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Organization of Cargo Containers and Packing Cases for Secondary Turnover in Logistic Systems

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Abstract
The thesis was focused on analysis of the most popular methods for secondary use of packaging in the world, especially in Finland and Russia, and the existing situation on both markets was described.
The main objective was to research the used methods for secondary use of packaging, and to suggest innovative and modern improvements. The theoretical framework was completed by studying literature that is related to the chosen topic. The empirical part is based on analyzing the information from theoretical research, annual reports and other information related to Finnish and Russian recycling companies, which were compared to each other.
Considering the fact that both countries that were studied in this thesis have their recycling systems, it should be noted that Finland has much developed recycling practices. In order to improve the using of recycled plastic, production of filament for 3D printers was suggested.

Keywords
logistics, reverse, optimization, packaging, recycling

CONTENTS

ABBREVIATIONS

CH_4 – Methane

HDPE – High Density Polyethylene

HG – Hydrargyrum

HORECA – Hotels, Restaurants, Cafes

HSY – Helsinki Region Environmental Services Authority

ISO – International Organization for Standardization

MSW – Municipal Solid Waste

NRP – Non-Recycled Plastic

PE – Polyethylene

PET – Polyethylene Terephthalate

PP – Polypropylene

PVC – Polyvinyl chloride

ROE – Return on Equity

ROI – Return on Invested Capital

RVM – Reverse Vending Machines

WACC – Weighted Average Cost of Capital

WTE – Waste-To-Energy

1 INTRODUCTION

The objective conditions of economical development require effective management for moving enormous number of goods through long supply chains. Increasingly frequently we can hear that developing logistic becomes the key factor of globalization. Products along with financial and information flows move rapidly, consumers receive their goods faster, and due to this the world economy is growing and developing. Nevertheless, experience has proven that one of the modern logistic weaknesses is cargo packing because the principles of choosing the method of packing influence transportation costs due to the fact that handling most of cargoes from manufacturing to consumption and service sphere becomes impossible without packaging. In addition, it is quite expensive to provide a return flow of empty cargo containers and packing cases.

However, not only economic efficiency plays such critical role in developing logistic field, and also ecological aspect helps companies to reach sustainability. In developed countries, returns of retail containers for recycling have increased. A shining example of a country with widespread reverse turnover of packing is Finland, where recycling rate nowadays is approximately 33% (Lassila & Tikanoja, 2015). In the future, it has to be over 50% because the European Union demands that. For example, in all 28 member-states of European Union it has been recycled approximately million tons of paper wastes monthly from January 2002 to 2013 (Eurostat, 2014).

Recycling impacts the environment in a positive way. It saves energy, reduces pollution, and improves the soil. Recycling saves money for the manufacturer and final customer. Cons are hazardous chemicals in recycled debris (plastic contains toxic substances). Paper recycling is not quite as great as it seems (one of the reasons is that paper recycling is more expensive than other recycling), and plastic recycling is complicated (for example, some varieties of plastics are nearly impossible to recycle).

Main objective

The main objective of this thesis is to investigate methods for organizing the backflow part of supply chain using recycled packing cases as raw materials for new packages or for other fields of business.

In order to obtain the main objective, it is important to consider the following sub-questions:

- What role is packing plays in logistic systems?
- What are the most popular methods to utilize expended packing nowadays?
- How is recycling supply chain typically organized?
- What are the main conditions and trends in Finnish and Russian recycling markets?

Research methods

The theoretical part of the thesis will be based on an analysis and description of reverse logistic related literature, press-releases, statistics, companies' reports, and packaging market researches.

For the empirical part, a method focused on an analysis of existing methods for recycled packages was chosen. In addition, this thesis will include materials from annual reports and other information connected to "LASSILA & TIKANOJA", "Finnish Packaging Recycling RINKI Ltd" and "PLARUS". Finally, it will be suitable to suggest improvements related to recycling systems and reverse logistics.

2 THEORETICAL BASIS OF REVERSE LOGISTICS

Reverse logistics is the process of planning, adaptation and monitoring of the flows of raw materials, semi-finished goods, final products and information flows from the consumption sphere to the originating point, with the aim to renew, add value or utilize residue. (Morana, 2013, 73).

The principal duties for reverse logistics are:

- reusing products for costs optimization for;
- Creating or using existing supply, distribution or backflow channels;
- Building optimized routes for moving material and information flows on conditions that costs for organizing and working of channel have to be minimal;
- Using information technologies providing effective backflow;
- Providing the actual and necessary information to all parts of channel;
- Using ecological- and economical-effective packing materials. (Bukrinskaya, 2010, 21).

2.1 Objects of management in reverse logistics

As presented in Figure 1, reverse logistics operates two integrated blocks of objects: material flow from manufacturers and from consumption sphere. In both of these blocks, the main categories are goods and packages. However, production and consumption spheres are usually differentiated by types of returned flows. Factories deal with raw-materials, supplied with breaching of contracts: it might be the wrong quantity, too early or, more often, too late delivery, or substandard-quality materials. The goods with deviations from manufacturing technology constitute a part of routine backflow for the factory: quality control prevents selling rejected goods. Existing products of low demand or backflow of the obsolete products is the result of marketing or product managers' mistakes, but if these goods have already exposed to the market, it is necessary to dispose of all inventories to use warehouses, shops, and vehicles more effective. Finally, returnable containers are a particularly important part of backflows, because durable packaging reduces transportation costs, on account of aggregated cargo needs less time to be handled. It helps to avoid wastes creation, but at the same time increases transportation costs for itself, when empty containers have to be delivered back to the manufacturer.

On the other hand, there is backflow from consumption sphere. Retailers must deal with finished products and its' packaging. Nowadays, especially in Finland, customers particularly often face all four kinds of these backflows. Discarded electronics, clothes, paper – shining example of used recycling products. Hg-filled lamps, some kinds of plastic, furniture – used non-recyclable goods. Everyone just once in one's life has changed broken product back to the shop – whether it was electro-kettle or mobile phone – that were goods with undetected manufacturing defects.

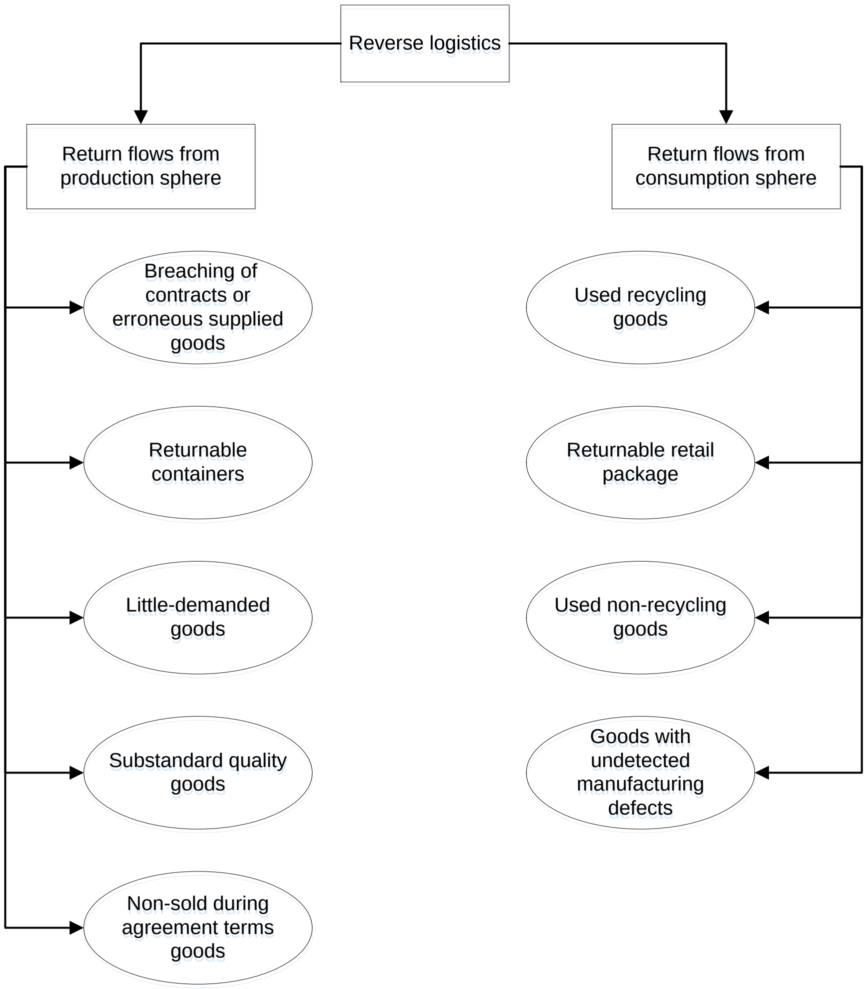

Figure 1: Objects forming return flows in reverse logistics (Bukrinskaya, 2010, 22)

Finally, returnable retail packages are for example, glass and plastic bottles, or aluminum cans. In the 20th century, glass bottles were returned universally, nowadays returning of the retail package is more common in developed countries because it is necessary to build a complicated but effective system for collecting, recycling and reusing empty containers.

