of waste electronic products, two-dimensional bar code label production, radio frequency identification label production (reading and writing), and logistics settlement management of waste material recovery. And so on. As shown in figure 4.

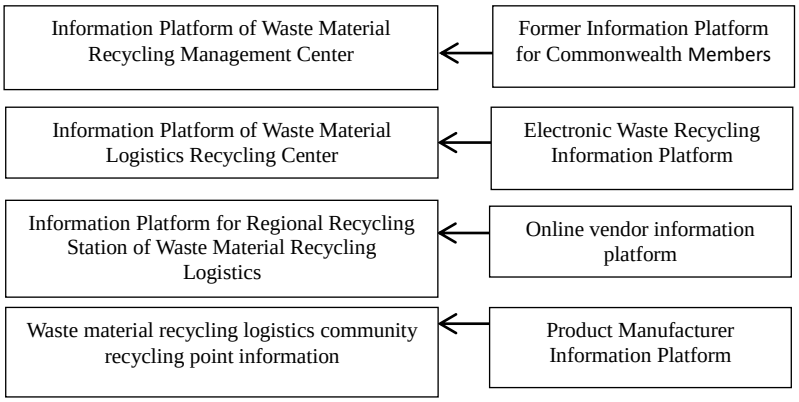

Fig. 4 Working Structure of Information Site

V. CONCLUSION

By building a flexible consortium structure model of waste material recovery logistics in urban communities, the resources that can be recycled and reused are comprehensively utilized through recovery classification and channel networking. Combined with internet technology, the number of other roles in the consortium can be changed dynamically except for the logistics management center of waste material recovery, which is directly directed by the logistics management center. The members of the consortium reserve certain storage space and vehicles according to the provisions of the cooperative contract, and the remaining resources can carry out independent business activities as usual. Unified mobilization of the available resources of each member and collaboration to complete the logistics task of waste material recovery can achieve the optimal allocation of resources within the consortium, thus reducing costs and maximizing the utilization of resources. At the same time, it improves people's environmental protection concept and recycling consciousness, and through the integration of social

resources, it can enhance the self-value of waste material renewable resources, and realize the economic, ecological and social benefits brought by waste materials.

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