

RETURN PACKAGING IN THE SHIPMENT PROCESS OF READY PRODUCTS ON THE EXAMPLE OF VOLKSWAGEN MOTOR POLSKA SP. Z O.O.

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Abstract: Nowadays, the effectiveness of the enterprise depends on all departments of enterprises, including logistics. One of the strategic areas of logistics, although often overlooked, is the turnover of returnable packaging. Turnover of packages is an additional process in the enterprise that creates additional costs. With the optimal management of this process throughout the entire supply chain, enterprises can minimize the costs associated with it. This study presents the process of managing returnable packaging. The aim of the work is to identify and analyze the possibility of using returnable packaging in the process of preparing shipment and transport of finished products in the automotive industry. The article uses a case study of one of the companies operating in the automotive industry - Volkswagen Motor Polska sp. z o.o. The article presents three possible solutions for the transport of engines manufactured by the described company. One of the solutions is currently used by enterprises. The other two are a proposal to apply. When analyzing the costs of these solutions, the best one was presented, the costs of which will be the most profitable in the long run.

1 Introduction

In the modern economy, the activity of almost every enterprise is based on cooperation with other co-operators in an integrated structure implementing tasks consistent with the common goals of its participants. An example of such a structure is the supply chain defined by J. Witkowski [1] as "mining, production, trade and service companies cooperating in various functional areas and their clients, between which streams of products, information and financial resources flow". The main goal of supply chain operations is to deliver products to the final customer while maintaining the highest quality and minimizing flow costs [2]. The success of supply chain management depends not only on the integration of main processes such as transport, storage or coordinating information flows, but also on many activities indirectly related to the main flows, among which packaging management can be distinguished. The use of appropriate packaging and effective management means that not only ensure that the product reaches the customer in an unchanged condition, but can also ensure long-term savings and the implementation of the principles of sustainable development. This means that companies must adapt to new customer requirements and constantly growing competition [3].

The aim of this study is to identification and analysis the possibility of using returnable packaging in the process of preparing shipment and transport of finished products in

the automotive industry. The article uses a case study of one of the companies operating in the automotive industry. For the purposes of the research, literature studies, documentation analysis and a single case analysis were carried out. This research seems to be very important from the point of view of the theory of logistics management and the practical aspects of the functioning of companies. This topic is located in the manufacturing, distribution, reverse logistics, but also sustainable development and environmental aspects. Currently, few companies use returnable packaging in supply chains, but this is undoubtedly the direction of further development and challenges faced by companies.

2 Role and types of returnable packaging in supply chain management

Packaging plays an important role in the supply chain during almost all phases of its activity, i.e. material delivery, storage, preparation for production and distribution [4]. Among the functions of packaging can be distinguished, among others [5,6]:

- securing the content - preventing the product from reaching the customer incomplete or defective by e.g. additional securing the goods on the pallet with foil, placing a set consisting of several products in one package,

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- mechanical protection of products - reduction of the risk of potential damage caused by external factors (e.g. shocks, pressure, temperature, etc.),
- providing information - placing information on the packaging regarding the use of the product, storage methods or handling waste generated after the use of the product or packaging,
- marketing function - using the packaging as an element to encourage customers to buy the product by designing the right combination of colours, shapes, graphics and size.

The role of packaging also depends on the characteristics of the product. Depending on the subject of the flow, additional requirements must be met, for example, food and drugs must be stored in sterile containers to prevent biological and chemical transformations, and metals need additional protection against corrosion.

Packaging can be divided according to various criteria. Due to the function performed, one can distinguish unit packaging (direct packaging of a single product), transport packaging (used for storage and transport operations before delivery to the final customer) and collective packaging (intermediate between unit and transport packaging, often used in retail outlets). Another classification can be proposed taking into account the material that was used to make the packaging. In this case, the most popular are paper and cardboard (e.g. paper bags, cartons), wooden or metal (boxes, pallets) and plastic (foil, containers) etc. From the point of view of environmental protection, they can be divided into undergoing or not subject to a natural decomposition process. In enterprises, packaging can be their own, belonging to the supplier or leased [7]. A very important issue in the marketing of packaging in the supply chain is whether it is disposable or reusable. Those used only in one process do not require additional activities related to the flow of returnable packaging, but can be disadvantageous from the point of view of costs and environmental protection. Multiple-use packaging has many advantages, but its use requires the coordination of chain-back processes.

