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Reverse logistics

In plastic supply chain in Vietnam

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Abstract <p>Today, reverse logistics is increasingly important in sustainable development, especially in the plastic industry. The main objective is to clarify the scientific and theoretical foundation for developing reverse logistics in the plastic supply chain in Vietnam.</p> <p>The theories which are collected from the academic document are then analyzed and researched and secondary data analysis was used to build the theoretical background for this research. Phone survey method was used to collect data for deep-research and primary data analysis was used to analyze the collected data.</p> <p>From the theories and data collected and analyzed such as reverse logistic activities and organization in Vietnam plastic supply chain, the fact of collecting and classify scrap plastic from sources, the main problem was found from in Vietnam plastic supply chain was inefficient of collecting plastic and the quality of collected scrap plastic. The results provided a recommendation for the development of Vietnam plastic supply chain is re-organized the whole system and organized a new department to control the collection and classify scrap plastic process from sources, to increase both efficiency and quality of the whole process.</p>		
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1 Introduction

1.1 Preface

Over the past few decades, along with the economic development, population growth and higher living standards in countries, the amount of discarded products and waste need to be treated has increased rapidly. Moreover, the product life cycle is shorter and shorter day by day means that customers are willing to give up using their old products faster to buy and use new products. In addition, the government of many countries have also issued regulations requiring businesses to carry out production activities in an environmentally responsible manner. E-commerce appeared and developed rapidly, which made the rate of recall goods increase. As a result, combining all the above mentioned reasons, reverse logistics is applied to recycle used products and waste in order to effectively get bigger attention in business activities as well as in many research fields.

The theory of reverse logistics was systematically studied in developed countries in the US and Europe from the 90s of the last century. Besides the basic contents such as definition, characteristics, influencing factors, reverse logistics management in many different industries and other fields. These studies have shown an increasingly vital role of reverse logistics in the economy, in supply chain and in businesses. As a function in business, reverse logistics is an important solution to help businesses reduce costs, increase revenue, improve customer service levels and reduce the impact of business and production activities on the environment. Therefore, gaining a competitive advantage and implementing corporate social responsibility (Rogers and Tibben-Lembke, 1998, 5).

In fact, while the volume of solid waste generated across Vietnam is about 28 million tons per year with a growth rate of 10% per year, the collection rate is about 83-85% in urban areas and 40-50% in rural areas, the rate of recycling and reuse is only about 10-12% (Ministry of natural resources and environment, 2015, 49).

Furthermore, parties do not be aware of the role of reverse logistics in creating competitive advantages and sustainable development of the company. The limitation of high quality management level, the weakness of infrastructure and poor

technology has made Vietnamese enterprises have not organized, developed and controlled reverse logistics activities in a professional way.

To be more specific, in Vietnam, the plastic industry is dependent on the supply of imported plastic materials. According to the report of the Vietnam Plastics Association (2017, 11), in recent years, the plastic industry needs 3.5 million tons of input materials and hundreds of other auxiliary chemicals each year. Meanwhile, the domestic raw materials production only meet 900,000 tons per year. Therefore, Vietnam plastic industry has to import 70% - 80% of raw materials each year. To come up with the solution to solve the problem of lacking input materials, the plastic industry should recycle and handle scrap plastics through the development of concentrated plastic recycling centers to avoid the widespread import of plastic materials which affects the environment. All the above analysis shows that the current theory of logistics has not been popularly applied in Vietnam. At the same time, it is necessary to develop reverse logistics for plastic products - a product with its special characteristics and great benefits from recall, recycling, reuse.

The research on this thesis " Reverse logistics in plastic supply chain in Vietnam" will illustrate the solution requirements in the current situation of Vietnam plastic industry.

1.2 Aim of the thesis

The main objective of the thesis is to clarify the scientific and theoretical foundation for reverse logistics development in the plastic supply chain in Vietnam. In order to achieve the research objectives, the thesis must be studied within three tasks.

Firstly, the thesis must develop a theoretical foundation for development reverse logistics in the supply chain. To accomplish this task, the thesis must answer the following research questions:

- What is reverse logistics in supply chain?
- What are the contents of reverse logistics in the supply chain?

Secondly, the thesis needs to measure and evaluate the reverse logistics in the Vietnam plastic supply chain through the analysis of the current situation of organiza-

tion and deployment of reverse logistics in Vietnam, as well as all members participate in Vietnam plastic supply chain. The questions needed to answer are:

- How are members of Vietnam plastic supply chain organized in reverse logistics activities?
- What factors affect reverse logistics development in Vietnam plastic supply chain?

Lastly, this study will show some proposals to help companies in Vietnam plastic supply chain achieve competitive advantage through satisfying customer requirements, reducing costs and sustainable development by answering this question:

- What are the solutions for Vietnam plastic supply chain in order to develop reverse logistics.

1.3 Research methods

1.3.1 The thesis research process:

The thesis research process including steps is illustrated in Figure 1 as follow:

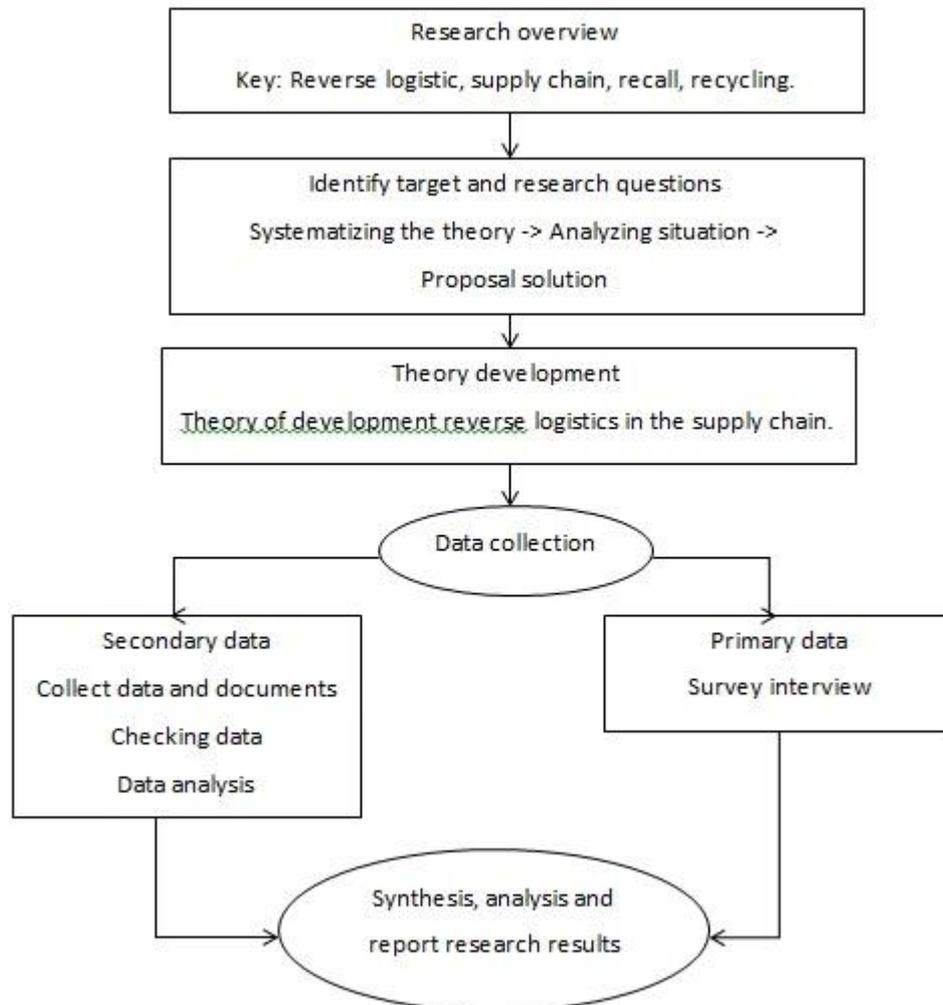


Figure 1: The thesis research process.

Reverse logistics is new project research, the author identifies the research problem of the thesis, which is: "reverse logistics in the Vietnam supply chain" - a very new issue both in terms of theory and practice in a developing country nowadays.

1.3.2 Research method.

To ensure the comprehensiveness, objectivity, and accuracy, the thesis uses a combination of both research methods of secondary and primary data. The theories

which are collected from the academic document are then analyzed and researched. All information and data analyzed will lead to the answer of thesis object.

Secondary data:

Data collected by someone else for some other purpose (but being utilized by the investigator for another purpose)(Joop Hox, 2005, 2).

Secondary data for the thesis research includes data on the development of the plastic industry in Vietnam and enterprises in the plastic industry, data on solid waste management systems in Vietnam... Sources for secondary data of Vietnam plastic industry are published in the Master Plan for plastic industry development of the Ministry of Industry and Trade, Report of Vietnam Plastics Association, Vietnam Plastic annual report, Specialized magazine of Vietnam Plastics Association, national and international scientific conferences related to plastic industry, website of Vietnam Plastics Association and Vietnam plastic production and trading enterprises...

Primary data:

Data collected by the investigator himself /herself for a specific purpose. (Joop Hox, 2005, 2).

Primary data need to be collected and analyzed are data reflecting the status of reverse logistics in the Vietnam plastic supply chain, including contents such as reverse logistics organization; reverse logistics flows and activities; factors affecting the development of reverse logistics in the Vietnam plastic supply chain. Primary data is collected by survey method: This method is used to study the status of reverse logistics in typical enterprises; discussing with experts about the system of measurement criteria, assessing the situation of reverse logistics in the supply chain of Vietnam plastic products and the content of survey papers.

- Investigation of the telephone survey:

The purpose of this method is to conduct a quantitative study on the current situation of reverse logistics development in the Vietnam plastic supply chain. The simple random sampling method is used to select enterprises to conduct surveys to ensure

the ability to obtain the highest feedback and consistent with the time limit and survey cost.

The survey process:

- *Step 1- Complete the survey:* The main contents of the survey form as follows

The first part includes the first 03 questions, to collect general information about businesses such as type of business, production and business sector, year of establishment.

Part 2 consists of 3 questions, from question 3 to question 6, designed to gather information about the current status of logistics organization and deployment at enterprises in the Vietnam plastic supply, focusing on the contents such as the importance of reverse logistics for businesses, the reason of reverse logistics organization; In-company logistics organization plans and overall satisfaction level of enterprises for reverse logistics activities.

-*Step 2 - Determine the research sample:* There are more than 2,200 businesses in research objective (N). The sample calculation formula (Copper, Donald R., Schindler and Pamela S., 2000, 23) is used:

$$x = \frac{N\sigma^2Z^2}{N\epsilon\frac{z}{x} + \sigma^2Z^2}$$

Where N = Population size: 2200

δ^2 = Variance of the variable being measured: 1,2 -2

ϵ = Margin of error in terms of the value of the variable being measured: 0,25

z = Standard score based on an assumed confidence level-95%

Then we calculate the minimum sample need is 85 to get a confidence level of 95%

- *Step 3 - Conduct survey:* The author contacted the businesses by telephone to ask the business to cooperate with the survey. The investigation was conducted for nearly one week. After contact with 120 enterprises, the survey collected 86 answers, satisfy the minimum condition of 85 samples.