2.2 Process of reverse logistics

In figure 2, the process of reverse logistic is presented, which includes, besides the main stages, integrated information systems (that make the whole process faster and more effective by providing communication between stages), and shipping (or redistribution system) where the main function is compensation of repaired (or with some other influence) product or money. The elements of this system might be transport, labeling or packaging equipment.

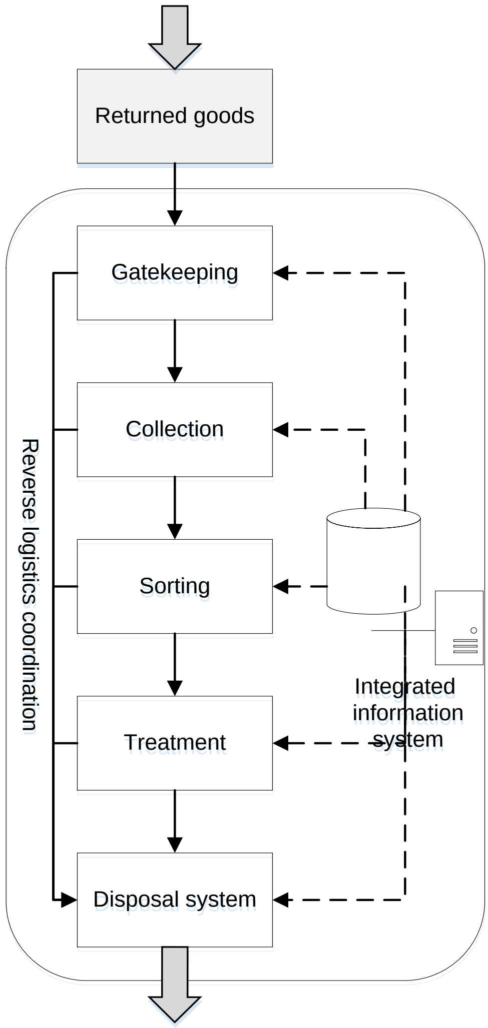

Figure 2: Generic process of reverse logistics (Ait-Kadi, 2012, 41)

The inflow might be goods as described in Chapter 1.1. During the process, the system is changing the condition, size, and quantity of the object. The outflow might be products, spare parts, raw materials, or materials that might be used in other fields depend on the product.

In the first phase of the process of reverse logistics, customer service (if the company is dealing with products, not packaging) is responsible for accepting the goods and estimating if it is necessary to receive certain goods. It is reputed that this stage is the entrance to the reverse logistics system, but it also can be the end if the client communicates with customer service by phone, email, or in the shop, and this service suggests him a satisfactory solution. In addition, if the customer service cannot solve the problem immediately, the workers are responsible for sending objects to the correct place, or to the correct company which has property rights for sent products.

In case of dealing with recyclable products, such as containers (including reusable) or paper items (for example, magazines, and paper bags), reverse system does not need the gatekeeping stage and products go directly to the collection phase. At this stage, the main actions is transportation of returned products back to the manufacturer or repair or recycle center. There are three possible responsible parties involved in a collection process: a customer, company and third-party service. If the customer wants to replace or repair his good, and the company policy does not include reverse delivery costs, this customer has to send the defective part to the service center by himself via mail, courier or another way, depends on the product and the company. If the company service provides the opportunity to use its assets for transportation, the courier can collect the product directly from the customer, or the customer can bring it to an authorized center. Finally, the outsourced company might be involved in the collection process which will make it easier both for the customer and the company. The transportation of goods is finished at the sorting point.

For sorting the main steps include receiving and verifying the returned good. The service center needs to accept the necessity of that return and relate to the returned request (is it the right product, do the quantity and condition correspond to declaration). If there are some discrepancies, the company communicates to the customer and makes a decision to send it back to the customer or to the treatment phase.

There are three main activities at this stage – inspection, inventory management, and processing stage. The inspection is designed to ensure an appropriate way of treatment, and inventory management is made to confirm that condition of the product will satisfy the customer needs. The mail activity at this stage might be repackaging, repair, disassembling, reconfiguration, remanufacturing, upgrading, recycling, donation, selling or disposal.

- Repackaging might be used when the package of the product brakes, and the seller decides not to sell it with a cut price in that condition. The activity is simple and consists of putting the product into new package.
- Repair is the process for that products which main or secondary function is not performing. Firstly, it is needed to make an inspection to decide if this product repairable and how profitable it is to repair it. After repair, the product is packaged again and sent to the customers.
- Disassembling is usually used to reduce costs for the producing of new detail or reducing the environmental impact from production or utilization of used products, and it consists of disassembling of the product to smaller parts.
- Reconfiguration is used for adopting the product for specific customer needs, for example, for the foreign market, but without changing the main functionality.
- Remanufacturing usually consists of preparation the product or its details for reuse, and the difference from the repair is the quantity and complexity of operation processes.
- Upgrading (updating) is the process when a previous version is upgraded by adding new functionality, replacing some technologies, or fixing some mistakes.
- Recycling is the technology of removing recyclable materials separately such as metal, glass, plastic, paper or rubber from the product to reuse or resold these materials.
- Donation means giving products that are useless for the business but still working to some organization such as an orphan home, hospital, or rest home for free.
- Selling on secondary markets is usually used when the product is not meeting customer needs on the current market, and the company is redirecting it, for example, to the developing countries which do not require modern technologies.
- Clean disposal means that used or broken products are sent to landfill, because other ways of treatment are not suitable or profitable.

There is a shipping system at the end of the reverse logistic system which includes a compensation system, transportation, packaging, or some place for preparation and dispatch.

The information system is used for supporting, monitoring, controlling, forecasting, and analyzing the volumes, quantities and time used for returned products. This information will help the company to avoid mistakes and unnecessary expenses in the future or to improve the reverse logistics system and reduce the environmental impacts of the company. (Ait-Kadi, 2012, 41-83).

2.3 Role of cargo containers and packing cases in logistics systems

Nowadays, in the context of growing volumes of trade, it is crucial for companies to increase the effectiveness and efficiency of supply chains to be able to meet competition. Packaging as a category was created to ensure saving the product before consuming due to the many handling operations during long supply chains require stability and protection of the condition of the product. At the same time, all these handling operations need time, and packages help to aggregate small freight units to reduce the quantity of handling operations, and, afterwards, to reduce the ultimate price for the customers.