The use of returnable packaging is the key to achieving the principles of sustainable development and long-term savings. Multiple use of pallets, boxes, Big Bags and other containers is an integral part of the activities of many enterprises. This is a positive phenomenon, however, it concerns the main transport packaging, and does not include auxiliary ones, such as stretch foil [8]. The consumption of materials (mainly plastics and paper) and the increasing amount of packaging waste are becoming more and more important environmental problems. The scale of the problem is evidenced by the fact that, according to Eurostat data, in 2018 around 77.7 million tonnes of packaging waste was generated in the European Union, which is approximately 174 kg per capita [9]. Such a situation requires the use of modern solutions that will

effectively and positively replace the methods of securing products used by enterprises. An example of a real alternative to single-use packaging used to secure pallets are covers of companies such as Techcycle Technology Inc. and Pallet Wrapz Inc. which can successfully replace stretch foil [10,11].

Additionally, the environmental criterion should take into account the economic aspect of using returnable packaging. Giving up disposable packaging can bring long-term savings, but also turn out to be unprofitable, so the decision should be based on an analysis that takes into account all the advantages and disadvantages. The costs related to the use of returnable packaging include: the need to invest a large amount of money at one time to purchase the amount of reusable packaging necessary for the system to function, costs of packaging transport and those related to the management of packaging flow within the company and quality control. On the other hand, this solution brings benefits resulting from the lack of the need to cyclically buy packaging and get rid of the used ones, as well as greater efficiency of logistics processes [12]. In addition to the above-mentioned factors, the specific nature of the supply chain has a significant impact on the profitability of introducing returnable packaging. The first issue that should be distinguished is the effectiveness of packaging flow management, and more specifically ensuring that they always go to the right place at the right time. Any downtime of containers at customers or other chain links means that the system does not use its full potential, which may lead to the feeling that there is too little packaging and force you to buy them. This is a significant issue as each excess container in the system increases payback times. In addition, controlling the shipment of products is crucial. The returnable packaging system is more effective for more frequent shipments with a shorter cycle time and less effective for longer distances and in situations of large fluctuations in demand [13]. It depends on the frequency of shipments when the investment in reusable packaging will pay for itself, and on their stability and regularity, determining the demand for containers that will be optimal for the functioning of the system.

The returnable packaging system in the supply chain can be organized in various ways, depending on the needs and preferences of its links. One of the classifications distinguished in the literature identifies the following systems [14]:

- system of removable pool,
- system with return logistics,
- system without reverse logistics.

In the **system of removable pool**, responsibility is distributed - each participant has a specific number of containers that he manages and maintains in the best condition and quality. The participants of the system may only be the sender and the recipient, or additionally a carrier who has its own pool of packages and passes them on to other participants when collecting full containers. In the **system with return logistics**, the packages are owned

by the central link in the supply chain, which is responsible for the return of empty containers. In this case, the flow of packages may take place on the sender - recipient line or with an intermediate link - the container warehouse. In the **system without return logistics**, there is also one company that owns but only rents the containers. During the temporary possession of the packages by the sender, he is responsible for their technical condition, storage and all processes related to return logistics.

The use of new solutions and tools to optimize logistics processes is valuable, but the costs of these implementations should always be reimbursed in relation to the total costs incurred by the company [15].

3 Process of preparing products ready for shipping and transport in Volkswagen Motor Polska sp. z o.o.

Volkswagen Motor Polska Sp. z o.o. belongs to the Volkswagen AG concern, which is one of the leaders in the automotive industry. The headquarters of the company was established in 1999 in a subzone of the Legnica Special Economic Zone in Polkowice in Lower Silesia. The company specializes in the production of diesel engines in Common Rail and MDB technologies. The factory in Polkowice is a very important link in the concern's supply chain providing key components for cars for the needs of the assembly plant in Poland and around the world, including in the Czech Republic, Germany and Spain. Ensuring the highest quality requires not only the improvement of production processes, but also logistics, which include organizing and controlling the shipment of finished products.

