

# INVENTORY MANAGEMENT IN REVERSE LOGISTICS - ANALYSIS OF CROATIAN AUTOMOTIVE INDUSTRY POSTSALE PRACTICES

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Preliminary notes

The success of inventory management in organizations is the presumption for optimal functioning of the supply chains. With the advent of the reverse logistics and the broader concept of the Green supply chain management, management of reverse flows of materials and therefore appropriate methodologies and models for inventory management with returns, have become topics of interest to researchers and in practice. Most scientific papers in the literature, however, observe inventory management with returns from the position of the manufacturer, while inventory management problems of reclaimed products somehow remained on the sidelines by their retailers. For this reason, research was undertaken on the current status, potentials and problems of inventory management of recovered products (parts) in the aftersales automotive industry in Croatia.

**Keywords:** *automotive industry post-sale, inventory management, reverse logistics, spare parts, supply chain*

## Upravljanje zalihama u povratnoj logistici – analiza postprodaje u autoindustriji u RH

Prethodno priopćenje

Uspješnost upravljanja zalihama u gospodarskim sustavima pretpostavka je optimalnog funkcioniranja opskrbnih lanaca. Pojavom Povratne logistike, ali i sveobuhvatnijeg koncepta Zelenog upravljanja lancima opskrbe, upravljanje povratnim tokovima materijala, a time i adekvatne metodologije i modeli upravljanja zalihama s povratima, postale su teme od interesa istraživača i prakse. Većina radova u literaturi ipak promatra upravljanje zalihama s povratima s pozicije proizvođača, dok su problemi upravljanja zalihama oporabljениh proizvoda od strane njihovih prodavača nekako ostali po strani. Iz tog razloga napravljeno je istraživanje o trenutnom stanju, potencijalima i problemima upravljanja zalihama oporabljениh proizvoda (dijelova) u poslovnim subjektima postprodaje autoindustrije u Republici Hrvatskoj.

**Ključne riječi:** *opkrbni lanac, postprodaja autoindustrije, povratna logistika, upravljanje zalihama, rezervni dijelovi*

### 1 Introduction

Raised ecological and environmental consciousness of both consumers and governments in the 90-ies of the last century regarding the necessity of avoiding and reducing waste resulted in various legislative regulations, but also ecological and marketing initiatives from producers about increasing the level of recovery and recycling of products and materials. The management of all operations related to reuse of products and materials in any form appeared, named Product Recovery Management (PRM). The need to investigate the logistics aspects of reuse and recycling has been generally recognised. From a logistics perspective, product recovery initiates additional goods flows from users to producers. The management of these flows, opposite to the conventional supply chain flows, is addressed in the field of 'Reverse Logistics' [4].

Nowadays there is even more and more ecological awareness among people (consumers), and every day there are more people who think and act *green*. There are many ways how one can go *green*. For example, going *green* means buying products that are produced from recycled material, the other people want to buy products that are more energy efficient or in their production use resources that are friendlier to the environment.

Apart from end consumers, *green* thinking has spread also in the various initiatives adopted by companies. There are three main reasons why companies implement the *greening* process into their corporation [1]. They have to comply with the environmental regulations (*legislation*), address the environmental concerns of their customers (*marketing*), and mitigate the environmental impact of their production activities (*ecological awareness*). The concept that encompasses environmental

initiatives in all stages of supply chain is called *Green Supply Chain Management (GSCM)*, defined in [2] as "integrating environment thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to consumers, and end-of-life management of the product after its useful life". Being recognized as an important part of sustainability, Green supply chain management (GSCM) has gained increasing attention also within academia, easily seen from the categorized literature review in [3].

Reverse logistics, defined by Reverse Logistics Executive Council as "the process of moving goods from their typical final destination to another point, for the purpose of capturing value otherwise unavailable, or for the proper disposal of the products" [8] already has a *green* component inherited in itself, contributing to the different ways of product recovery or proper disposal. Nevertheless, one can make it even *greener* by optimizing activities for collection, transportation and storage of returnable products, and at the same time, applying the principles of *green* logistics to those activities [5].