- Step 4 - Review, encrypt and import data into the computer: After collecting all samples, the author using Ms.excel to analyze data and have an overview of the Vietnam plastic supply chain

2 Reverse logistics

2.1 Overview of reverse logistics

Beginning in the mid-twentieth century, Beckley and Logan (1948), Terry (1969) attention to goods recall but did not mention them as reverse logistics. One of the earliest ideologies about reverse logistics was given by Lambert and Stock in 1981. They describe reverse logistics: "Some movement is going in the wrong way according to the forward direction because most shipments are going in the same direction" (Lambert and Stock, 1981, 25). This description of Lambert and Stock pays attention to some activities, objects which are not followed to the rules of most other shipments.

In 1989, Murphy and Poist more emphasized on reverse movement when they describe those reverse logistics as: "the movement of goods from a consumer to a producer in a channel of distribution". During the 1980s, reverse logistics was limited in the movement of shipments in the opposite direction to the main flow, from customers to manufactures.

Pohlen and Farris (1992, 42) also define reverse logistics by emphasizing its direction in distribution channels but more expansion than the viewpoint of Murphy and Poist. The concept as follows: "The movement of goods from customers toward manufactures in channels of distribution". In the beginning of the 90s of the XX century, reverse logistics was studied carefully and systematically in developed countries such as the US and Europe. In 1992, The Council of Logistics management has issued an official logistic definition. This definition emphasizes the recall aspect of reverse logistics: "The term often used to refer to the role of logistics in recycling, waste disposal, and management of hazardous materials; a broader perspective includes all issues relating to logistics activities carried out in source reduction, recycling, substi-

tution, reuse of materials and disposal.”(Stock, 1992, 23). This definition has been greatly expanded and clearer than the previous concept of reverse logistics. Besides, it also originated from a waste management perspective.

Kopicky (1993, 54) defined reverse logistics in another way:” Reverse logistics is a term related to logistics management and handling of packaging, toxic or non-toxic products. It includes the distribution flow of goods and information in the opposite direction to forward logistics activities”.

Fleischmann (1997, 38) pays attention to the ability of reverse logistics is transforming products that have been removed in order to recover product value through the concept:” Reverse logistics is a process that includes all logistics activities whereby products that no longer meet consumer requirements will be transformed into reusable products on the market”

Carter and Ellram (1998, 42) mentioned the environmental benefits of reverse logistics with the concept:” Reverse logistics is the process whereby companies can become more environmentally by minimizing, recall and recycling used materials.”

In the last year of the 1990s, Rogers and Tibben-Lembke (1999, 43) described reverse logistics through emphasizing the goals and logistics processes:” Reverse logistics is the process of planning, implementing and effectively controlling the flow of raw materials, semi-finished products, finished products and relevant information from consumption points to manufactures to recover the value of products”. This concept mentions reverse logistics as a functional activity of businesses.

So far, there have been many different concepts of reverse logistics. However, the above concepts are identical in some aspects as follows:

- Objects of reverse logistics can be raw materials, semi-finished products, finished products, packaging or waste.
- The direction of reverse logistics flow is opposite to the forward logistics process, return from customers to manufacturers.
- The purpose of reverse logistics is to recover the remaining values of the product or elimination them appropriately

Based on the analysis of the above concepts, the thesis proposes reverse logistics is: Reverse logistics is the process of optimizing the flow of materials in the opposite direction to the forward logistics process, or from the consumer to the manufacture or distributor to recover the remaining values of product or elimination them appropriately.

2.2 Some concepts related with reverse logistic

2.2.1 Green logistics

The concept of "Green Logistics" was first introduced in the mid-1980s to describe a logistics system and methods which is using advanced technology and equipment to minimize the bad effect on the environment. Today" Green logistics is defined as all efforts to minimize the impact of logistics activities to the environment" (Thiell, 2012, 42). In other ways, green logistics is a form of logistics that brings a balance between economic efficiency and environmental efficiency. Some environmental issues in green logistics include: reducing the consumption of non-renewable natural resources; reducing emissions and noise pollution, reducing traffic jam in transporting and safely handling waste. The similarities and differences between green logistics and reverse logistics are illustrated in Figure 1.

"Reverse logistics" is often confused with "green logistics" because both concepts have many similarities, because reverse logistics and green logistics both mention about recycling, remanufacturing, and reusable packaging. However, reverse logistics has a fundamental difference compared to green logistics that green logistics often emphasizes environmental aspects for all logistics activities, but especially focusing on forward logistics activities, or from manufacturers to customers. Green logistics is an effort to minimize the impact on the environment of logistics activities rather than an effort to recover the value of goods as in reverse logistics.

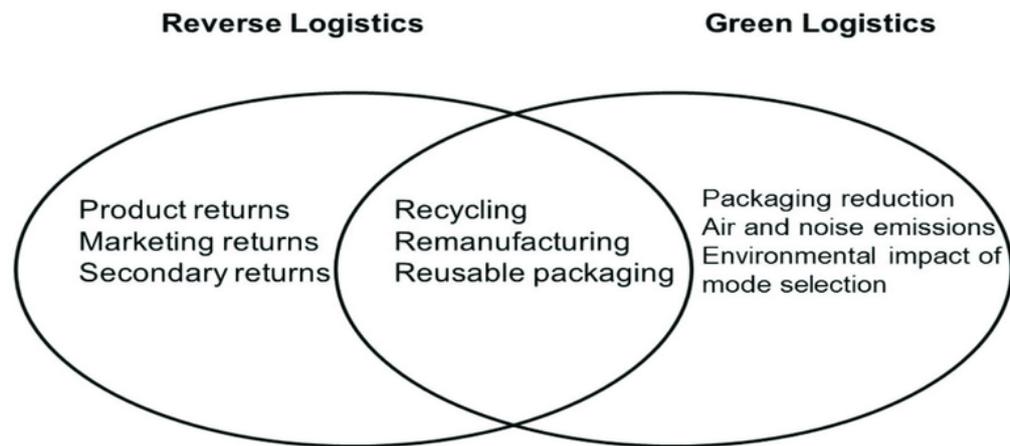


Figure 2: Comparison between reverse logistics and green logistics (Rogers and Tibben-Lembke, 2001, 24)

2.2.2 Waste management

Waste is material discharged from production, business, service, living or other activities and waste management is the process of prevention, reduction, monitoring, classification, collection, transportation, reuse, recycling and handling waste. Therefore, reverse logistics and waste management are similar in some processes such as collection, transportation, classification and some solutions such as recycling and reuse. However, there are many differences between them, included:

Firstly, objects of waste management are products that have been eliminated because they are no longer or very little value. Meanwhile, objects of reverse logistics are raw materials, selling products, products, packaging .etc while they are still some recoverable values. Therefore, the output of reverse logistics can return to the beginning supply chain or join another supply chain.

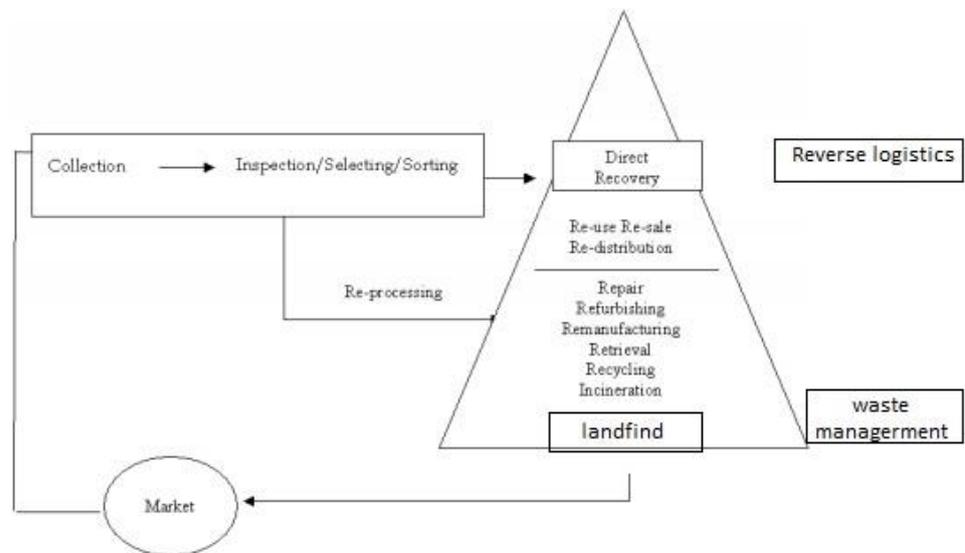


Figure 3: the different reverse logistics and waste management (Brito, 2003, 12)

Secondly, waste management focuses on handling waste after it has been generated. While, reverse logistics focuses on preventing or minimizing the elimination of discarded products or waste in the production process rather than managing after the waste has been created, then aiming to reduce waste on using resources.

2.3 Overview of Supply chain

In general, there are many studies on the supply chain according to different aspects. Many concepts of "supply chain" have been presented and analyzed in these studies. Here are some typical concepts:

According to Ganeshan and Terry (1995,22) define the supply chain as a network of production and distribution options for the trade of materials, convert them into semi-finished products, finished products and distribute them to customers

According to Lambert, Stock and Elleam (1998, 13-15) are believed that the supply chain is a co-operate between businesses to create a product or service to the market

Chopra and Meindl (2001, 14) understand that the supply chain includes all relevant processes, directly or indirectly, to meet customer needs. Supply chains not only

manufacturers and suppliers, but also transportation, warehouses, retailers and customers. Or the supply chain can understand as the connecting between suppliers, customers, manufacturers and service providers related to the business process.

Christopher (2005, 4) argues that the supply chain is the network of organizations involved processes and activities to create value for product and service for customers

Those concepts show that the supply chain is a process that begins with raw materials until the final product is created and distributed to consumers in order to achieve two goals: effective and efficient for the whole system based on the connection between the members involved in the supply chain. For all above reason, the supply chain is a unified entity of many organizations, operating on the basis of taking advantage of each organization in order to optimize the entire chain.

Under the impact of globalization and the development of e-commerce, businesses increasingly recognize the value, role and key benefits of the product supply chain. Therefore, developing production and business in the supply chain based on cooperation between organizations is an inevitable trend in modern business. According to Christopher (2005, 48), the product supply chain can bring four major advantages:

Advantage of speed: The supply chain has this advantage thanks to the close coordination among members, information management capabilities and the support of professional logistics service providers. The supply chain helps to distribute goods directly to the store without going through the distribution center while still increasing the value of the goods during transportation.