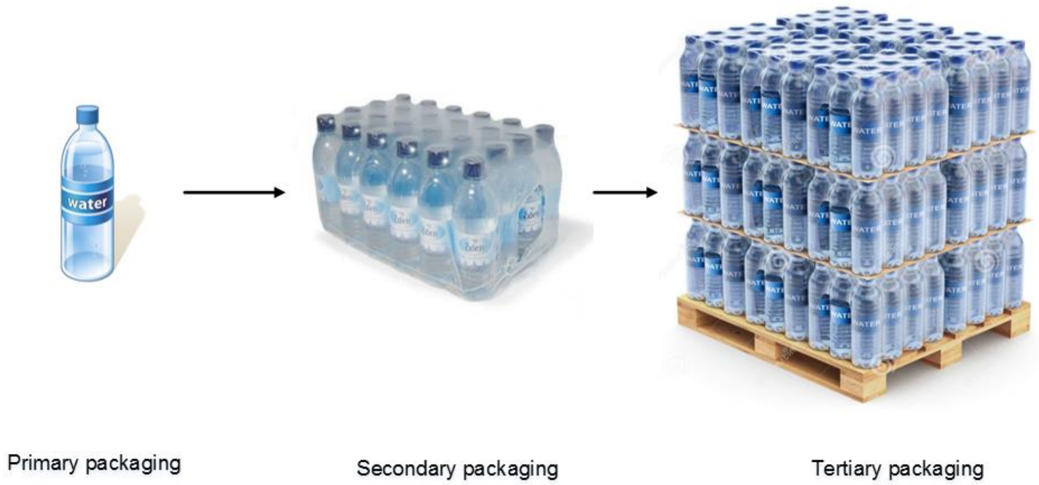

Figure 3: Levels of the packaging system (Sparks, 2006, 71)

Figure 4: Levels of the packaging system (Ebnesajjad, 2012, 182)

As can be seen from Figure 3, logistics usually takes into account three levels of packaging: primary, secondary and tertiary, where each operates in different place in the supply chain or the product lifecycle. The primary level (or sales, consumer packaging) is in direct interaction with the product, and customers see this level more often than other levels because they face it every day in any sales point. The main functions are to inform customers about the product and to protect it from external influence. The secondary level usually represented in heat-shrink film, carton boxes, or plastic crates. The main function is the grouping of it several product items together for easier and faster handling, and saving thus original condition of primary packaging during transportation and storage. The tertiary packaging was created to aggregate several secondary packages and for the most part, reduce time for handling. Examples of tertiary packages are all types of pallets, tension nets and stretch films. (Sparks, 2006, 71-73). In some cases, as can be seen from Figure 4, depending on the product, levels may change, but functionality stays the same. Summarizing the above, in Table 1 are presented the main functions of packaging.

№	Function	Description
1	Information about the product	Firstly, packaging is providing information about the product to consumers, quite often they choose product using only visible, not rational feelings. Secondly, goods marking is helping to identify cargo in all parts of supply chains.
2	Protection	Packaging is able to protect product from aggressive environment and physical impacts during the transportation and storage.
3	Increasing of transportation and handling efficiency	It is crucial function in the context of logistic management: cargo bulks, form, density, and availability for handling influence to ability to aggregate single items to integrated freight

		units. It evaluates transportation and storage costs of the goods in logistic system.

Table 1: Functions of the packaging (Ebnesajjad, 2012, 181)

The world logistics network has been starting to rapidly grow in the second part of XX century, because pallets were invented in 1939 (Trebilcock, 2012) and containers in 1956 (van Ham, 2012, 1), which encouraged the development of the world trade.

As can be seen from Figure 5, nowadays, tremendous economic growth in Asia, especially in China, stimulated moving leadership from the European market, compared to 2005 (Sparks, 2006, 75). Enormous volumes of international trade with China have provided by improving the efficiency of logistics and using cheaper workforce. For this reason, there is quite large difference between Asian and other packaging markets.

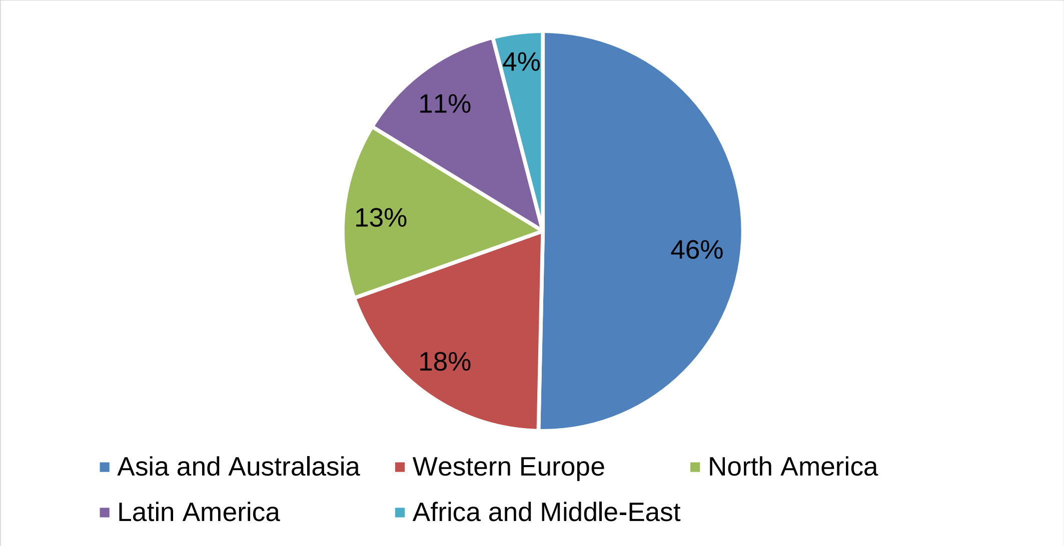

Figure 5: Total packaging volume by region, 2015 (Euromonitor International, 2015, p. 14)

In terms of using materials, in the modern world, plastic predominates over other possible alternatives, even paper, because it has higher quality storage with a longer shelf-life (Figure 6). In production of the plastic packaging, there are used multi-layer laminates, vacuum-packing and modified atmosphere packing. Besides, common humanity has taught to recycle and reuse most types of plastic, and nowadays this has become a gaining traction trend which will continue to grow in the nearest 5 years. As such, more consumers are buying goods with modern recyclable or reusable package because they have started to feel their responsibility for the environment (Euromonitor International, 2015, 8). As a new trend for developed countries, it is also reputed that due to reducing of the free time, consumers prefer to buy smaller and more convenient pack sizes, for example, snack food and beverages, which are easier to use with “on-to-go” lifestyle (Euromonitor International, 2015, 11).

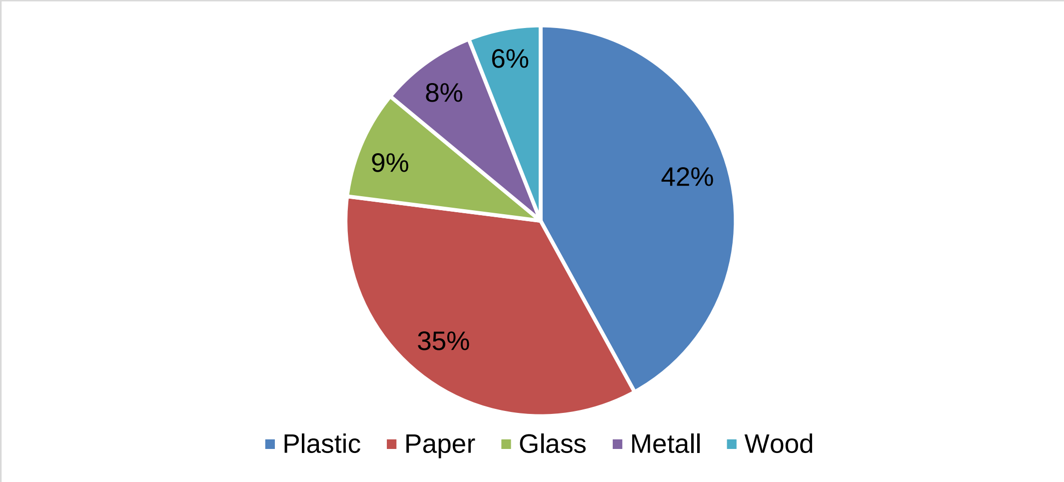

Figure 6: World material share in terms of value, 2015 (ALL4PACK, 2016, p. 11)

2.4 Main characteristics of cargo containers and packing cases

The main rule in distribution is to move cargo as far as possible using as large as possible freight units, and to reach this aim it is needed to aggregate cargoes moving to the end of the supply chain. Building-block principle is the basis of packaging goods: products are placed in rational and easy-to-use blocks, for example, containers. In Table 2 are presented the most widespread types of freight units used in logistic systems.