The process of preparing engines for shipment begins at the time of final production acceptance, where the products are packed and prepared for storage and transport. The next processes related to the execution of the customer's order take place after the engines are transported to the shipping warehouse. A simplified scheme for controlling the shipment of finished products is shown in Figure 1.

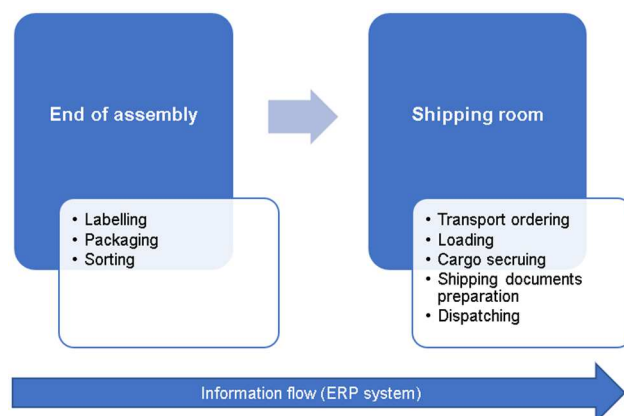


Figure 1 Controlling the shipment of finished products

After exiting the final assembly line, the motors are inspected for compliance and then labeled. If the product meets the requirements, it is marked with a label with the number of the material card (HU – handling unit). The products prepared in this way are packed on MTG – steel pallets for 6 motors. In addition, the products are secured with adapters that prevent shifting within the pallet. A set consisting of a pallet, 6 motors and 6 adapters is marked with a label containing, among others place and date of production, purpose of shipment, gross and net weight of the set, identification number and barcodes enabling communication with the ERP system. After the finished engines are booked into the warehouse and the audit is carried out, they are protected with corrosion protection foil and stored.

The next stage of preparing products ready for shipment and transport begins after the engines are transported to the shipment warehouse and booked in there by the forklift operator using a barcode scanner. The next steps depend on the engine shipment control worker ordering the shipment in the system ERP and the person ordering the transport at the forwarder. Upon arrival of the transport, it is checked for compliance with certain conditions. The truck must first of all be equipped with anti-slip mats and load securing belts that minimize the risk of damage to the engines during transport. If the arrival is consistent with the order, the order is printed and then the products are taken from the warehouse, which must be confirmed in the ERP system. After the products are picked up, they are loaded on the truck and secured by the driver. In each transport, from 12 to 15 pallets are loaded, which means from 72 to 90 engines. The last step before the truck is cleared is to prepare the shipment documents and hand them over to the driver. For the shipment of engines, the necessary documents are the transportation workflow, the CMR international consignment note and the ERP shipment document. Handover of documents and truck clearance are activities that end the shipment of finished products in the company. The result of the process is then assessed by the customer according to the group's "supplier quality assessment" procedure.

4 Proposal of new solutions in the process of preparation and transport of finished products in Volkswagen Motor Polska sp. z o.o. - results and disussion

The potential area of optimization of the preparation and transport of finished products at Volkswagen Motor Polska Sp. z o.o. there is a change in the packaging used. Currently, two types of returnable packaging are used for shipping - MTG pallets and adapters that prevent the cargo from shifting. Additionally, in the period from October to March, due to the high risk of corrosion of engines, additional disposable packaging - VCI bags are used. These packages are an important flow element as they protect products against loss of quality and corrosion

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damage. In the VCI bag, in which the engine is packed, volatile corrosion inhibitors evaporate and form a protective layer on the metal. An additional advantage of this solution is that after unpacking, the products can be immediately used for subsequent processes without the need to get rid of the agent from their surface [16]. These packages are successfully used in practice, but there are alternatives. The rest of this article will be proposed alternative solutions to the use of returnable packaging.