Advantage of accuracy: Accuracy in the supply chain is created thanks to the fact that investment build transparency, apply advanced technologies in communication and management. Thanks for sharing data, all members of the supply chain can work together with a clear goal.

Advantage of flexibility: the supply chain also has the flexibility to react rapidly for the market demand. For example, transport flexibility can be achieved through the build-up of a global network that allows rapid transport and source looking. Lean

manufacturing and Vendor management inventory helps reduce risks of lacking goods while maintaining inventory at the lowest level, optimize the transportation and distribution network.

Advantage of cost: With effectively connection, handling and combine goods supply chain, reduce the time of goods stay in the warehouse and increase the accuracy of distribution allowing supply chain members to make greater profits than the costs.

From all above analysis, if placing reverse logistics in the supply chain will help these supply chains satisfy customers' requirements, improve competitiveness and sustainable development. In the other hand, reverse logistics also become more effective by taking advantages of the supply chain.

2.4 The model of supply chain

According to Christopher (2005, 34), the supply chain, whether simple or complex, developed at a high or low level, including three flow lines throughout the entire chain, they are physical flow, information flow, and cash flow.

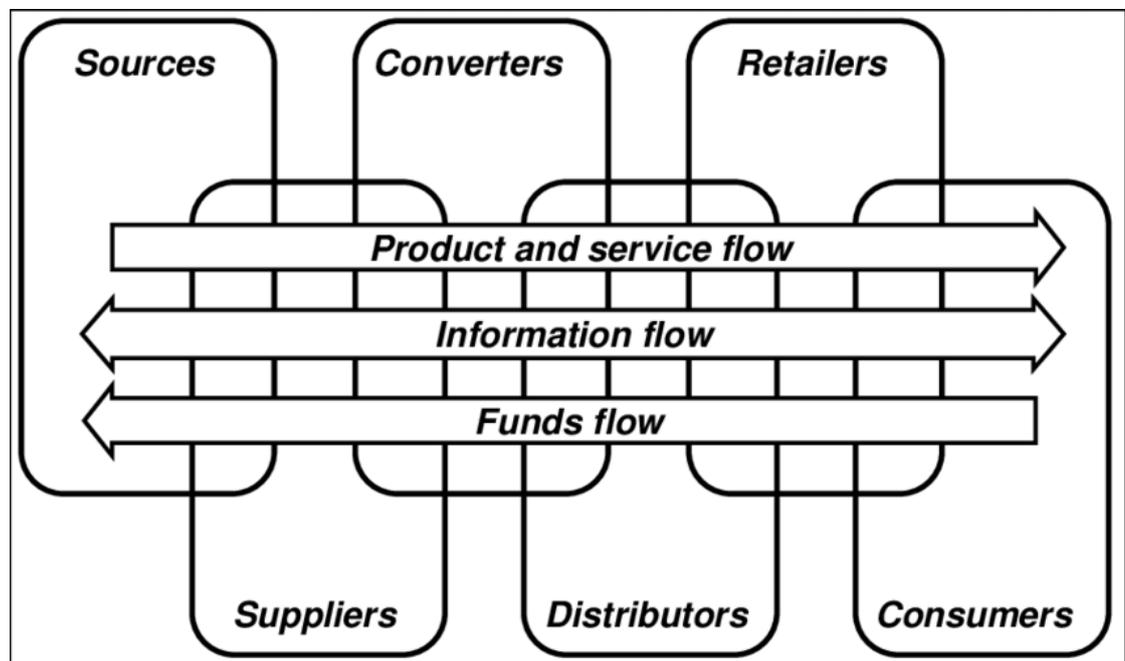


Figure 4: The model of supply chain (Christopher, 2005, 34)

According to Christopher (2005, 34), there are three main flows in the model of supply chain as follow:

Physical Flow:

It is the flow of circulation and transformation material; starting with the raw material from the first supplier, moving to the manufacturing to create the product and distribute it to the end up consumer. This is the most expensive flow in terms of cost and time to implement, easily causing bottlenecks in the supply chain and decide the efficiency of the chain. The inaccurate operation of physical flow is one of the reason generate reverse logistics activities. Therefore, the material flow needs to be carefully designed to the optimal model to achieve the target for the whole chain, reduce arising recall and recycle activities. Transportation and storage are the two most important activities that contribute to streamlining the physical flow.

Information Flow:

In the supply chain, the information flow is the first flow appear, moving throughout all supply chain processes, even when the product line and cash flow are completed. Information flow helps connect physical flow and coordinate activities among members. Information flow is two-way, including: (1) Order flow starts from customers, carries market information, customer information, and their feedback after using the product. And (2) response flow starts from suppliers, reflecting the situation of the supply market, being handled very carefully before delivered to customers. The timely and accurate combination of two-way information flow will help reduce related costs in the supply chain and improve customer service efficiency. At the same time, sharing information in the supply chain often benefits members, however, administrators should categorize information, determine the right partner, the type of information to share and especially the level of sharing that information.

Cash Flow:

These are payments for goods and services between customers and suppliers. The cash flow is put into the chain by the consumer only when they have received the product per service fully valid invoices and documents. The acceleration of money flow flows has a major impact on streamlining supply chains and accelerating the order cycle. However, the cash flow in reverse logistics will be more complicated because it is difficult to delimit responsibilities between the parties for recalled products.

In briefly, the fact that flows are the main activities between the members to support the transactions in the supply chain, create a smooth connection in the whole supply chain. Consequently, a supply chain only achieves outstanding advantages when operating smoothly across product, information and money flow on the basis of close coordination among members of the supply chain.

2.5 Reverse logistic in supply chain

In the supply chain, reverse logistics is the opposite movement compared to the forward supply of material objects. Figure 4 below describes the direction of movement and the position of reverse logistics in the supply chain.

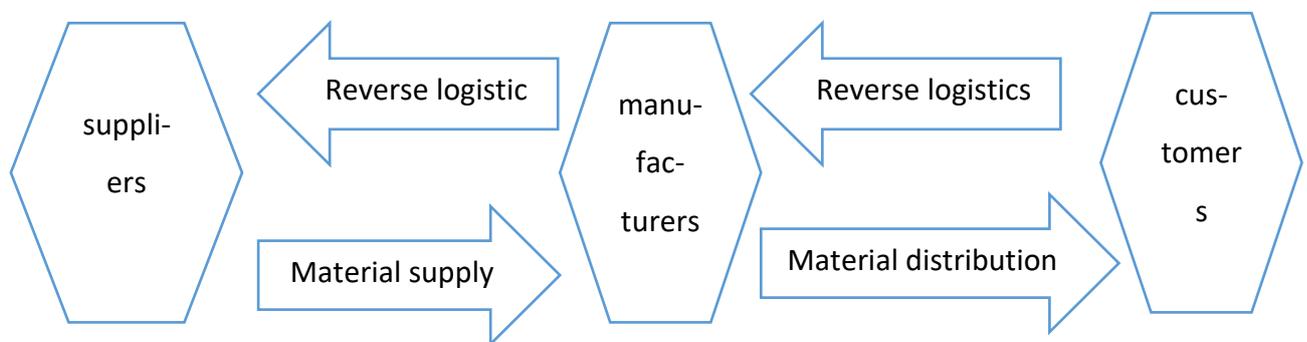


Figure 5: the position of reverse logistics in the supply chain.

Based on all concepts of reverse logistics presented above and position of reverse logistics in product supply chains, we have concept about reverse logistic in supply chain:

“Reverse logistics in the supply chain is a logistics operation that manages the reverse movement of physical objects sent from a member to any member standing in front of them in the supply chain to restore the value of the product and reduce the amount of waste need to handling.”

This concept of reverse logistics in the supply chain emphasizes on some contents as follows:

Firstly, to define a reverse logistics flow exist in a supply chain or not we must define a few aspects: This reverse logistics flow affects the flow of material in the supply

chain, for example, does the logistics product of the reverse logistics flow return to the supply chain to form a closed-loop supply chain? Do the participants in the reverse logistics flow establish connection or relationships with the members in the forward supply chain?

Secondly, objects of reverse logistics are very diverse, they are raw materials, fuels; spare parts or products that do not meet requirements, need to be repaired, repaired or need to be eliminated; packaging, etc.

Thirdly, the goal of reverse logistics in the supply chain is to restore as much as possible the economic-environmental value of the product while cut down amount of waste must be handled, thereby help supply chain members reduce cost, better responding to customers' requirements as well as fulfilling corporate social responsibilities.

When logistics was first-time introduced, all supply chains was developed to closed-loop supply chains. Closed loop supply chain (Figure 5) efforts operational in both ways (forward or reverse) to maximize the economic and ecological values. Therefore, in addition to forward logistics processes such as sourcing, manufacturing and distribution, closed-loop supply chains also include activities such as gathering, sorting, filtering, dismantling and refurbishing , repair, reuse, re-manufacture and recycle, etc. Thus, the value of the product is restored and regenerated at the necessary positions as well as the whole supply chain. On the basis of connecting and integrating both forward and reverse logistics lines, closed-loop supply chains ensure the goal of sustainable development at the same time with the efficiency in supply chains. The difference between closed-loop supply chains and traditional supply chains represents six aspects, including:

Objective:

Traditional supply chains aim at reducing costs and improving members' efficiency to maximize economic benefits. The closed-loop supply chain also seeks to maximize economic benefits but based on reducing the consumption of resources and energy, reducing pollutant emissions, all these efforts are to create a responsible business, ensure balanced economic benefits and environmental.

The management structure of the supply chain: In the traditional supply chain, environmental management is not a mandatory concern. In closed-loop supply, environmental activities are mandatory both in internal and external management.

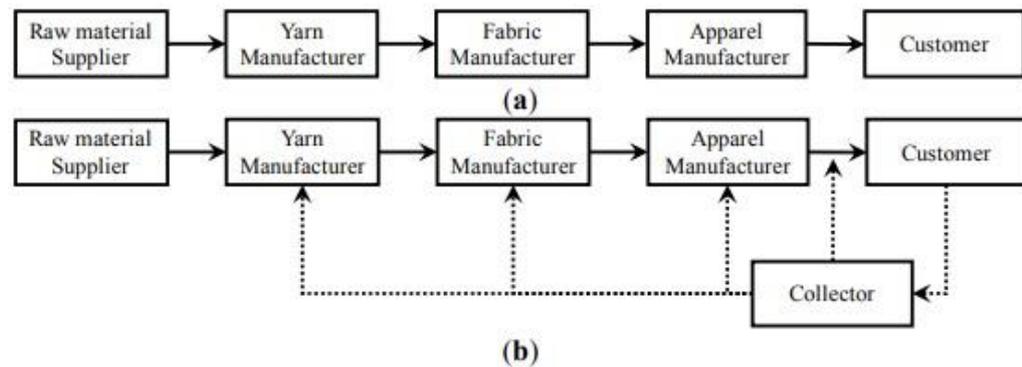


Figure 6: The difference between forward and closed-loop supply chain (Jisoo Oh, Bongju Jeong, 2014, 24).