№	Type of freight unit	Classification	Characteristics
1	Pallet	Classification by sizes: 1200×800×150 mm – EUR 1200×1000×145 – FIN Classification by purpose:	• Gross weight • Net weight • Length • Width • Height • collapsing strength • Square • Cargo height • Load size • Availability of protection • Speed of transportation
2	Container	Classification by sizes: 10 ft, 20 ft, 40 ft, 45 ft Classification by purpose: dry general purpose, flat rack, open top, ventilated, refrigerated, high cube, tank, tunnel, open side, double	

		doors, half height, car, special purpose.	• Interdependence and independence of cargo and freight units of measure • Availability for different modes of transportation
3	Package	Can, bottle, cardboard box, canister,	

Table 2: Characteristics of freight units (Kuparinen, 2016, 8)

Any measuring unit in logistic is based on negotiation between partners which are service suppliers of some products inside the supply chain. Usually, they arrange the measuring units once, at the beginning of a relationship, to make repeated operations easier, because the harmonization between freight units and vehicles will help to complete orders faster, and every participant of supply chain will understand all processes of distribution. Vehicles have some characteristics such as load-carrying capacity, weight-carrying capacity, reliability or speed, and cargoes have to be adopted for this. In any transport mode, every freight unit is counted either in proportion t/m^3 (full usage of vehicle’s weight-carrying capacity by freight units), or m^3/t (full usage of vehicle’s load-carrying capacity by freight units). Measuring units are divisible by freight units (box, pallet, or container) because standardization of the sizes increases the effectiveness of handling. By defining any types of sizes as modules, it is possible to create types of sizes of sub-modules of pallets and further use it to organize the whole module (for example, the sub-module 600×400 mm corresponds to the module 1200×800 mm). The height of module has to correspond to ISO containers, but the most universal sub-module is 300×200 mm because it is possible to make all combinations for most of modules. It is reputed that the most optimal module provides the minimal quantity of operations.

Examples of freight units, such as above, are the basis of technologies of physical distribution, and different types of packaging reduces transportation time and risks. Aggregating batches of the single items makes economic sense if cargoes are transported in universal containers or on pallets. In this case, the transportation unit is not separated to single cargoes but united to a container or package batch of the same cargo with much more weight. Usually, the consignor aggregates cargoes into batches, and after that the whole batch becomes an infrangible freight unit through the whole supply chain, even if the transportation mode changes.

The typical schemes are used for housing cargoes on the transport platforms, which increase the productivity of vehicles as a result of increased volumes of cargo transportation during one working cycle. In consequence, the prime cost per freight unit is reduced. All forms of aggregating cargo units, from manually consolidating a few boxes using handling equipment, fall within the concept of containerization, which can be described as the second predominate inconvertible trend in logistics. (van Ham, 2012, 297-309).

3 ANALYSIS OF ORGANIZING THE SECONDARY TURNOVER OF CARGO CONTAINERS AND PACKING CASES

In this chapter, popular recycling methods will be described, including some examples from Finland and Russia, and also Finnish recycling companies will be analyzed. The main objective is to study the experience of utilizing beverage cases.

3.1 Analysis of the most widespread ways to reuse and recycle cargo containers and packing cases

Nowadays, there are three main methods for using post-consumer (including recycling) beverage packaging: deposit-based return system, system for usage refillable bottles and waste-to-energy system. Independently from the type of secondary usage, packing cases are collected, sorted and transported to the next stage. Firstly, customers return their used containers to the collection station. Developed systems use reverse vending machines (RVM) which have a hole in the wall with an intake-reading system (which identify the type of container using barcode), small display showing the number of inserted containers, and a receipt printer. After printing the receipt, the customer can buy products in that grocery market for refusal sum, or simply return his money in the cash desk (if the system proposes it). The first sorting may occur at this stage, the second may take place in the sorting, recycling or other phase, depending on the system. Manual sorting is usually used for glass, sometimes for plastic, although most developed systems include mechanical equipment which sort already milled plastic by types (for food and beverages usually used polyethylene terephthalate (PET) and high density polyethylene (HDPE)) using an infra-red sensor. After sorting, used packaging goes to the next phase, depending on the secondary usage system. (Andrady, 2015, 257).

Other methods such as pyrolysis, anaerobic digestion, or landfilling with methane (CH_4) recovery (which have positive environmental impact) and degradable, landfilling, or outdoor burning (with negative environmental footprint) will not be considered in this chapter due to unattractiveness and lower usage. (Andrady, 2015, 277).

3.1.1 California model

The first method which is based on collecting used containers and recycling its for secondary usage is called California model. It has developed in two states from 1972, when the first adopted law, Bottle Bill, was published. In 2009, 11 states had already joined this police in USA (California, New-York, Connecticut, Delaware, Hawaii, Iowa, Maine, Massachusetts, Michigan, Oregon, and Vermont) (Jørgensen, 2011, 3). The idea of this method nowadays is familiar for many European countries such as Finland, Germany or Estonia. In order to provide container return, the shop collects deposit from the buyer and gives him a refusal when he brings empty cans or bottles to the collecting point. (Ackerman, 2013, 124-139). Using this method, the above mentioned 11 states reached 61.4 % of returns of all beverage containers compared to 24.2 % in other states (Jørgensen, 2011, 3); in Finland this rate is 92.4% (Palpa, 2014).

As can be seen from Figure 7, the present supply chain for containers looks like circle: the beverage producer puts his product to a new bottle or can, sells it to consumers, who, in turn, bring it back to the shop, from where the used container goes to the sorting station, and then to a material utilizer which produces raw materials for new containers (or even makes ready containers) and sends its to the beverage producer, thus creating a closed circle.

There are some advantages in implementing this method:

- Preferences from the government. For example, in Finland manufacturers and importers that have the return system are exempted from the beverage packing tax which equals to EUR 0.51 per liter (Palpa, 2014);
- Reducing need for natural resources (Palpa, 2014);
- Reduced manufacturer costs (usually recycled materials cost less than new raw materials) (Ackerman, 2013, 128);
- Cleaner environment due to the reduction of wastes from production and consumption spheres (Ackerman, 2013, 133);
- Transformation wastes to resources, which can be a key element of sustainability in the modern world (Jørgensen, 2011, 4);
- Potential opportunities for the poor and homeless people to earn some money and, in turn, clean the urban and nature environment (Jørgensen, 2011, 3).

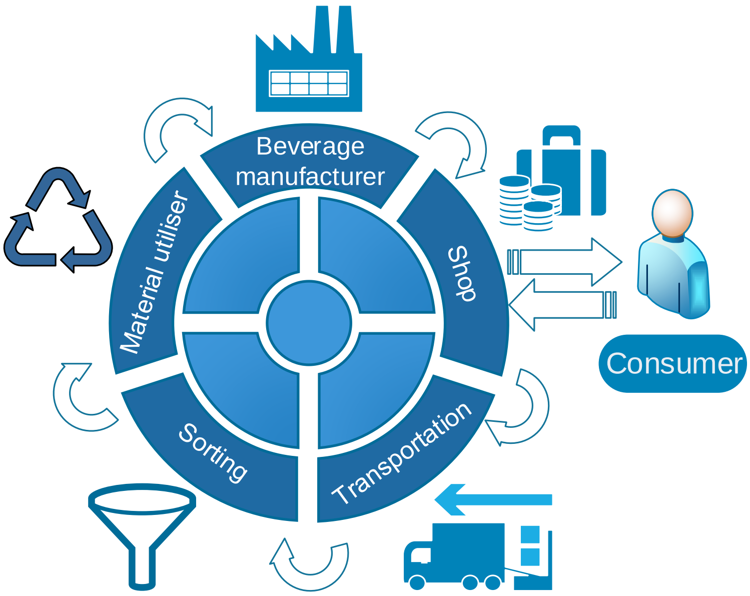

Figure 7: Containers flow in California model (Palpa, 2014)

3.1.2 Refillable bottles

This method was created between XIX and XX centuries, much earlier than the previous one, and in some countries it is still used. The main difference from the California model is that containers (in most cases glass bottles) are not remanufactured. The collection system can vary: it might be either a deposit-refund system as in the previous model, or a simpler system used mostly in developing countries. Usually it is less official and less universal: bottles might be collected in the neighborhood shop, in some separated collecting station or simply by a self-employed entrepreneur in his garage. Some systems are based on mandatory returning empty packaging, otherwise the customer has to pay a penalty for a lost bottle.

As described in Figure 8, after receiving used empty containers from customers or sorting stations, manufacturer workers are washing and sterilizing suitable bottles, but only after manual inspection and sorting. Then its go to refilling, labeling, and corking, after that ready bottles are packaged to aggregated form. (Ackerman, 2013, 124-139).