Figure 2 Example of VCI bag

The first solution to replace the current one is the use of a corrosion protection pouch that can be used repeatedly in place of disposable VCI bags. An example of such a package is reusable VCI cover made by Australian producer Daywalk [18]. This product is made of PVC and contains volatile corrosion inhibitors. It is durable, resistant to rain, dust and UV radiation, and for better tightness it can be closed with a zipper or Velcro. Depending on the dimensions and customer preferences, the prices of the cover may vary, but they start from around 195 euros. Opting for this solution would completely exclude single-use packaging from the process of preparing products for shipment, but would require a significant initial investment.



Figure 3 Example of Daywalk Reusable VCI Cover

Another reusable packaging that could be used in the process are containers for transporting engines by Endural

LCC [19]. These packages are made of high-density polyethylene, which is characterized by high strength and durability at a relatively low weight (approx. 25 kg). The containers can be stacked and are equipped with internal straps that provide additional protection for the product. Polyethylene alone is not enough to protect engines against corrosion, but the manufacturer offers the use of Static Intercept technology, which can successfully provide it. Static Intercept consists in fusing plastic with copper particles, which react with the elements causing corrosion and prevent its formation [20]. The approximate price estimated on the basis of the manufacturer's information is 185 euros. An appropriate number of this type of containers could replace not only the VCI foil, but also other packaging used so far - pallets and adapters.



Figure 4 Engine Cases - made by Endural

Deciding on the choice of packaging requires taking into account the financial factors and additional benefits for the company. For the purposes of the analysis, 55,000 engines shipped monthly (average for 2020) were assumed, packaging prices estimated on the basis of manufacturers' data (which may vary due to additional requirements, the scale of orders, negotiations) and the need to have 24,000 returnable packaging units to realize the flow (which found based on the number of adapters the plant currently has at its disposal). An important element was also the fact that single-use VCI bags are only purchased for 6 months a year when the products are most exposed to corrosion. The comparison of the existing solution with the proposed alternatives is presented in Table 1.

For a reliable calculation of the use of returnable packaging, the method of returning returnable packaging between delivery links should be analysed as another factor for the calculation. In the case of the described company, the costs of transport were not included, because the lorries go to Volkswagen Motor Polska sp. z o.o. in Polkowice to get the engines without any cargo or with pallets and adapters, so organizing additional processes would not be necessary.

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Table 1 Comparison of packages for transporting engines

Package type	Engine Cases (Endural)	Reusable VCI Cover (Daywalk)	VCI bags
Unit price	€185	€195	€4
Demand in 1 year	24 000	24 000	330 000 ¹
Costs in 1 year	€4 440 000	€4 680 000	€1 320 000
Approximate percentage of packaging consumption	5% for year	20% for year	100% for year
Additional benefits	<ul style="list-style-type: none"> - preventing the formation of packaging waste, - replacement of previously used packaging (less returnable packaging in the chain), - lower gross weight of the engines shipped, - greater durability. 	<ul style="list-style-type: none"> - preventing the formation of packaging waste, - replacement of previously used packaging (less returnable packaging in the chain), - easier way of transport between the links of the supply chain (take up less space). 	<ul style="list-style-type: none"> - no need for rotation between the links in the chain.

Table 2 Calculation of the implementation costs of selected returnable packaging solutions

	Engine Cases (Endural)	Reusable VCI Cover (Daywalk)	VCI bags
Base material			
Number of engines shipped monthly	55 000	55 000	55 000
Number of direct packages in monthly turnover	24000	24000	55000
The use of 1 year	24000	24000	330 000 (55 000x 6 months)
Approximate level of use	5%	20%	100%
Consumption for 1 year taking into account the level of consumption	25200	28800	330000
The cost of 1 piece	€185	€195	€4
The total cost of the basic material for 1 year	€4662000	€5616000	€1320000
Additional costs			
Pallets - need for 1 year	0	4000	4000
Consumption level for 1 year	0	0,05%	0,05%
Number of pallets for 1 year taking into account consumption	0	4002	4002
Average cost of 1 transport pallet – metal	0	€220	€220
Total pallet costs for 1 year	0	€880440	€880440
The period of consumption	0	15 years	15 years
Adapters - need for 1 year	0	24000	24000
Adapters- 1 year consumption level	0	0,10%	0,10%
Number of adapters for 1 year taking into account consumption	0	24024	24024

¹ 55,000 packages are used for 6 months a year (in autumn and winter).