According to Jisoo Oh and Bong Jeong (2014, 24), the difference between forward and closed loop supply chain can be shown as below:

Business model:

Closed-loop supply chain offers a more complete business model. Business activities, logistics, and supply chain management efforts with the entire product life cycle, raw material sourcing, industrial design, production, delivery while using low carbon volume energy resources and meet environmental protection requirements.

Business process:

Traditional supply chains start from suppliers and end at consumers. While the product flow is an irreversible road, also called "Cradle-to-Grave" or from the time the product was produced until it was lost. Closed-loop supply chains change this management method and hope to reach "Cradle-to-Cradle" or recycle. With the closed loop supply chain, the product flow is closed, resilient and cyclical. All products must be managed throughout the entire life cycle and help the "waste" section seek a second life that is to become available for new production or for other purposes.

Consumption model:

The traditional supply chain is governed by the interests of consumers and business activities. Meanwhile, closed-loop supply chains can be promoted through government green procurement, social responsibility, consumer education, and sustainable development.

Profit:

Closed-loop supply chains creating cheap material resources through the recovery of materials, spare parts, and waste products. Therefore give companies the opportunity to produce cheaper products with higher profits. For example, in the car industry, recycling car parts can reduce production costs by up to 50%, while the selling price is negligible.

In summary, the development of reverse logistics have promoted the development of reverse supply chains; thereby combining with the traditional supply chain to create a closed-loop supply chain with much more superiority

2.6 The difference between forward logistics and reverse logistics

Although forward logistics and reverse logistics are all parts of the logistics system, there are many differences between them. In this section, the thesis will analyze the basic characteristics of reverse logistics in comparison with forward logistics in many different criteria.

According to Fleischmann (2001, 56) the difference between Forward logistics and Reverse logistics can show in follow table (Figure 6):

Factors	Forward logistics	Reverse logistics
Control mechanism	Pull - Demand driven	Push - Supply driven
Moving direction	Convergent and Divergent	Divergent
Focus	Speed	Resilience
Forecasting	Easy	Difficulty
Quality, product price, packaging	Uniform Easy to control	Inconsistent complex

Process	Purchase Production support Meet orders	Gather, transport Check and classify Handling Redistribution
Members	Supplier Producer Distributor Logistics service Customer	Like logistics forward & The collector Recycler Related organizations dismantling
Cost	Clear and lower	Difficult to estimate and higher

Table 1 : The difference between Forward logistics and Reverse logistics (Fleischmann, 2001, 56)

Push mechanism:

While the forward logistics flow is driven by customers demand (Pull-Demand driven mechanism), reverse logistics flow operates because of the push of recalled product (Push-driven supply mechanism). These recalled products are the reason for a series of reverse logistics activities such as gathering, inspecting, classifying, recovering and redistributing products. According to Fleischmann (2004, 23), recalled products are pushed into reverse logistics by economic benefits, customer requirements as well as legal provisions. The push from recalled products such as "start button" for reverse logistics

Moving direction:

In the supply chain, forward logistics flow includes convergent moving flows of many types of input materials for the production process and divergent flow of products from manufacturing enterprises to many distributors, then dispersed according to market demand. In contrast, reverse logistics are convergent flows starting from many different locations focusing on one destination, usually from many customers to recall centers or waste treatment points. Besides that, the route and the next destination of the recalled products are often unclear and only determined after making

decisions on treatment measures for these recalled products. This is opposite to the forward logistics - where the journey of the product is always easily determined based on the customer's requirements. It is this characteristic that has created a significant challenge for the supply chain, that is to combine the forward and reverse logistics; because it can save a lot of costs by reducing the unloaded journey.

Speed:

The speed of the supply chain in forward logistics is one of the most important factors that increase the value and satisfaction of customers. Thus, it is creating a competitive advantage for the supply chain. On the contrary, in reverse logistics, the speed of recovery is not the priority factor, but customers often pay more attention to the ability to recover and return the product value. However, the time the product stays in the recovery center can reduce the value of the product, especially for products with short life cycle.

Difficulties in forecasting:

According to Guide (2000, 12) because of the lack of planning and the schedule for receiving recalled products, it is more difficult to forecast reverse logistics activities than forward logistic. The recall of products from each customer is different in terms of time and rates.

The quality and value of recalled products are not uniform: Recalled products in reverse logistics flow have different levels of damage, so the quality is often heterogeneous. At the same time, the gathering of recalled products also becomes more difficult because the packaging often does not remain because products were opened or damaged; this makes the product recall become more complicated. Damaged packaging also increases product risk and difficult to identify products in reverse logistics.

Reverse logistics process complicated:

Meanwhile, forward logistics has three basic processes including purchasing, production support and meet orders in comparison to traditional logistics consisting of many complex activities such as gathering, transporting, storing, inspecting, classifying, restoring, destroying, etc. Specially, the members of the supply chain only know

next step in the logistics process after reviewing and inspecting carefully the recalled product.

In addition, logistics are more complicated than forward logistics because there are many parties involved in the logistics process. The reverse logistics network includes all members of the forward logistics network plus third parties related to reverse logistics operations such as the collector, repair, remanufacture, recycling and other organizations such as industry associations, government agencies, charities, etc.

Reverse logistics costs are more difficult to predict and often higher: All these differences lead to an important difference between costs of forward and reverse logistics. The cost to operate the forward logistics flow is often predictable and lower than the reverse logistics. Meanwhile, businesses are difficult to deal with backlog related reverse logistics and these costs are also higher. Roggers and Tibbens (2002, 13) has compare between cost of forward and reverse logistics in the table below:

Cost	Compare with forward logistics
Transports	Higher: small scale, dispersed
Possession of reserve goods	Lower: products with lower value
Loss	Much lower: Limit usage
Depreciation	Much higher: because of delay
Classification and quality control	Much higher: for each product
Reverse	Much higher: heterogeneous numbers and sizes
Renovate	Not in forward logistics
repack	Not in forward logistics

Table 2: Compare between cost of forward and reverse logistics (Roggers and Tibben, 2002, 13)

Thus, it is clear that reverse logistics costs are generally higher than forward logistics. However, it should be noted even with higher costs but the benefits of reverse logistics systems are really important.

3 Reverse logistics activities in Vietnam: Difficulty and solution

3.1 Overview of Vietnam plastic industry

Plastics are polymeric compounds, can be deformed when subjected to heat or pressure and still retain that deform when heat or pressure stop working. In manufacturing and recycling, plastics are often divided into 2 groups according to product characteristics, including:

Thermoplastic:

As a plastic when heated to a soft temperature, the plastic will soften and when the temperature is lowered, it solidifies. Thermoplastic is not changed chemical structural when impacted by the environment or can change but very slightly, therefore thermoplastic is able to regenerate many times. Some common thermoplastics are: Polyethylene (PE), Polypropylene (PP), Polystyrene (PS), Polyethylene terephthalate (PET), Polymethyl Methacrylate (PMMA), etc.

Thermosetting plastic:

A plastic that is possible of forming shape under the effect of temperature or chemical reaction and then cannot be melted or dissolved again. Thermosetting plastics are plastic which chemical structure change during processing. Therefore, its waste is not recycling, or in other way, thermosetting plastic products are not included in reverse logistics flow for recycling. Some types of thermoset resins include: Urea ferrite (UF); Phenylacetaldehyde (OF), melamine plastic, epoxy plastic, unsaturated polyesters, etc.

The year 1961 gave birth of Vietnam Plastic Industry when Viet Tri No.1 Chemical Plant went into production after nearly 2 years of construction in order to develop a PVC production line with the installed capacity at the beginning is 350 tons per year, then will increase to 500 tons per year in 1975. However, in 1975, the volume of plastic consumed per capita in Vietnam was only 1kg per person per year and there was no sign of any increase until 1990. In the early 80s, Vietnam plastic market was flooded with imported products. However, along with the process of political and

economic innovation in Vietnam in the late 1980s, the plastic industry began to grow with a growth rate of 20-25% per year, product types are diversified, product quality is improved. Since then, Vietnam's plastic manufacturing industry has been interested and investment, gradually meeting the demand of the market in the country and exporting to the world market.

As in many other Southeast Asian countries, Vietnam's plastic manufacturing industry started with PVC manufacturing. PVC manufacturing industry in Vietnam started in 1998 with the presence of TPC Vina joint venture (formerly Mitsui Vina). TPC Vina's capacity is 100,000 tons per year. At the end of 2002, the second PVC manufacturing plant (Joint venture between Petronas Malaysia and Ba Ria - Vung Tau) with a capacity of 100,000 tons per year also started operation.

At the 2000s, the average domestic plastic production volume per capita reached 11 kg per person per year. Plastic industry only developed strongly from 2003, when it is planned to be one of the priority industries. In 2005, plastic consumption per capita reached 21kg per person per year. The growth rate continued to reach a high level in the 2006-2010 period, an average of 23% per year, especially up to nearly 40% in 2009. In the period 2009-2010, when the world oil price dropped to a record after the economic crisis in 2008, the price of plastic materials also dropped the most since 2006. In the period 2011-2014, the world oil price surged again due to political instability from the Middle East, the price of plastic materials increased but not as strong as the price of oil. The domestic plastic production and growth company in this period only reached an average of 7.6% per year, of which the lowest was only 3.4% in 2014.

In 2015-2016 with the strong development of shale oil in the US, oil prices once again fell sharply, the price of plastic materials also decreased to the lowest level after the 2008-2009 crisis. Falling raw material prices are the motivation for companies to increase production during this period. Therefore, Vietnamese plastic enterprises have boosted production, helping the total volume of imported plastic materials increase by an average of 23% per year, from 2.9 million tons in 2014 to 4.4 million tons in 2016.

According to statistics of the Vietnam Plastics Association (VPA), the entire plastic industry has about 2,200 enterprises of all economic sectors, of which 99.8% are private companies. Domestic companies occupy 85%, foreign ones occupy only 15% in the total, but accounting for 40% of capital investment.