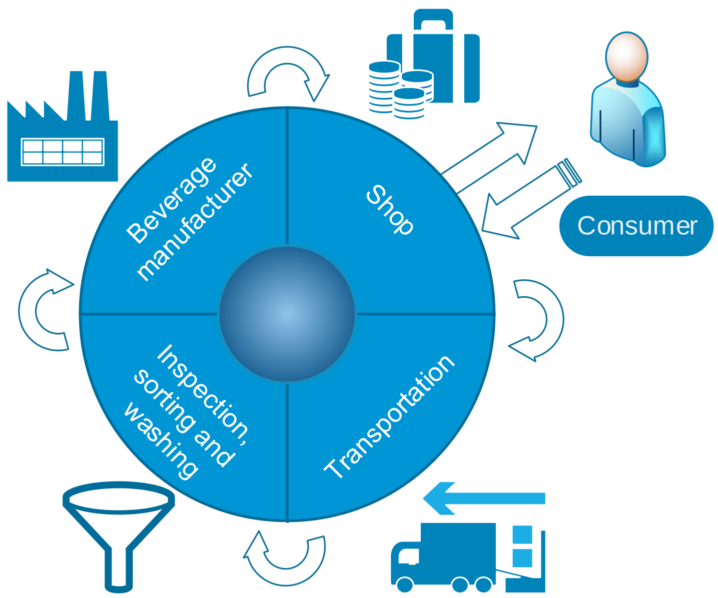

Figure 8: Containers flow in refilled bottles model (Palpa, 2014)

There are some advantages of using this method:

- Highly-repeated usage of the same containers, expenses decrease
- Most of operations, except for the nspection and sorting, run automatically;
- Lower amount of wastes reduces environmental impact;
- It can help poor and homeless people to earn some money, and they, further, are cleaning the urban and nature environment (Jørgensen, 2011, 3);
- Liquid does not enter into a reaction with glass, in contrast to plastic and metal, which prevents the taste of beverage from changing.

Disadvantages of using refillable containers:

- Methods for motivating usual customers to return these containers without deposits are needed. HoReCa customers are more flexible because it is possible to return empty containers at the time of next delivery;
- After many rounds of recirculation, containers lose their attractiveness;
- Glass is usually heavier than other packaging materials, and it is not possible to decrease the volume as with plastic or aluminum. All of this increases transportation costs and complexity;
- Glass is fragile, and special tools and containers are needed for moving it back through the supply chain;
- Extra packaging units must be available to correspond with requirements;
- Resources are needed for washing used bottles. (Ackerman, 2013, 124-139).

3.1.3 Waste incineration

WTE plants are power stations based on the transformation of calorific energy of wastes to useful electrical energy. The operation principle is the same as in thermal electric power station: upward calorific steam is moving the turbine installed on electrical generator, but, as can be seen from Figure 9, the most popular plastics in food packaging industry have higher rates in calorific values than coal, which means more effectiveness of usage WTE plants than old-fashioned thermal electric power stations. Furthermore, modern technologies allow to achieve precious little dioxin emissions because at the end of a burning cycle, the temperature is growing up to 850°C for thermal breakdown of dioxins. (Andrady, 2015, 272).

Advantages of incineration of wastes in WTE plants:

- Minimal hazardous emissions compare to other thermal electric power stations;
- Reduction of operations, because sorting is not needed, wastes might be just shredded;

- Metals which are left in the ash might be sold for recycling, and profitability might be increased;
- Automation of the most processes;
- Reduction of environmental influence by reducing wastes;
- Reduction in the use of renewable and nonrenewable resources.

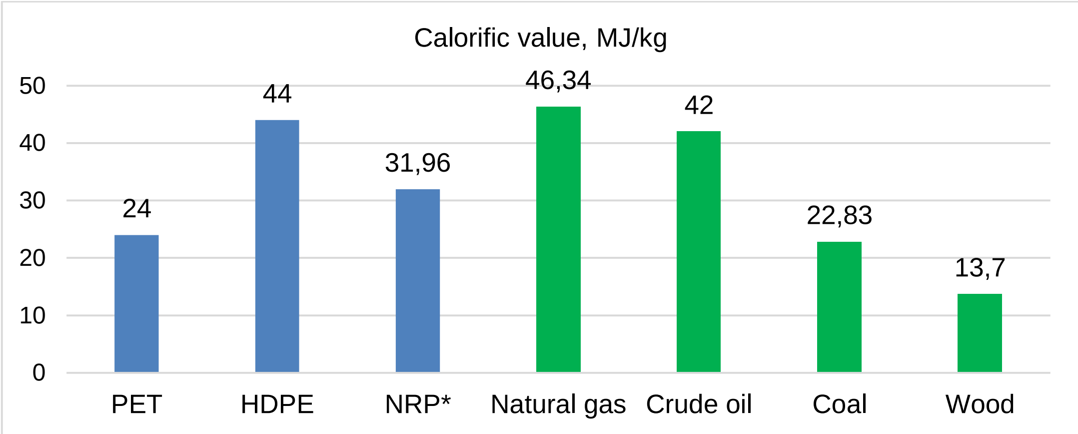

Figure 9: Heating values of plastic in MSW and fossil fuels (Arsova, 2011, 19)
*NRP – non-recyclable plastic

WTE plants add electrical and heating energy to the existing energy system, and in modern digital world it is particularly important. (Andrady, 2015, 273).

3.2 National and foreign experience in organizing the secondary turnover of cargo containers and packing cases

In Finland there is a particularly strong recycling system: 33% of all generated wastes are recycled (the maximum in EU is 63%, in Austria, average in EU is 39%), and the recycling level of packaging waste is 58% (for example, in Austria it is 66%) (European Environmental Agency, 2016). One of the reason of such high levels of these rates might be the developed legislation regarding wastes and actions with its. According to the Waste Act, every enterprise or private person has to take care of their obligations in terms of waste management. First of all, the amounts of produced wastes have to approach to the minimum. If it is not possible, wastes have to be prepared for reusing or recycling. If it is not possible to recycle its, energy should be made from these wastes. Only when all possible ways to derive any benefit from waste are used, it may be disposed of in a landfill. (Waste Act, 2011).

Furthermore, Finland has a reliable deposit-refund system (as described in Sub-clause 3.1.1) for returning the packaging. Packaging is collected in places where customers come particularly often: supermarkets and grocery shops. Reverse vending machines are implemented where people can return their beverage packaging, and, depending on the origin of this packaging, to return their deposit. For other products, the situation is easier since collecting points are usually situated near dwellings. The quantity of these points is dictated by population, but even in small towns it is mandatory to implement a point for different types of wastes: glass, metal, paper, electronic and hazardous wastes. Summarizing the above, the benefits of developed waste management system become clear.

Compared to Finland, Russia has very poor rates: the average recycling rate is approximately 6%, and recycling of packaging waste is 15%, including 1% of recycling of PET bottles and aluminum cans. (MSW, 2012). Furthermore, Russia does not have any common system for the sorting of the wastes. For example, to return used packages people have to go for a few kilometers to suspicious places, even in Moscow. (Sphere of ecology, 2017). Usually wastes go to landfills and are imbed layer upon layer, or incinerated in the special area outside the city or in special plants, but without generating power or using filters. All these problems can be explained by the following reasons:

- Deficiency of economic sector for waste processing;
- Lack of innovations in this field: recycling enterprises are competing, but not cooperating when they do their businesses;
- Lack of investments;
- Low level of society’s awareness about ecology problems and saving of resources;
- Lack of parliamentary agents who responsible for lobbing interests of ecology;
- Lack of coordination in the market of wastes;
- Lack of public and private partnership;
- Incompleteness of legislation related to the waste management;
- Limitation of selling market for recycled materials;
- Producers’ concernment only about rubbish removal, not about reusing and recycling;

- Inefficiency of controlling and regulating of ecology conditions;
- Lack of political priorities related to the waste management;
- Slow building of infrastructure for saving resources;
- Lack of stimulation for saving resources by private persons and enterprises. (Sattarov, 2014, 86-87).

The administrative barriers and high-level taxes might be the main reasons of the underdevelopment of the waste management system. Enterprises have to work with high-level profitability without any tax exemptions. Experts see some reasons for the negligence of the government concerning recycling and reusing of materials:

- Lack of stimulation for changing traditions of waste disposal;
- Low level of qualification and awareness about waste management in regional municipalities;
- Corrupt practices related to choosing more expensive and less effective methods of waste disposal;
- Businessmen’s poor understanding of the requirements of doing this business in Russia.

Comparing Finland and Russia in this field, it is clear enough that Finland is leading. It was possible to achieve such high results by virtue of developed legislation and understanding the importance of building circular economy for a large part of society, including the government.