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Average cost of 1 adapter	0	€25	€25
Total adapters costs for 1 year	0	€600600	€600600
The period of consumption	0	15 years	15 years
Total cost of additional materials for 1 year		€1481040	€1481040
Total product cost	€4662000	€7097040	€2801040
The period of consumption	5 years	5 years	for only one use

The table 2 presents an analysis of the implementation costs of three returnable packaging solutions for transporting engines for Volkswagen Motor Polska sp. z o.o. in Polkowice. There are three solutions:

- **Engine Cases (Endural)** - do not require any additional equipment. The engines are only transported in the described containers. Can be stored in layers during transport.
- **Reusable VCI Cover (Daywalk)** - requires the use of pallets and adapters to prevent motors from moving. There are 6 engines on the palette.
- **VCI bags** - form only one use. They are disposed of after use, requires the use of pallets and

adapters to prevent motors from moving. There are 6 engines on the palette.

Table 3 presents the costs of implementing the above 3 solutions for the described enterprise. The period of 5 years was adopted due to the longest wear of the material Engine Cases (Endural). The analysis covers the costs of implementation: purchase of packaging, its consumption (damage, loss) and replenishment per year, purchase of additional materials (pallets and adapters). The analysis took into account the consumption time suggested by the packaging manufacturer.

Table 3 Analysis of the implementation costs of the proposed solutions

EUR	Engine Cases (Endural)	Cumulative costs	Reusable VCI Cover (Daywalk)	Cumulative costs	VCI bags	Cumulative costs
Costs including years	4662000		5616000		1320000	
	0		1481040		1481040	
start	0	4662000	0	7097040	1320000	3021040
1st year		4662000	1040	7098080	1321040	4342080
2nd year		4662000	1040	7099120	1321040	5663120
3rd year		4662000	1040	7100160	1321040	6984160
4th year		4662000	1040	7101200	1321040	8305200
5th year		4662000		7101200	1320000	9405200

Considering the financial aspect, reusable packaging requires a significant initial investment, but brings long-term benefits. The analysis of the implementation of the presented 3 solutions for the use of returnable packaging shows that the most advantageous will be Engine Cases (Endural), then Reusable VCI Cover (Daywalk), and the least currently used VCI bags solution.

Analysing the costs of implementation and application of these solutions should be checked at which point reimburse the cost of the proposed alternative solutions in relation to their current solutions. For this purpose, a

cumulative cost analysis was used. This has been shown in Figure 5.

It should be noted that the first solution will pay for itself in the 15th month. The second solution will pay off only in the 38th month. Due to the fact that the company operates a delivery system using VCI bags, it was decided to analyse an additional variant. This analysis did not take into account the purchase costs of pallets and adapters, as they are already purchased and used at Volkswagen. Figure 6 shows this solution.