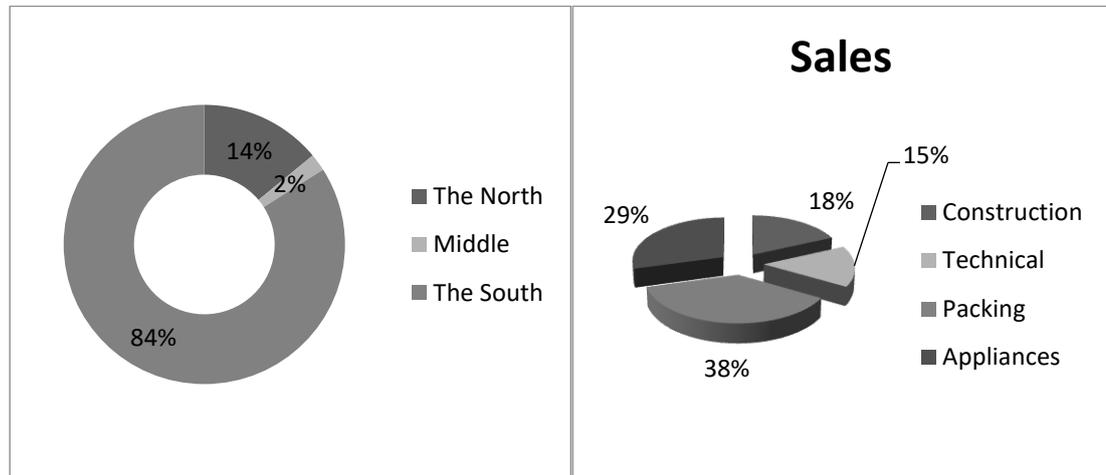


Figure 7. Structure of Vietnam plastic industry by geographical and by product (Vietnam Plastics Association, 2017, 50).

Plastic industry structure by geographic:

Considering the structure of the plastic industry by geographical, in Ho Chi Minh City and the southern provinces such as Dong Nai, Binh Duong, and Long An ,etc. there are about 1,669 enterprises (occupy 84%); Northern provinces have about 267 enterprises (occupy 14%), and the central provinces only have about 64 enterprises (occupy 2%). Thus, Vietnamese plastic enterprises are distributed unevenly by geographical. The level of concentration and competition in the South is much higher than in the North and Middle (Figure 6).

Plastic industry structure by product:

Vietnam plastic products are divided into 4 main groups: Appliances plastic (tables, chairs, cabinets, cups, bowls, plates and other plastic furniture ,etc.), packaging plastic (plastic bags, plastic bottles, plastic boxes ,etc.), construction plastic materials (plastic pipes, plastic walls, plastic doors, plastic roofing sheets ,etc.), and technical plastics (plastic used in cars, motorcycles, electronic devices, medical equipment

,etc.). If classified by product, the plastic packaging industry has about 810 enterprises, occupy 37%; appliances plastic is about 640 enterprises, occupy 29%; construction plastic has 340 enterprises, occupy 18%; technical plastics with 330 enterprises, occupy 15% (Figure 6). This structure shows the development level of plastic production technology in Vietnam today. Simple technologies for manufacturing packaging and household plastic products, occupy the majority of the industry.



Figure 8: Vietnam plastic production yield in 2001-2016 (Vietnam Plastics Association, 2017, 42)

Since 2003, Vietnam plastics industry has developed strongly with production output increasing steadily over the years (Figure 8). The plastics industry is one of the highest growth industries in Vietnam, behind telecommunications and textiles and is considered one of the dynamic industries. Regarding the consumption information, in Vietnam, there is a tendency to increase the use of plastic products in everyday life, especially plastic packaging types. According to statistics, Vietnam's average consumption of plastic products per capita in 1990 was only 3.8kg per person per year, in 2012-2014 reached 38kg per year, in 2015 increased strongly to 41kg per year and reached 53-54kg per person per year in 2016 (VPA report,2017 ,67) equivalent to an average increase of 16.5% per year. The above data shows that plastic consumption per capita of Vietnam is quite similar to other countries in the region such as Thailand and China, but still much lower than the average level of the world (Figure 9)

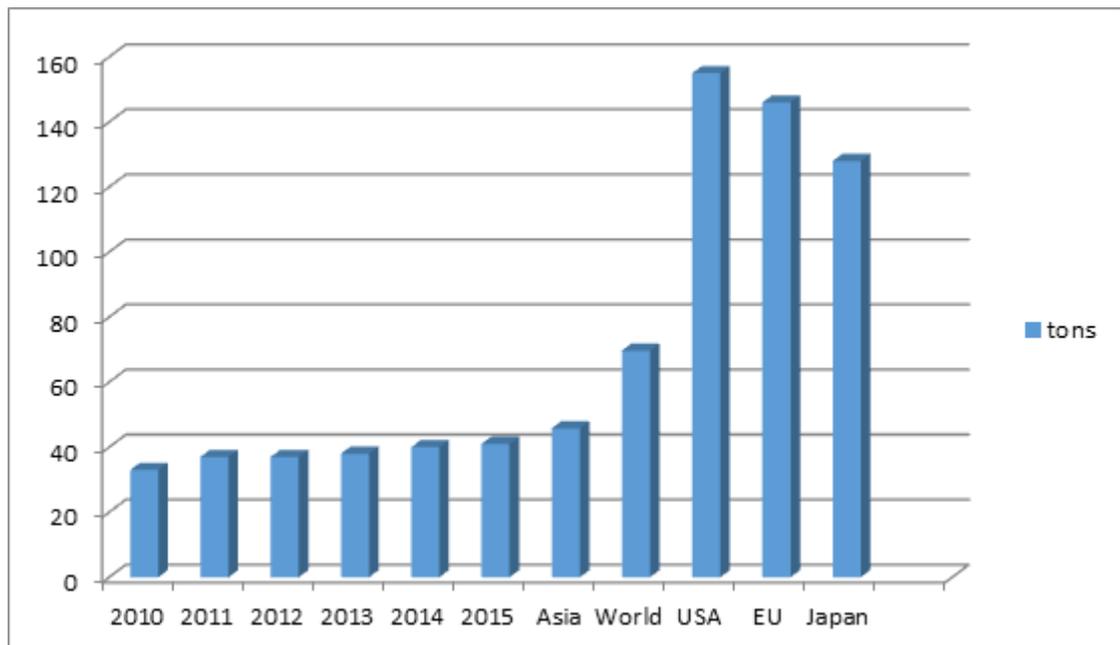


Figure 9: Plastics consumption in Vietnam (2010-2015) (Vietnam Plastics Association, 2017, 82)

Along with the general development of the whole industry, the production and consumption of each type of plastic products in Vietnam also increased accordingly, specifically as follows.

Household plastic products:

Currently accounts for about 32% of the industry's production value, including products for furniture, cabinets, disks, furniture, and footwear.

Plastic packaging products:

This is a low value-added product flow, but accounting for 39% of the industry's production value. The consumer goods sector in the country is growing well thanks to the increasing demand for shopping and consumer. This is a key factor to help the plastic packaging industry ensure stable output. Plastic packaging industry can be classified into: flexible packaging (mainly for food industry), Plastic bottles and jars (mainly used for beverage industry); Hard plastic packaging (served in industrial production).

Plastic products for construction materials:

Occupying 14% of the industry's total production value, including products for pipes, main frames, windows.

Technical plastic products:

Occupying 9% of the production output, including products for plastic spare parts used in automobile and motorbike assembly; medical equipment and equipment used in the composite industry.

International market:

If as before, plastic production in Vietnam mainly served consumption in the domestic market, since 2001, Vietnamese plastic products have been exported to the world market. Currently, Vietnamese plastic products are available in 151 markets around the world; including markets that require high quality, technical standards are Japan, US, EU. There are 530 plastic companies in Vietnam operating in the export sector, of which FDI companies account for 60% of the industry's export value. The traditional export market of Vietnamese plastic companies (Figure 10) is Japan (accounting for 22.1% of export turnover); US 14.6%; some European countries (Netherlands 5.9%; Germany 5.8%; England 4.9% ,etc.) and ASEAN (Cambodia 5%; Indonesia 3%; Philippines 2.5% ..). Recently, Korea has become a large export market with the proportion of export turnover accounting for 3.9% of Vietnam's total export turnover of plastic products.

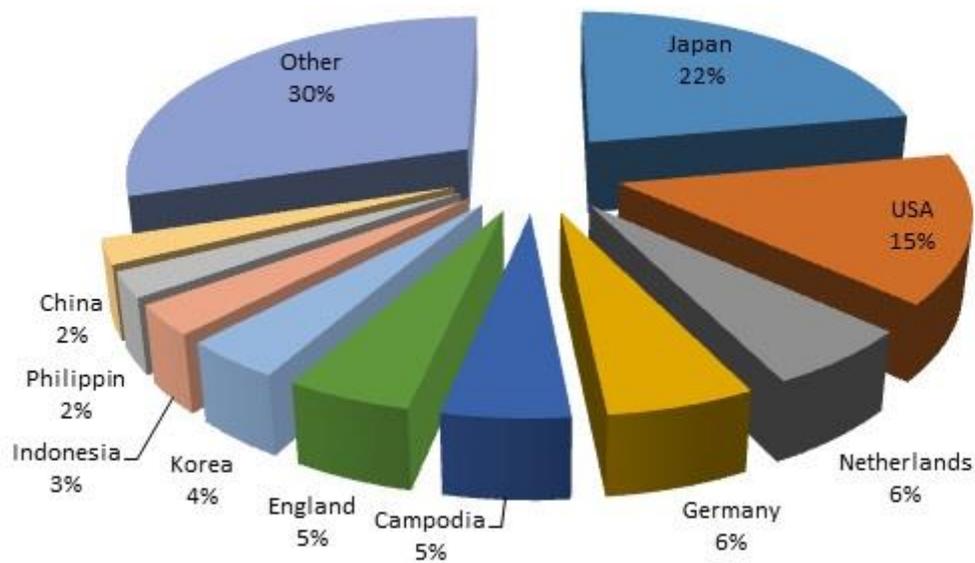


Figure 10: International market share (Vietnam Plastics Association report, 2017, 86).

3.2 Current situation of reverse logistics in Vietnam Plastic supply chain

In this section, the thesis will focus on studying the status of reverse logistics in two businesses representing two groups of members who play an important role in the reverse logistics flow in the Vietnam plastic supply chain, they are plastic manufacturing enterprises and plastic recycling enterprise. All data was collected from main website and phone interview those companies.

3.2.1 Reverse logistics at Hanoi Plastic Joint Stock Company

Introduction about Hanoi Plastic Joint Stock Company

Hanoi Plastic Joint Stock Company (HPC) is a company manufacturing and trading industrial plastic products (including manufacturing molds and specialized equipment for plastic production technology). The former of Hanoi Plastic Joint Stock Company is Hanoi Plastic Factory established on January 29, 1972. Hanoi Plastic Joint Stock Company specializes in providing high-quality plastic products for the automotive, motorbike, electric, electronics and construction industries and many other plastics products such as PP, PE, PS, PMMA, PA, POM, ABS, PVC, PV, etc. The company's

products are recognized as the key industrial products of Hanoi City with major customers are Honda Vietnam, Toyota Vietnam, Piaggio, LG and export to Japanese market.

By the end of December 2017, the number of employees at the Company was 1350 people; in there are 112 university graduates, 65 people graduated from colleges, 35 people graduated from secondary schools, the rest are electric, mechanical workers, plastic production workers. The company has also built 2 factories with a total area of 46,000 m² located in Phuc Loi - Gia Lam - Hanoi and Van Lam - Hung Yen. In the past 8 years, HPC has had outstanding development. Currently, HPC is still on a strong development trend and is considered one of the leading plastic enterprises in the Northern region.