3.3 Analysis of a recycling companies’ business operations

In this clause, three companies will be described, analyzed and compared with each other: Lassila & Tikanoja, Finnish Packaging Recycling RINKI Ltd, and PLARUS.

3.3.1 Lassila & Tikanoja

Lassila & Tikanoja is a service company operating in the following fields:

- Waste management and recycling;

- Cleaning and support services;
- Property maintenance and maintenance of technical systems;
- Sewer maintenance;
- Damage repair services;
- Process cleaning;
- Construction of waste areas;
- Sanitary, cleaning and wastes services for events;
- Forest services.

In this thesis, mostly waste management and recycling will be taken into account because, firstly, that are directly related to the topic of this study, and, secondly, as can be seen from Figure 10, environmental services bring almost the largest part of net sales.

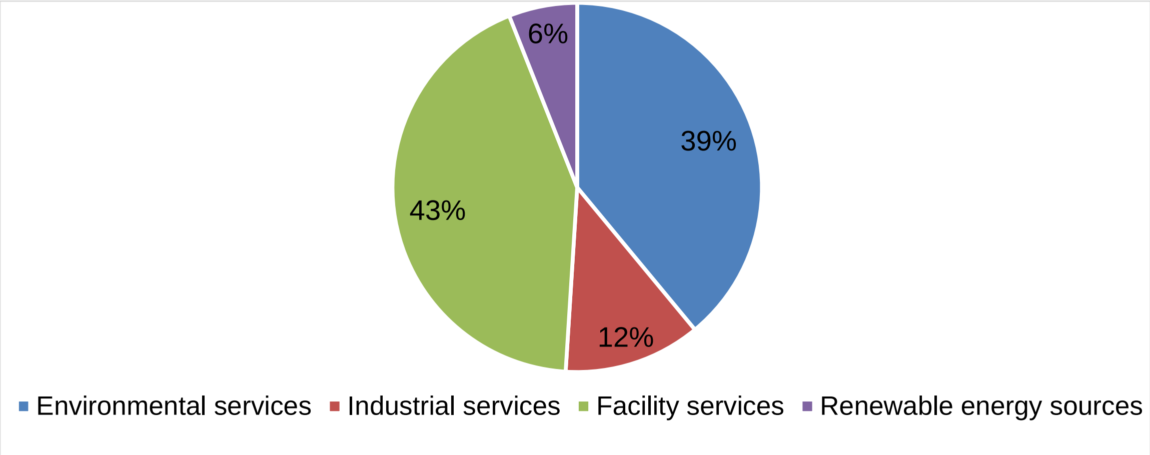

Figure 10: Net sales of Lassila & Tikanoja by division (Lassila & Tikanoja, 2016)

Nowadays, due to the increasing consumption and production, demand of raw materials is growing, and, according to the supply and demand economic model, the value of raw material is also growing. In order to avoid that, it is necessary to improve efficiency by recycling and reusing materials, or if this is not possible, to transform its to energy. Lassila & Tikanoja is a shining example of a company which provides all these services to protect the environment, and, at the same time, to earn profit. This company is working both in B2B and B2C markets, building long-term partnerships to achieve the maximum level of customization, to satisfy all customers, and, finally, to protect the environment. The management of the company see material efficiency, cost efficiency and energy efficiency as key factors of sustainability. Furthermore, Lassila & Tikanoja is taking part in building a recycling society, and, at a later stage – circular economy that prevents the waste of materials and energy, or creating unnecessary wastes.

The environmental services of this company consist of collecting wastes at the points of origin, sorting mixed wastes to different materials by using infra-red scanners, and directing it to the next stages. Recyclable packaging is sent to beverage producers, other materials are recycled and sold as secondary raw materials, and non-recyclable materials are transformed to energy in Vantaan Energia power station. Landfill disposal of organic wastes was banned in 2016, and now these wastes are turned into diesel fuel. Furthermore, Lassila & Tikanoja created the Hävikkimestari application for minimizing food wastes in HoReCa businesses.

Thus far, the company has achieved recovery rate of 94% (in 2015 it was 92%) and recycling rate of 54% (in 2015 it was 53%) of wastes managed by Lassila & Tikanoja. Furthermore, the company completely avoids landfills, and all wastes are used in other fields. The business model is work as an outsourcing company – their clients are 50000 corporate customers and 170000 households in Finland. For households, the services are necessary, and they cannot avoid its. Enterprises contract out functions that are not related to the main business such as cleaning, collecting and sorting wastes, technical maintaining or sanitary services. Most significantly, this reduces costs due to the economy of scale in Lassila & Tikanoja, compared to the organization and maintenance of own service.

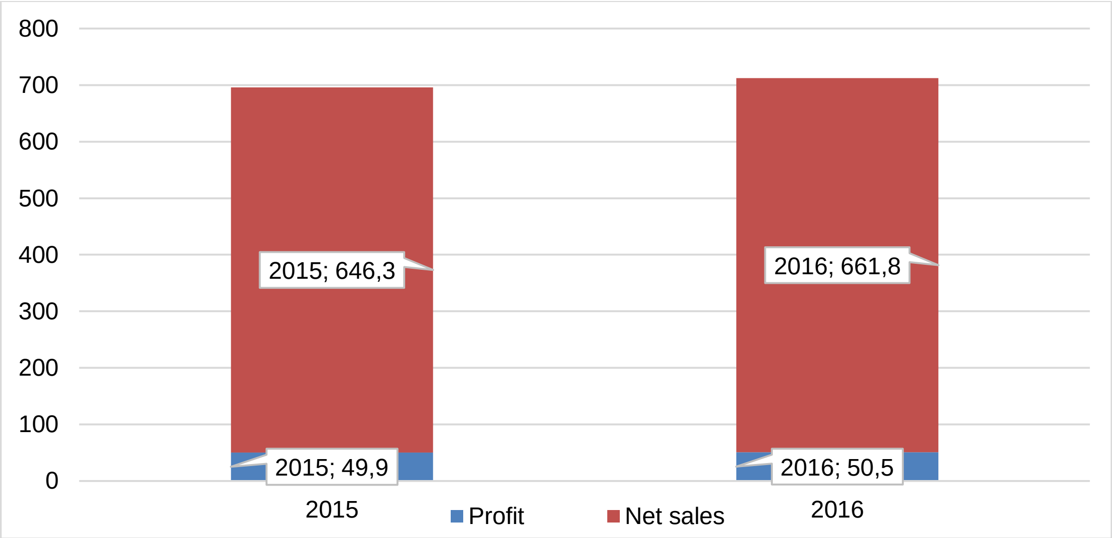

Figure 11: Net sales and profit in 2015 and 2016 (Lassila & Tikanoja; 2016)

For companies which are operating in other fields of business, these functions are usually unprofitable, but, as can be seen from Figure 11, for Lassila & Tikanoja it is particularly profitable business. As revealed in Table 3, 2016 net sales show positive dynamics equaling to 2.4% compared to 2015, but, as shown in Table 4, some divisions such as Environmental or Renewable Energy Sources shown a declining tendency.

	2016	2015	Change %
Environmental Services	264.8	256.5	3.2
Industrial Services	82.1	77.0	6.6
Facility Services	288.3	282.9	1.9
Renewable Energy Sources	36.8	39.4	-6.6
Eliminations	-10.1	-9.5	
Total	661.8	646.3	2.4

Table 3: Net sales by division in 2015 and 2016 (Lassila & Tikanoja; 2016)

The difference of 12.7% between the operating profits earned by Environmental Services can be explained by the declining paper recycling market, the shift of the responsibility for household packaging materials from collecting companies to producers, and continuing low prices and low demand for secondary raw materials and solid recovery fuels.

The declining operating profit from Renewable Energy Sources division can be defined as a positive trend due to the decreasing popularity of using wood sources for producing electricity and warmth, and also because of substitution by other materials, prevalently cheaper than wood fuel.

	2016	2015	Change %
Environmental Services	31.3	35.8	-12.7
Industrial Services	7.8	6.8	13.8
Facility Services	13.5	8.1	67.7
Renewable Energy Sources	1.5	2.1	-28.0
Group administration and other	-3.7	-3.0	
Total	50.5	49.9	1,2

Table 4: Operating profit by division in 2015 and 2016 (Lassila & Tikanoja; 2016)

In order to better understand the financial position in the company, a holistic analysis was conducted, based on the financial report made by KPMG for Lassila & Tikanoja. (Lassila & Tikanoja, 2016).