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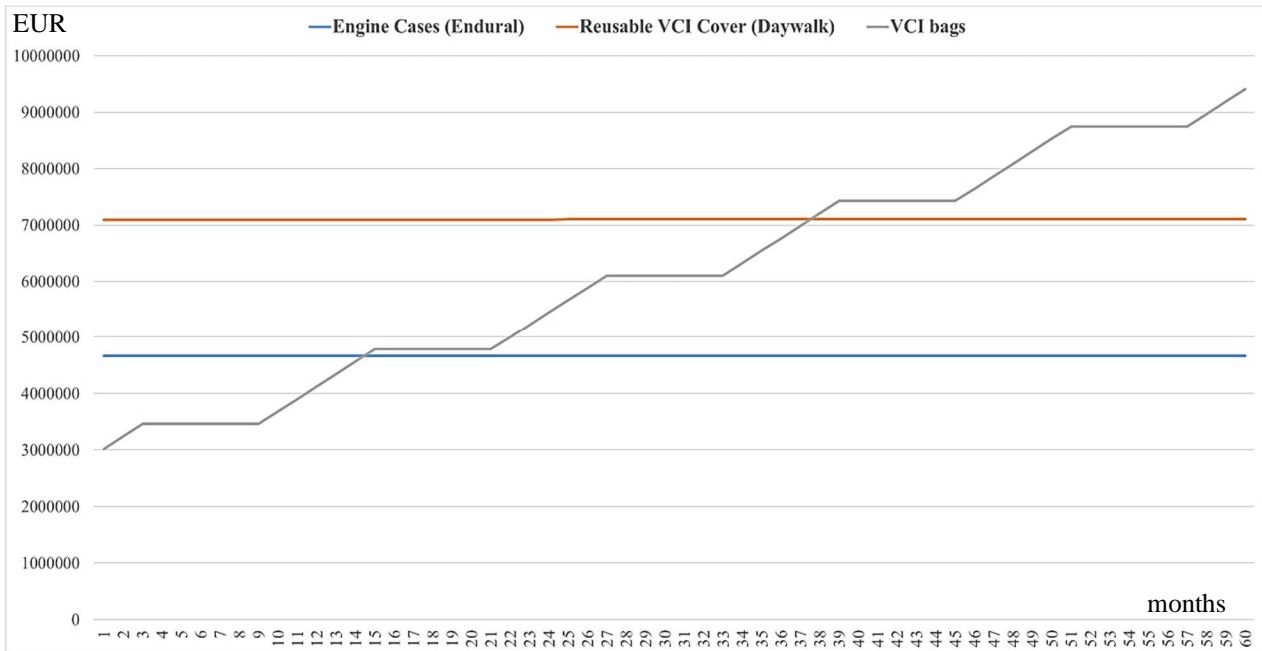