At Hanoi Plastic Joint Stock Company, the thesis focuses on study the recall unsatisfactory plastic products (the company called unsuitable products) to put them into repair and remedy to suitable products or chopped into recycling materials (Figure 10).

Identification and detection: unsuitable products may be detected and reflected by the customer or be discovered by other departments during the production and inspection process.

Classify unsuitable products: unsuitable products after detection will be divided into 2 categories depending on the degree of inappropriate

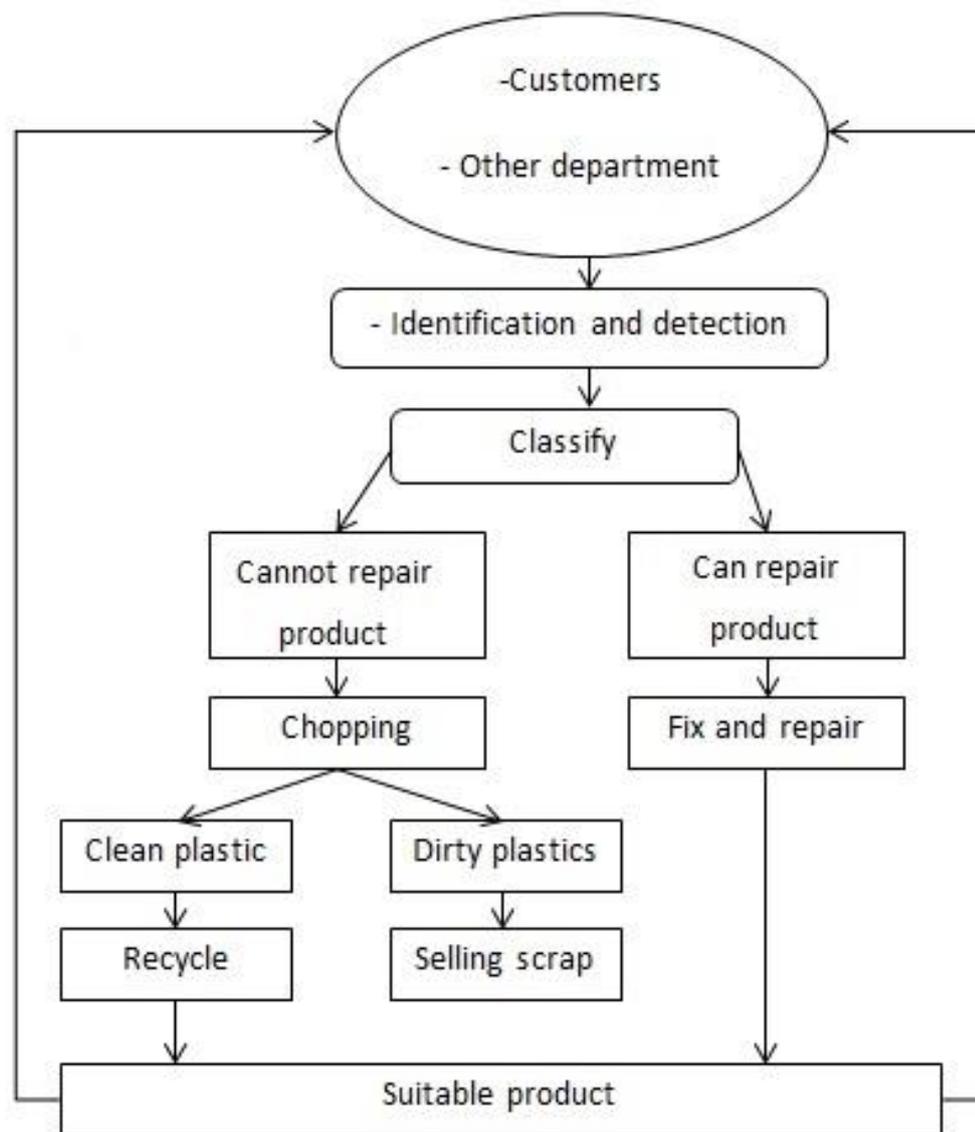


Figure 11: The reverse logistics process for unsuitable products at HPC

Repairable product: is a product that does not meet quality standards due to objective reasons (obsolete products, shipping errors), easily recover and treated (products with slight scratch, stickers of products are not properly positioned, assembly details are not properly required ,etc.) or in cases of changes due to customers (customers set new standards for products).

Unrepairable product: is that the product does not meet quality standards, has a basic reason, must take preventive measures to prevent the repeated occurrence such as: the product is warped, defective, scratched, non-standard size...

Product handling: Depending defect level of each type of product, the functional departments will decide the corresponding treatment measures.

- Repairable product: The pretreatment department will repair failure product to turn into a suitable product, such as: Cut down burrs of the product; polish the product to remove slight scratch; peel and re-label the label in accordance with the prescribed position; reassemble details, etc.
- Unrepairable product: Since the unrepairable products are not suitable for repair, they will move into the pre-treatment department to chop the product. After chopping, we can collect clean plastic (not mixed with materials, scraps, etc.) and dirty plastic (mixed with scraps, other materials or mixed with many other additives, etc.).
- Dirty plastic: will resell to scrap collection companies or other companies that require low-quality plastic materials to produce other plastic products such as sandals, trash bin, packaging, etc.
- Clean plastic: will be recycled by mix with new materials and put into the production process to create suitable products. Depending on the quality requirements of each type of product and commitment to customers, the ratio of mixing with new materials ranges from 5 to 20%. For example, for computer case products the mixing ratio of clean plastic and new materials is 5% and 95% respectively. Meanwhile, for plastic parts used in construction or industrial containers, the mixing ratio can be up to 20% for clean plastic and 80% for new materials. Particularly, for plastic products supplied to Honda, Toyota the customer require HPC not mix cleanly plastic with new materials to ensure high-quality standards.

3.2.2 Reverse logistics at Tan Tai Co.Ltd

Introduction about Tan Tai Co.Ltd:

Tan Tai Co.Ltd is a scrap plastic recycling facility, established on March 26, 2005, at Minh Khai plastic recycling village (Nhu Quynh, Van Lam, Hung Yen, Vietnam). The main business of the company is purchasing plastic scraps and producing recycled plastic products such as: Plastic bags, supermarket bags; thin film, stretch film used in agricultural production; sewing thread, lanyard; recycled plastic particles

Up to now, the company has invested in the area of the factory including the main area of 1,000 m² to serve the production process and sub-areas of 400 m² to classify waste materials and recycle plastic materials. The company is currently employing 31 employees, of which the majority are unskilled, low-skilled workers to classify waste and control machines.

The process of collecting and recycling plastic waste at Tan Tai Co.Ltd:

Purchasing scrap plastic: Tan Tai Co.Ltd buys scrap plastics from two main sources including scrap collection facilities and plastic product factories. In particular, purchasing scrap from plastic factories accounted for a large proportion with more than 60.8%. The rest are purchased from scrap collection facilities and mainly are plastic packaging wastes.

Recycling process plastic waste: At Tan Tai Co.Ltd, plastic waste is recycled according to the following basic steps:

Waste classification: Plastic waste after being purchased will be classified according to product categories (plastic threads, plastic packaging), colors or materials

Chopping and washing scraps: After sorting, scraps will be put into the chopping-washing machine. This is a rudimentary machine with a system of hash knives and hoses. At the same time with the hashing process, the water will be put in to wash away the dirt mixed in the plastic waste. Particularly for plastic packaging waste, after passing the chopping-washing machine, plastic packaging continues to be put through a water tank about 7m - 8m long to remove impurities.

Smoothing: Plastic scraps after being chopped and washed will be put into a kneading machine without drying. Under the impact of high temperature, plastic waste will flow out in the form of a thick, flexible mixture.

Granulating: This mixture continues to go through the granulator system. First, the flexible plastic mixture is passed through the yarn extruder. Then, the fibers will then pass through the water trough to cool and shape. Finally, the fibers go through the cutting section to create plastic beads.

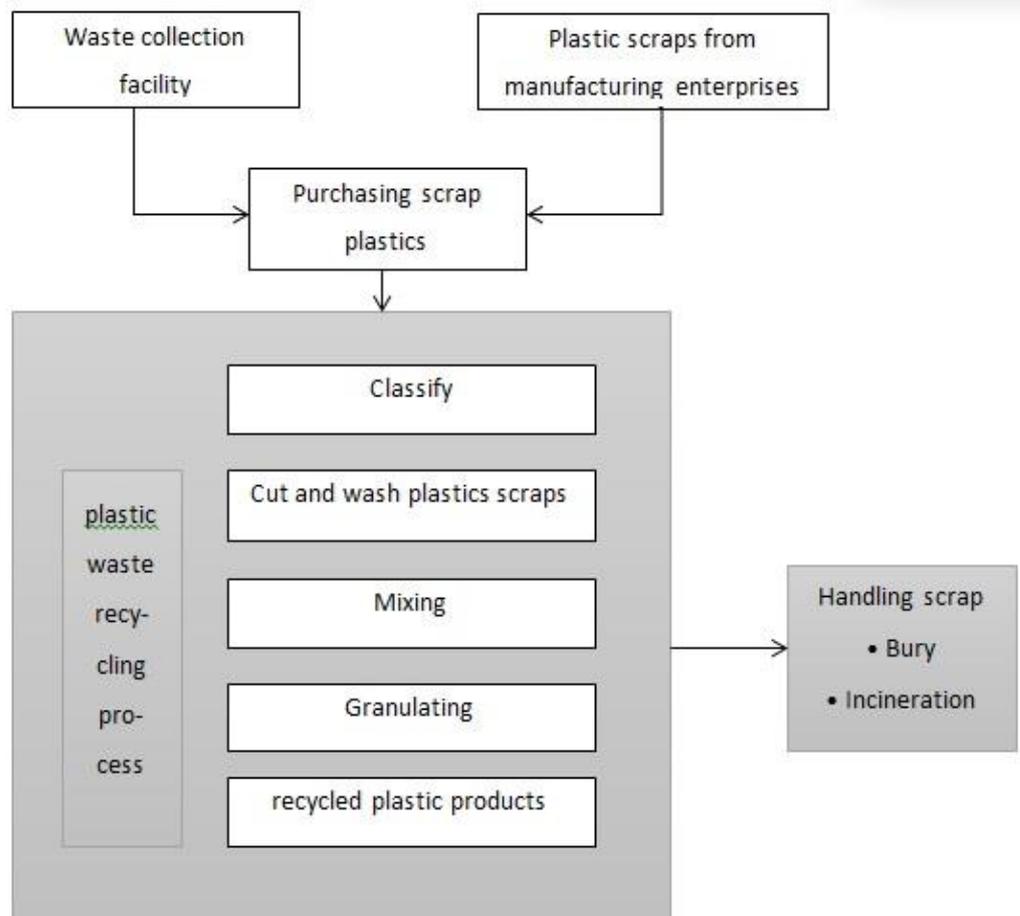


Figure 12: The process of collecting and recycling plastic waste at Tan Tai Co.Ltd

Production of plastic products: Recycled plastic beads will then be returned to produce different types of plastic products

3.3 Current situation of reverse logistics in Vietnam plastic supply chain

Reverse logistics organization model:

Organizational model of reverse logistics network for plastic products in Vietnam includes reverse logistics enterprises in a certain geographical area such as urban environmental companies (URENCO), collection points, Recycling facility...This network is divided into two main branches, they are:

For plastic scraps sorted by families and officers from other solid wastes, they will be sold to waste materials buyers. Plastic waste is not classified at the source, mixed in other types of waste because they are low value and mainly plastic packaging will be

collected by road pickers, pick up garbage at transfer points or landfills. After that, those scrap plastic will be sold to small and medium-sized scrap buying facilities. In their turn, small and medium-sized purchasing plastic scrap facilities will sort plastic waste and resell it to large-scale purchasing establishments.