One of the positive trends, as can be seen from Appendix 1, is the growing net sales, from 2.8% in 2014 to 6.6% in 2016 which is higher than deposit rate (in Finland it is approximately 0.5%) (Taloustaito, 2015). Return on equity has been also growing since 2014, from 8.7% to 20% in 2016, and it means that money invested by shareholders is more profitable. Furthermore, ROI is 16% in 2015 and 16.9% in 2016 more than deposit rate, and it shows particularly large earning from invested money. Nevertheless, the company invested in new recycling equipment in 2016. This can be also seen from payout ratio, which declined from 86.5% in 2015 to 81.3% in 2016, and simultaneous increase of ROI and decrease of payout ratio means the projects where the money were invested were effective. The stability of WACC (in 2012 it was 7.1%, in 2016 6.56%) shows the possibility for effective strategy planning of the investments. It is important to note that WACC includes different risks, i.e. political and economic, which means that company is operating in sustainable business environment.

3.3.2 Finnish Packaging Recycling RINKI Ltd

Finnish Packaging Recycling RINKI Ltd is a non-profitable (in contrast to Lassila & Tikanoja) company which operates in the Finnish market and works with more than 5000 firms. The main function of B2B sector is to provide relationships between the firm and producer, and the responsibility for used packaging is shifted from the firm to producers. The recycling fee in 2016 was EUR 50 per ton, including VAT. For consumers, the company offers two options: the network of eco take-back points for the collection and sorting of different types of wastes (for free), or collecting wastes from households (120 EUR per ton, including VAT). After collecting wastes, RINKI sends it to the next phases – recycling, reusing or waste incineration. That enterprises are usually owned by the third parties, but not RINKI Ltd.

As shown in Figure 12, the supply chain for used packaging consist of four main phases: collecting and sorting wastes, transporting its to the recycling factory, transformation of waste into raw material or new products, filling the new packaging or producing new product, and, finally, selling it on the market.

In this supply chain, RINKI Ltd acts as an intermediary between the customer or firm and the packaging or beverage manufacturer.

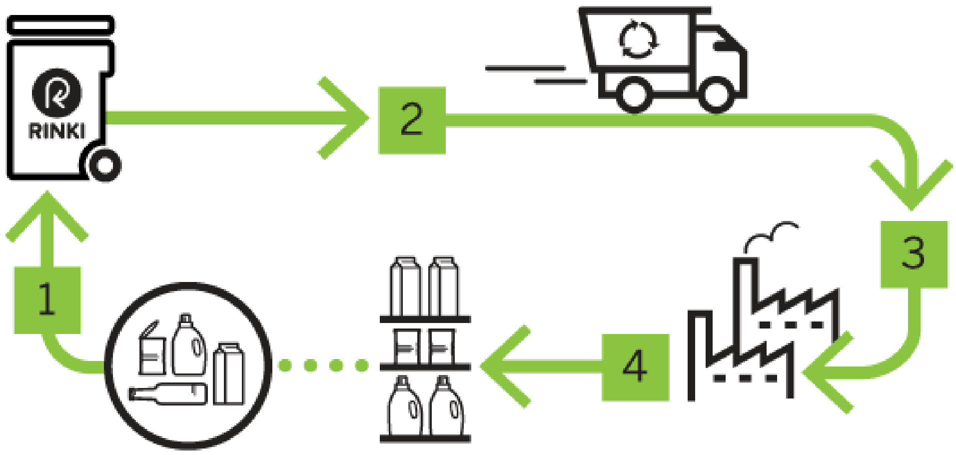

Figure 12: Supply chain for packaging in Finland (Rinki, 2016)

There are some conditions of applying cooperation with companies:

- The firm has a Finnish business ID and at least one location on the mainland of Finland;
- The firm has a turnover of EUR 1 million or more in Finland;
- The firm packs products in Finland or is an importer of packed products for the Finnish market.

Furthermore, RINKI Ltd is working under The Council of State Packaging and Packaging Waste Decree based on Finnish Waste Act, Packaging Waste Directive and European Packaging. It means that the company has to organize the collection and recycling of packaging according to these documents.

For private persons, there are also some rules related to collecting and sorting wastes:

- Caps, lids and similar should be removed and put in the recycling bin separately;
- Packaging should be empty, washed and dry;
- Plastic has to be suitable for recycling, PVC has to be sorted separately;
- Every item has to be sorted separately from each other;
- Packaging must not contain of hazardous materials.

It also stands to mention that RINKI Ltd provides a high level of packaging returning, even without deposit base: in 2014 25% of plastic wastes were recycled for new raw material (with the assumption that nowadays the Finnish recycling rate is approximately 33%) (Lassila & Tikanoja, 2016).

3.3.3 PLARUS

PLARUS is the only company in Russia (it is located in Solnechnogorsk, Moscow region) which recycles used plastic bottles or PET chips to secondary raw materials for new bottles or other products (a using technology called “bottle-to-bottle”). The outcome materials are “Clear PET” granulate, PET chips, PE and PP chips, and useful production wastes, such as pressed carton, scrap metal, fusion and fine fraction of PET, and pressed PET film. The number of personnel is 180 workers, capacity is from 1500 to 2500 tons of used bottles per month, but outcome of final products is 850 tons of “Clear PET” granulate and 100 tons of PET chips per month. The main suppliers are landfill sites and stations for sorting of wastes, and the recycling fee for firms is approximately EUR 400 per ton. It is also possible for private persons or other enterprises to bring bottles. Furthermore, the company has its own 76 collecting containers in Moscow and 64 in Solnechnogorsk (collaboratively with Coca-Cola HBC) where bottles are accepted for free.

There are some rules for collecting bottles from enterprises:

- Transparent PET bottles from 0.3 to 7 liters must be of the following colors: transparent, green, brown and light blue;
- Bottles should be pressed to bales;
- Bales should be dry;
- Baling has to be made less than 3 months ago;
- Fastening of bales has to be made by metal wire or strapping tape;
- Density of the baling has to be less than 280 kg/m^3;
- It is not allowed for bales to include foreign objects such as wood, metal, or water;
- Bales may not include monolithic bottles;
- It has to be possible to identify the colour of bottles;

- Square of label may not be more than 50% of the surface area of the bottle.

The production process consists of three main phases: sorting, fragmentation and washing, and granulation and polycondensation.

At the beginning of the production process, bottles come in bales, and a machine separates the bottles from each other. After that, the bottles are sorted to four main colors (transparent, green, brown and light blue) by an automatic scanner. If it is not possible to identify the colour, the bottles are washed.

The next stage is fragmentation and washing where labels, metals, and liquids are removed from the bottles. After this phase, the bottles are fragmented to PET chips, and chips are washed again. If the manufacturer decides to leave recycled plastic in chip conditions, the chips are packed in big-bags.

Otherwise, the chips are heated, extrusioned, degasificated, filtered, granuled, dried and sorted. Final products are accepted by the Center of Hygiene and Epidemiology of Moscow Region for packaging for food and beverages.

It was not possible to find any financial reports and rates, but it is clear that PLARUS is working for making profit (the company buys used bottles and recycles its to raw materials, which are bought by other producers) and for protecting the environment.

4 WAYS FOR IMPROVING THE SECONDARY TURNOVER OF CARGO CONTAINERS AND PACKING CASES

Sorting, recycling, and utilization of wastes are the routine processes for households in countries such as Finland because people understand what they are doing and how they can protect the environment. Although, it does not work all around the world, usually the most part of plastic wastes is transported to landfills, especially in Russia. It requires much investment to build full cycle economics. In addition, if the Government wants to make it possible to recycle plastic wastes, it is necessary to teach every inhabitant to sort their trash at home by themselves. Furthermore, for building no-wastes system, it is particularly important to use secondary products as raw materials. A good example is the paper and paperboard industry where all residues are used in other production or in generating of energy.

In consideration of universality and huge potential of 3D printing technology, 3D printers might be important part of recycling chains. Nowadays this kind of equipment costs considerably expensive, from few hundreds to thousands of dollars, but also manufacturer need to pay for raw materials for printing which cost at least EUR 20-100 per kilogram (3D printers and 3D printing news, 2017). One of the innovative ideas today is using utilized plastic as material for producing new 3D models. There are two ways to obtain raw material from, for example, an used plastic bottle: to buy an extrusion machine for EUR 800-900 and use it at home (Garmulewicz, 2016); or occasionally return bottles to the manufacturer (such as PLARUS) who has his own professional equipment for recycling wastes to material for printer, and buy new plastic fiber from this producer.