Figure 5 Cumulative costs of implementing returnable packaging solutions

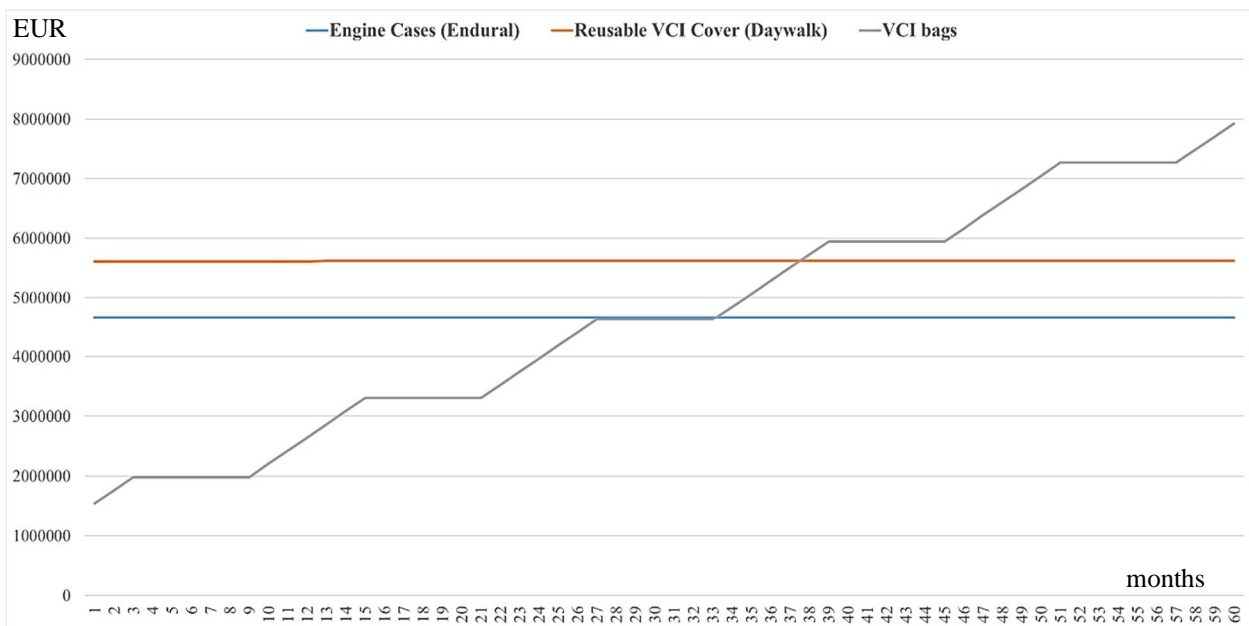


Figure 6 Cumulative cost analysis without taking into account the purchase costs of pallets and adapters

In the current situation where the pallets and adapters are in the company, the return on investment will be in the 34th and 38th months.

The financial criterion should not be the only determining factor in changing the packaging used in the enterprise. Their functional characteristics, the number of returnable packaging in the chain and compliance with the principles of sustainable development are also important. In terms of environmental protection, disposable VCI bags, generating approximately 330,000 pieces of packaging waste per year, are the least favorable. Both proposed

alternatives become waste at the end of their life cycle, but there are definitely fewer of them (engine cases - 30,000, VCI covers – 48,000 every 5 years). In relation to the number of reusable packaging in the chain, currently around 24,000 adapters and 4,000 pallets are required for the flow. Managing the largest number of packages would be required when using Reusable VCI Cover (24,000 adapters, 24,000 covers and approx. 4,000 pallets), and the smallest (24,000 units) with the introduction of Engine Cases, which would replace all previously used packaging. Another feature that distinguishes the Endural container is

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its low weight. Currently, cargo weight is one of the main characteristics limiting the number of engines transported in a single trip. A maximum of 15 pallets corresponding to a weight of 22,065 kilograms are loaded per truck. Each pallet contains 6 motors and 6 protections - adapters. The weight of such a set is 1471 kg, of which 397 kg is the weight of the packaging itself. Using Engine Cases, the engine with packaging would weight 204 kg, the 6 engines 1224 kg, and the 90 (maximum quantity currently shipped) 18,360 kg. A difference of 3705 kg to the present solution would allow 18 more engines to be loaded, which is also dimensionally feasible considering that the containers can be stacked.

After analysis, it can be concluded that Endural Engine Cases are the most cost-effective choice. Using these packages instead of the current solution would have long-term financial benefits, reduce packaging waste and the amount of packaging in the chain, and could make it possible to transport more engines on a single course. The second proposition, Reusable VCI Covers, would also pay for itself, but it is not that profitable due to the need to manage as many as 52,000 packages in the chain, which could reduce flow efficiency and generate additional costs.

5 Conclusion

The article presents the process of using returnable packaging in supply chain management. The description was based on a case study of Volkswagen Motor Polska sp. z o.o. The effective process of using returnable packaging in the process of product flow between the links of the supply chain is undoubtedly very important. Both in terms of cost reduction for individual companies and environmental impact. The study identified a process in which it is possible to replace disposable packaging with returnable packaging. It is the stage of shipping and transporting products between the links of the supply chain. In addition, a cost analysis was carried out for the use of 3 different types of packaging, which differ in cost, strength, consumption level and the number necessary for shipment. The most effective form of returnable packaging is plastic packaging - Endural Engine Cases, created for a specific order and transport of products. It is much cheaper to operate within 5 years, moreover, its weight is much lower than the currently used method of transport. Reusable covers with a zipper or Velcro are in second place. The last and the most expensive solution is currently used with VCI bags. They are disposable, but necessary in transport due to the possibility of corrosion of the finished product, which is the engine. The article identifies and analyses the possibility of using returnable packaging in the process of preparing shipment and transport of finished products in the automotive industry. The analysis should be extended to the costs of transporting the containers themselves back to the company. In this case, they were not taken into account, because the cars, without a load or with current reusable packaging, go for a product ready for Volkswagen Motor Polska sp. z o.o. This is another

argument for the use of returnable packaging, thanks to which we will save on disposable packaging and the transport will be used effectively.

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Single-blind peer review process.