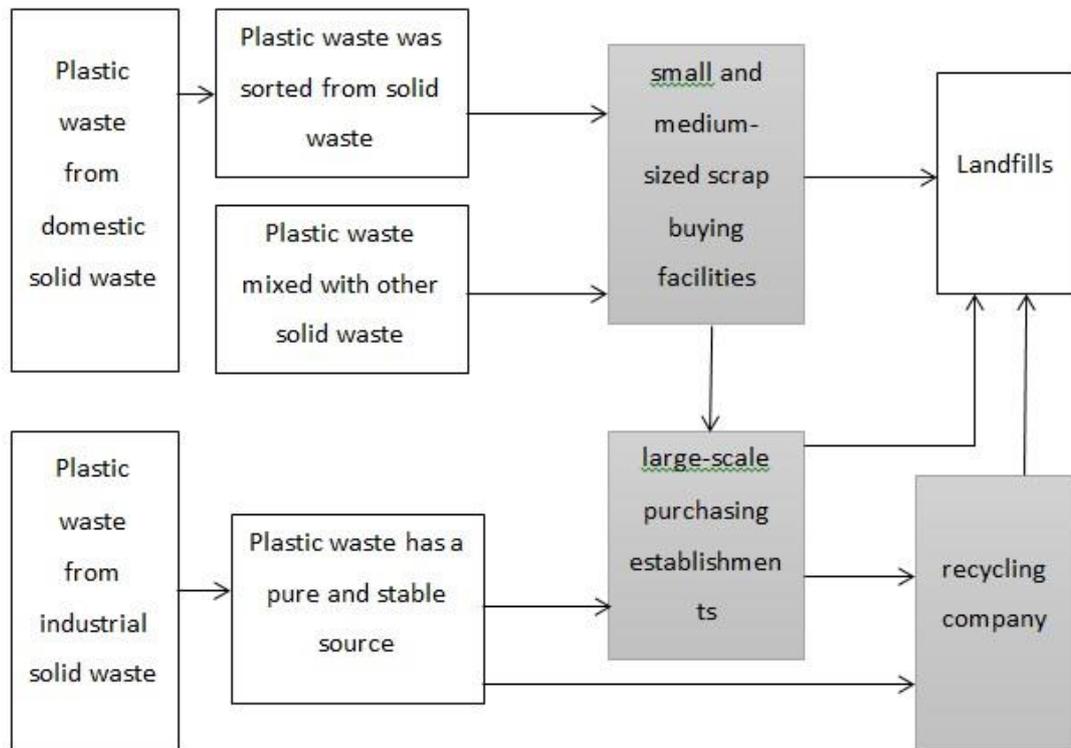


Figure 13: Organizational model of reverse logistics network in Vietnam

For pure, stable and non-mixed with other plastic waste from plastic product manufacturers, they are often sold directly or through brokers to large-scale scrap buying establishments or plastic recycling facilities through a legal procurement contract.

Plastic waste collection and recycling facilities play an important role in the reverse logistics network in Vietnam plastic supply chain with the same function as a regional center to collect and handle plastic products and waste from wholesalers, retailers, manufacturers and urban environment companies in the market area they operate. Most of these plastic collecting and recycling facilities are small and medium-sized,

regional-oriented activities in providing collection services combined with waste disposal services.

At recycling facilities, plastic waste will continue to be cleaned and processed to produce recycled plastic pellets. Recycling facilities for plastic waste often converge on craft villages. Among them, plastic recycling village at Minh Khai, Nhu Quynh, Van Lam, Hung Yen is considered one of the largest plastic recycling villages in the Northern region. There are nearly 1000 households (out of 1,056 households) in the village operating in the recycling sector with the average number of workers per household is 10-15 people, producing about 5,000 tons of products per year, mostly plastic pellets or plastic films consumed in the domestic market and a small part exported to the Chinese market (Ministry of Nature Resource and Environment, 2011). Recycling facilities in the craft village buy plastic scraps from scrap collectors or from plastic product manufacturers. Most of scrap materials brought to Minh Khai were cleaned, dried and packed according to different types such as PET bottles, plastic bags, plastics films...These plastic scraps are usually stored by the road, while most recycling activities take place in the family yard or the adjacent small buildings. Recycled plastic products of craft villages focus on few categories including nylon bags, supermarket bags; disposable cup, straw; water pipes; sewing thread, lanyard, etc.

In general, besides bringing about socio-economic benefits; plastic recycling facilities in Vietnam are facing many limitations: small-scale, outdated recycling technology, causing environmental pollution, low quality of recycled products, less diverse categories. Meanwhile, large-scale plastic recycling projects face difficulties in raw material source. The current system of purchasing plastic waste is not enough to meet the requirement of large-scale plastic recycling projects in both quality and quantity. Because of all reason mentioned above, to develop plastic recycling as an industrial production industry to use of resources, economic efficiency and minimizing related environmental issues, we need assessment of the current status of plastic recycling activities accurately to orientate the development of plastic recycling industry as well as developing policies to support the development of the plastic recycling industry.

3.4 Reverse logistics organization in member companies in the supply chain

3.4.1 Self-organized reverse logistics in Vietnam plastic enterprises

The proportion of enterprises in the chain that organized reverse logistics is quite high up to 74.5%. In which, the proportion of enterprises having organized logistics activities in the past 5 years is 48.8% and under 5 years is 25.5% (table 4). This fact is completely consistent with the characteristics of plastic products- a product with high recycling and reuse capacity, so it is necessary to organization reverse logistics activities. On the contrary, the proportion of enterprises does not yet implement logistics reverse, but they are expected do that in the near future are 11.6% and 13.9% of enterprises in the survey sample do not plan to organize logistics due to limited resources or they are retailers of plastic products.

Organizations	Number of enterprise in the sample selected	Rate (%)
Enterprises have organized reverse logistics over 5 years	42	48.8%
Enterprises have organized reverse logistics under 5 years	22	25.5%
Enterprises will organize reverse logistics in the next 5 years	10	11.6%
Enterprises will not organize reverse logistics	2	13.9%

Table 3: Timeline of reverse logistics organization at Vietnam plastics companies (Thesis survey).

The high proportion of enterprises with reverse logistics operations can be explained as most businesses in the chain see the benefits that logistics brings to enterprises such as cost reduction, better meeting requirements from customers, thereby ena-

bling increased profitability of the business. However, the reasons related to reducing the impact of production and business activities of plastic products to the environment, thereby creating a "green" image for businesses is not an important reason for businesses to operation reverse logistics organization.

3.4.2 Reverse logistics organization in Vietnam plastic enterprises

According to the survey results in enterprises in the supply chain of plastic products (Table 3) shows that the number of self-organized enterprises implementing reverse logistics activities accounts for a high proportion with 58 enterprises in the selected sample corresponding to 67.4%. The number of enterprises that outsource part of logistics activities is 21, corresponding to 24.4% of enterprises in the sample. Only 7 enterprises, equivalent to 9.2%, said they outsource all logistics activities

Organizations	Number of enterprise in the sample selected	Rate (%)
Enterprises self-implement reverse logistics activities	58	67.4
Enterprises outsource some reverse logistics activities	21	24.4
Enterprises outsource all reverse logistics activities	7	9.2

Table 4: Organizations reverse logistics in Vietnam plastic companies (Thesis survey)

The basis for making decisions to reverse logistics organization in enterprises in the Vietnam plastic supply chain is quite diverse. In which, there are 3 reasons are rated as most important by enterprises, including enterprise resources, characteristics of products and the risks for reverse logistics activities

3.4.3 Outsourcing of reverse logistics in Vietnamese plastic companies

When outsourcing logistics activities, members of Vietnam plastic supply chain said that activities such as collecting, transporting, inspecting, selling and recycling scrap are the most outsource activities. These are the main activities carried out by collectors and recycler of plastic scrap due to their advantages in the collection network. Other logistics activities such as product repair, product chopping or reproduction are only outsourced to a few activities. The reason is that those companies producing plastic products have invested in technology to process products that do not meet the requirements and waste generated in the production process right at the enterprise.

3.5 General evaluation of the current logistics situation in Vietnam plastic supply chain

3.5.1 Successes and reason

Based on the research of the above situation, it can be clearly seen that in the plastic industry, reverse logistics in the Vietnam plastic supply chain has achieved some success as mentioned below.

In general, the plastic industry has developed strongly in the past 5 years with high growth rate (average 15-18% per year), accounting for 4.8-5% of the total industrial production value and about 3% of Vietnam's GDP (Vietnam Plastics Association, 2017, 23). Export turnover increased strongly along with expanding export markets to more than 150 countries. The plastics industry is considered one of the ten key industries to be invested by the government. The analysis in chapter 3 shows that Vietnam has established the supply chain of Vietnam plastic with the participation of all members from suppliers of plastic materials to manufacturers, wholesalers, retailers, domestic and foreign customers.

In Vietnam's plastic product supply chain, reverse logistics organization has been implemented with the participation of relevant ministries and many other members. In addition, the reverse logistics network has been formed by regions and areas. Also according to the survey results in chapter 3, most (62%) of the members of the sup-

ply chain organized reverse logistics activities at the enterprises and or planned to reverse logistics activities in the near future (14.2%). This result is thanks to the fact that members of the Vietnam plastic supply chain are aware of the ease of recycling, reuse of plastic products and the meaning of this activity for enterprises to meet customer requirements, reduce production and business costs.

The reverse logistics activities from the collection, inspection, classification, processing to redistribution have been implemented according to each product in the Vietnam plastic supply chain. In particular, the activities of collecting and processing products that do not meet the requirements, spare parts and waste products by enterprises are effectively implemented with the high rate.