The second way is more accessible for common customers because it helps to save money by buying recycled materials (it is cheaper than new raw materials) and to improve environmental condition by understanding of participation importance in ecological policy of the particular country government and world at large.

Main tasks for this new developed supply chain are providing opportunities for consumers to send used materials to recycling plant and to take back ready filament. Waiting time has to be maximum short. Different processes may be involved in supply chain with 3D-printing (for example, to produce premium raw-material from PET-waste, allowing for full recycling into primary products). Garbage or waste collection for printing requires time and place, sorting of waste requires knowledge and experiences.

Simple and quick decision for new supply chain is just to add filament producers as a bridge between recycling manufacturing and 3D-printer operators in an existing chains. It is less time and energy consuming, because it can be started with small companies in most developed areas.

Another decision is to create new supply chains with integrated members and technologies according to local clients and volumes. This option may decrease long transportations, but it will increase local logistics. Additive production will take place at the nearest suitable printer, and transportation of waste and new product will affect the price of service individually in each case.

Currently, 3D-printing is more energetically intensive, for this reason costs for supplying are not so important compare to the price of whole service. But using renewable energy sources for low-volume production makes it more attractive for customer in future. Then additive manufacturing may take place almost anywhere, and with the same price as global manufacturing with the impact for the environment. And then at first place again will come supplying costs and its impacts.

Logistics will be changed by the 3D-printing industry, but printing will depend on supply chains on some extent. Likely, some phases of logistics, such as shipping of components, finalization, storage, handling, assembling will be eliminated. But leading decentralized production promotes increasing of local supplying and delivery. Eventually 3D-printers will come at homes and downloading of “computer aided design”-software will help customers print their own products form waste without needs to visit store or printing point. Before that 3D-printing makes manufacturing more personal and flexible, so, concept “make to order” is taken now to an entirely new level, and in the future trend of “design-it-yourself” will be constantly on the rise.

As seems in the future, almost everything can be printed out. In the case of most important spare parts for manufacturing, owner does not need to wait for a certain amount of time for delivery, because he can print replacement parts right now at the nearest printing center. It reduces the importance of express delivery but again increases local logistics, and manufacturer will no longer need to store spare parts and to keep warehouse for them, but only for recycling wastes.

Trends and their applications require better management of supply chain and more personal pathway for services. For increased and sustainable profits in recycling area, suppliers need advanced methods of customization and transportation. At the time of enormous 3D-printing development, involved and exposed supply chains must be prepared for changing itself very much.

Number of Logistics Services Providers already has services with supply chains for 3D-printing, also called additive manufacturing. It may be good solution for cooperation between logistic companies and customers for using new technologies in 3D-printing and recycling. For example, LSP can have own 3D-printers and use it for customer's needs with providing deliveries and adding values.

5 CONCLUSION

To sum up, it is possible to make a conclusion that in Finland there is particularly developed logistic system for secondary turnover of cargo containers and packing cases. The main scope of the research were used plastic bottles, and the most widespread method for secondary turnover becomes collecting, sorting, and recycling, and hereafter making new plastic bottles or other items from secondary raw material. There are some other methods for secondary using such as incineration for generating warm and electrical energy, or secondary using after washing (it works usually with glass bottles). Compare to Finland, Russia is undeveloped country in this field. The most of wastes goes to landfills for many-years decomposition, what deteriorates the environment all around the big country. Notwithstanding, there is one example of recycling company in Moscow, whose main activity is recycling of used plastic bottles, but only one company, which is operating only in the capital city – it is too less for such large country as Russia. The main problems which were identified are administrative barriers and misunderstanding of ecological aspect of used methods for utilizing of wastes.

As alternative way for secondary using of recycled plastic was suggested producing of plastic filament for 3D printers. Using of such modern technology will make supply chains shorter and quantity of suitable methods for secondary using of plastic will increase.

Both in Finland and in Russia there is requirement to implement and develop a new supply chains including 3D printing producers and producers of 3D printing, but in the nearest 10 years it will be universal trend for developing and developed economics.

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Waste Act 2011. (2011/646).

FIGURES

TABLES

APPENDIX 1. KEY FIGURES OF LASSILA & TIKANOJA

Key figures on shares

		2016	2015	2014	2013	2012
1.	Earnings per share (EPS), EUR	1.13	0.98	0.47	0.57	0.89
2.	Earnings per share (EPS), diluted, EUR	1.13	0.98	0.47	0.57	0.89
3.	Equity per share, EUR	5.81	5.51	5.34	5.46	6.01
4.	Dividend per share, € *	0.92	0.85	0.75	0.50	0.35
5.	Payout ratio, %	81.3	86.5	160.0	87.2	39.3
6.	Capital repayment per share, EUR	-	-	-	-	0.75
7.	Payout ratio, %	-	-	-	-	84.2
8.	Effective dividend yield, %	4.8	4.7	5.0	3.3	6.4
9.	Effective capital repayment yield, %	-	-	-	-	5.2
10.	P/E ratio, %	17.0	18.4	32.3	26.6	13.1
11.	Cash flow from operating activities per share, EUR	1.99	2.33	2.06	2.23	2.08
	Share price adjusted for issues:					
12.	lowest, EUR	14.37	14.54	12.75	11.60	8.59
13.	highest, EUR	19.59	18.74	15.84	15.59	12.15
14.	average, EUR	16.96	17.25	14.31	13.81	10.55
15.	closing, EUR	19.20	18.12	15.14	15.23	11.64
16.	Market capitalization, EUR million	744.9	703.0	587.4	589.5	450.4
	Number of shares adjusted for issue:					
17.	average during the year	38,375,007	38,589,658	38,728,721	38,703,933	38,688,373
18.	at year end	38,378,006	38,361,153	38,617,980	38,706,627	38,692,064
19.	average during the year, diluted	38,389,881	38,604,906	38,739,668	38,720,630	38,701,004
20.	Adjusted number of shares traded during the year	6,475,324	10,271,667	10,191,394	7,206,872	9,967,494
21.	As a percentage of the average	16.9	26.6	26.3	18.7	25.8
22.	Volume of shares traded, EUR million	110.1	177.2	147.2	99.5	105.1

* 2016 proposal by the Board of Directors

Key figures on financial performance

		2016	2015	2014	2013	2012
23.	Net sales, EUR million	661.8	646.3	639.7	668.2	674.0
24.	Operating profit, EUR million	50.5	49.9	48.5	33.2	48.4
25.	% of net sales	7.6	7.7	7.6	5.0	7.2
26.	Profit before tax, EUR million	50.1	47.7	26.6	30.3	43.0
27.	% of net sales	7.6	7.4	4.2	4.5	6.4
28.	Profit for the period, EUR million	43.4	37.9	18.1	22.2	34.5
29.	% of net sales	6.6	5.9	2.8	3.3	5.1
30.	Profit for the period attributable to the equity holders of the parent company, EUR million	43.4	37.9	18.1	22.2	34.5
31.	% of net sales	6.6	5.9	2.8	3.3	5.1
32.	EVA, EUR million	30.7	30.3	29.1	12.4	24.1
33.	Cash flow from operating activities, EUR million	76.4	89.8	79.6	86.4	80.5
34.	Balance sheet total, EUR million	452.8	465.8	458.3	496.0	481.3
35.	Return on equity, % (ROE)	20.0	18.2	8.7	10.0	15.3
36.	Return on invested capital, % (ROI)	17.4	16.5	15.4	10.6	14.4
37.	Equity ratio, %	50.4	46.5	46.3	43.7	49.4
38.	Gearing, %	17.3	19.8	25.2	30.4	35.3
39.	Net interest-bearing liabilities, EUR million	38.7	41.8	52.0	64.4	82.3
40.	Capital expenditure, EUR million	41.6	49.6	44.7	32.7	49.4
41.	% of net sales	6.3	7.7	7.0	4.9	7.3
42.	Average number of employees in full-time equivalentes	7,199	7,099	7,257	8,267	8,399
43.	Total number of full-time and part-time employees at year end	7,931	8,085	7,830	8,847	8,962