3.5.2 Limitations and reasons.

Beside the initial successes, reverse logistics in the Vietnam plastic supply chain exist many limitations and shortcomings that need to be solved. The limitations and causes of such restrictions include:

Limitation in reverse logistics organization:

Members of the reverse logistics network in Vietnam plastic product supply chain do not have the capacity to operate all reverse logistics activities but increase their capacity through relationships with other network members. However, the level of collaboration among members is below average.

The proportion of enterprises self-organizing rather than outsourcing logistics is high, however, the self-organizing capacity of enterprises is mediocre. Enterprises in the supply chain of Vietnam plastic have only organized logistics activities individually well but the strategies, plans, and policies for reverse logistics activities have not been methodically planned.

Limitations in the deployment of reverse logistics flows and activities:

Enterprises producing plastic are only deploying reverse logistics flows for products that do not meet customers' requirements or waste products and by-products generated in their factories without sufficient capacity nor being binding responsibility to

organize the collection and recycling of finished products from consumers such as can, bottle, etc.

The reverse logistics flows for end-use products from end-up consumers depend on informal establishments that collect and recycle plastic scrap. However, most plastic recycling facilities have a small area; the labor force is mainly low level, not high skills; operating on a family scale, the management capacity of plastic recycling facility owners is very limited. The rate of recovery and recycling, reuse for finished products from consumers is very low; the rest is buried in landfills. This situation leads to a waste of plastic waste, exacerbating environmental pollution.

For collecting activities, plastic scraps are gathered, collected from many sources, with unstable components and quality; causing difficulties for plastic recycling activities and affect the quality of recycled plastic products. The supply of scrap is not guaranteed in terms of quantity and quality, which also makes it difficult for collection and recycling facilities in order to make specific production plans and do not dare to scale up recycling activities.

The traditional recycling technology that currently uses in businesses is mostly obsolete and primitive. This leads to a low quality of recycled plastic products, products that are less diverse; at the same time, energy consumption and pollution levels are high; not ensuring the economic and environmental effects of plastic recycling activities of those establishments.

Recycled plastic products are redistributed including recycled plastic pellets and products made from recycled plastic pellets. However, in Vietnam, recycled plastic pellets are often in low quality, only used to produce household plastic products for the popular market, so the economic efficiency is not high enough.

- Reasons for the limitation:

Although recycled plastic products are being used extensively in the market but the psychological fear of origin of plastic waste is unclear, low quality plastic recycling will make Vietnamese consumers gradually lose their support for recycling plastic product. Besides that, the plastic product manufacturers themselves have not been

able to collect and recycle plastic waste from domestic waste because of concerns about the stability of input materials.

The problem of sort waste at source is one of the major barriers to reverse logistics development in the Vietnam plastic supply chain. Due to not being sorted right from the source, plastic waste contains many impurities; causing difficulties for collection and sanitation activities; reduce the quality of input scrap for recycling, cannot use the "resources" of plastic waste. If we can solve the problem of waste separation at source, it will create favorable conditions for the deployment of the next logistics activities.

Vietnam's plastics industry is dependent on imported raw materials because the petrochemical industry in Vietnam has not developed. However, the situation of importing plastic scraps is complicated and difficult to control makes the environment pollution become more serious. Besides it, the ability to recycle and reuse plastic products of Vietnam is too low, making Vietnam one of the five countries with the largest volume of plastic waste discharged into the sea in the world (including China, Indonesia, Philippines, Thailand, and Vietnam) with about 0.7 million tons of plastic waste being discharged into the sea every year (Jenna R. Jambeck, 2015, page 768-771).

The concept of reverse logistics is still very new in Vietnam, so most businesses in the Vietnam plastic supply chain are not aware of the role of reverse logistics for production and business activities and the goal of sustainable development of businesses, supply chains as well as of the country.

4 Solution to develop reverse logistics in Vietnam supply chain.

Proposing a reverse logistics organization throughout the Vietnam plastic supply chain

The target of the solution:

The target of this solution is to build a multi-channel logistics organization model for Vietnam plastic supply chain with the official collection and recycling plastic systems. This multi-channel logistics organization model will create a close connection be-

tween members in the official collection and recycling system; at the same time promote the role of the current collection and recycling system in Vietnam and solve the remaining limitations of this system. Multi-channel logistics model will be effective in the first phase from now to 2025, when moving to the next stage, it is necessary to adjust this model to suit the actual conditions at that time.

Subjects implement solutions:

In order to create an office reverse logistics network based on a multi-channel model, enterprises in Vietnam plastic supply chain cannot implement themselves. It also requires the administration, organization of government as a subject to create compulsory or encouraging mechanisms. the participation in the management of the government will encourage the members of Vietnam logistic supply chain to consider developing reverse logistics at the enterprise, at the same time coordinate with other members in the reverse logistics system about responsibilities of collection and recycling plastic activities. In other words, in order to implement this solution, there needs to be coordination among enterprises in the chain as the main implementing entity and the government as a facilitator of the conditions for developing the reverse logistics network.

Solution content:

The official organization in Vietnam plastic supply chain will be formed as multi-channel with a central role is the official collection and recycling system will be shown in Figure 11 below. In particular, the official logistics network will be the connection between entities including urban environmental companies under URENCO in provinces and cities; producer; retailers; collecting and recycling plastic companies with business registration.

Along with the proposed model, the thesis also points out the role and the reverse logistics programs corresponding to each member in this model. Thus, focuses on 4 programs for the official reverse logistics network include producer's waste collection program, retailer's exchange program, separation plastic waste at source program for urban environmental companies and waste collection programs of government organizations.

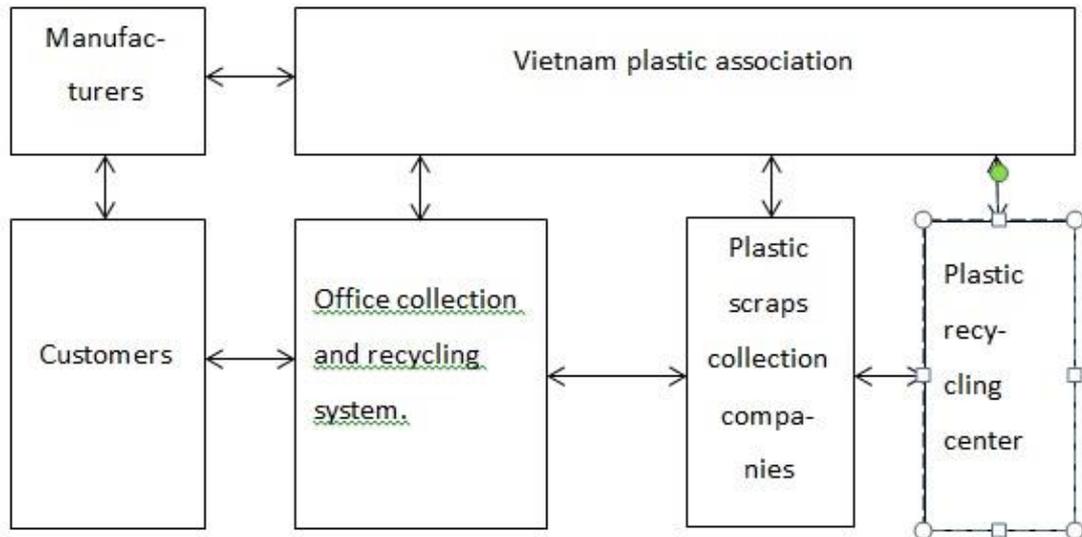


Figure 14: The proposal for the official reverse logistics organization model in Vietnam plastic supply chain.

Official collection and recycling system: Including 4 main members with reverse logistics programs suitable to the characteristics of each member.

Collection point of manufacturers: Collections point model has been successfully implemented in other Asian countries. This experience can be applied in Vietnam by encouraging or using a legal mechanism to require producers and importers to cooperate to develop collection and recycling facilities. In addition, manufacturers should be encouraged to invest in eco-friendly productions.

Retailer: Retailers can operate plastic collection programs through the "old exchange for new ones" program. This form of collection is done at retail stores, when customers bring old products to the store and buy new products, they can get some bonuses or discounts from the retailer. In order for this program to be effectively implemented, the manufacturer should have an agreement with the retailer about the discount for the customer in the "new old exchange" program and support them with the collection (responsibility, cost) as well as plastic waste collection system.

Plastic waste collection companies: are registered, large-scale collection facilities that carry out warehouse functions in the official reverse logistics system.

Local government, social organizations: they can periodically organized the "Plastic scrap collection day per week" programs or maintain this program as a regular activity.

URENCO waste collection network: In order to improve the efficiency of collecting plastic waste from URENCO network, it is necessary to well implement the "Source waste separation program" through policies to encourage, mobilize or force agencies, households, and individuals people classification waste at source.

- Plastic recycling center: The plastic recycling center is a collection of businesses, producer and business establishments in the recycling sector such as industrial recycling zones, recycling villages, a group of small recycling facilities distributed in a geographic area

5 Discussion.

The thesis has pointed out the most important issue of reverse logistics in the plastic supply chain in Vietnam, this is low quality and un-classify of scrap plastics at the sources. For example, at Hanoi Plastic Joint Stock Company, due to the problem of plastic waste quality is not meet the requirement, the company cannot produce company products from 100% recycled plastic. Meanwhile, at the Tan Tai Co.Ltd, the quality of recycled plastic is too low, it is impossible for the company to expand its plastic product production. Besides, the technology problem is also one reason limiting the development of reverse logistics in Vietnam. From these difficulties, the thesis proposes a solution to build a multi-channel logistics organization model for Vietnam plastic supply chain, increase both efficiency and quality of collected plastic scrap, thereby enhancing the ability of the Vietnam plastic supply chain.

The thesis has contributed to systematizing, supplementing and completing the theoretical framework on reverse logistics development in the Vietnam plastic supply chain. Research results of the thesis can help members in Vietnam plastic supply chain to objectively recognize the reverse logistics system; then, apply appropriate solutions to build the reverse logistics system and improve business efficiency. In addition to the achievements mentioned above, with research conditions having many limitations, the thesis still has many issues that have not been thoroughly

solved. The lack of unified management, low awareness of households, unable to classify waste at source, this makes the development of reverse logistics in Vietnam plastic supply chain take long time and effort. Meanwhile, with the uncontrolled discharge of plastic waste into the environment, the problem of plastic waste collection is becoming the most urgent issue for sustainable development of the country. However, after several years the environment will be exhausting and pollution, so the companies have to act for environmental sustainability.

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Appendices

Appendix 1. Survey question

1. Year of establishment of the enterprise?
2. Total number of employees in the enterprise? people.
3. Please indicate the main markets of the business?
4. In your opinion, reverse logistics is important to the business or not?
5. Time to organize reverse logistics activities at enterprises?
6. Which of the following reverse logistics organizations does the business conduct?