Inventory management plays a significant role in a Reverse Logistics context. Even without return flows, inventory management is very complex in context of optimal functioning of supply chains. Consideration of the product returns and remanufacturing options causes two additional complexities in traditional inventory management approaches [6]. First, an uncertain element is added due to uncertain product returns. Second, there is a need for coordination between the remanufacturing and regular mode of procurement. Researchers have developed various inventory models to deal with these complexities. Some small portion of papers deals also with spare part inventory policies by considering the

recovered parts from EOL products as a source of spare parts supply [6]. However, inventory management with returns' issues is mainly seen from the producer's perspective. In automotive industry those are car producers. On the other hand, after-sale service providers (car services) and automotive spare-parts retailers have another point in supply chains as a link between producer and end user (consumer). Supply chains of automotive spare-parts with reverse flows therefore include more organizations, processes, functions and IT applications, with their interrelated connections. Overall goal is to achieve efficient and effective both flows: return flow of returned parts from end user back to the producer, and normal flow of recovered parts along with new produced ones from producers to consumer.

Optimized inventory management in the return logistics is segment of the logistics activities that can provide a competitive advantage in modern companies business, in accordance with the theory of sustainable development. The challenges of inventory management in the automotive industry aftersales are not reflected in keeping as much as possible inventory levels, but in distinguishing important from less important one, ensuring as much as possible higher activity ratio and adjusting inventory levels to market demand. In this way the high level of quality customer service is maintained. Optimal supply of spare parts that are important for optimal delivery of services to customers can be maintained only with quality planning, management and selection of decision criteria that management provides as a basis for managing business processes for supply optimization. Too much inventory causes unnecessary costs and could jeopardize the entire business of the company, and not enough inventories causes problems in business continuity and quality of service delivery to customers.

The development of the reverse logistics concept in the automotive industry dates back to 1950s, when the vehicle manufacturers began with the recovery of engines. Recovery of used parts or components (in any form, like direct reuse, repair, refurbishing, remanufacturing; in later text recovery is used as general term) not only affects the rational consumption of materials, primarily steel and other metals, but rationalizes other important resources in the production process, energy, equipment and labour. Aware of these facts, Volkswagen AG published the figure of 100 000 remanufactured engines in 1960s. In year 1981 1 million engines was rebuilt. In year 2008 the same manufacturer published information on the organization of the reverse logistics system that ensures the possibility of repairing more than 10 000 car components, and delivery of over 3,83 million different remanufactured parts worldwide [7].

In order to analyze the activities and methodology of reverse logistics and inventory management of parts to be recovered (from consumers to producers) and recovered parts (from producer to consumer) from the position of automotive industry post-sale organizations, the research was conducted described in the next Chapter. The results and derived conclusions are presented in last two Chapters.

## 2 Research methodology

The purpose of this study is two-fold: first, to analyze the activities and methodology of inventory management in reverse logistics of the automotive industry post-sales organizations as an attempt to determine the current status of inventory management of recovered products (parts) in the automotive industry post-sales businesses in Croatia; and second, as attempt to identify the possibilities of improving consumption of remanufactured spare parts.

The study focused on the automotive business sector, and within that, to the post sales of the leading car brands by market share in Croatia. The study was conducted in a period of one year (started in May 2010, completed in April 2011). First step of research was aimed to explore overall inventory management in supply chain from manufacturer to consumer. After that, the next step was a specific research, targeted to inventory management and logistics of parts and components that are moving through the supply chain in the direction of the consumer to the manufacturer. With this approach the study sought to collect objective indicators of inventory management in the reverse logistics, and to propose a concept of increased consumption of remanufactured spare parts based on research findings.

In order to study inventory management in reverse logistics of post-sales in the automotive industry in Croatia, a research questionnaire was made and sent by e-mail to the persons responsible for managing the post-sale of leading brands of cars. The research questionnaire included the representatives of vehicle brands on the Croatian market that take almost 50 % of the market<sup>1</sup>. The questionnaire with summarized answers is shown in Tab. 1.

In addition to using the research questionnaire, information regarding inventory management of returned and recovered products (spare parts, components) were also collected by talking with the managers of post-sales organizations that are responsible for the tasks of optimization of inventory management. Apart from strictly inventory management issues, questionnaire and interviews collected data about IT support of relevant processes, organizational structure of companies, strategies for managing (parts of) supply chain, as well as their opinions on trends, obstacles and potentials of improving recovered parts consumption in automotive post-sales. The methodology is schematically shown in Fig. 1. Quantitative and qualitative collected data were analyzed and synthesized for relevant conclusions.

<sup>1</sup> The survey includes representatives of the following car brands: Volkswagen Group (includes Volkswagen, Audi, Porsche, Seat, Skoda), Opel, PSA Group (includes Citroen brands, Peugeot, Renault), Mazda and Fiat. The market share of these brands of cars in period I to V 2011 cumulative amounted to 45,36 % (Source Promotion Plus).

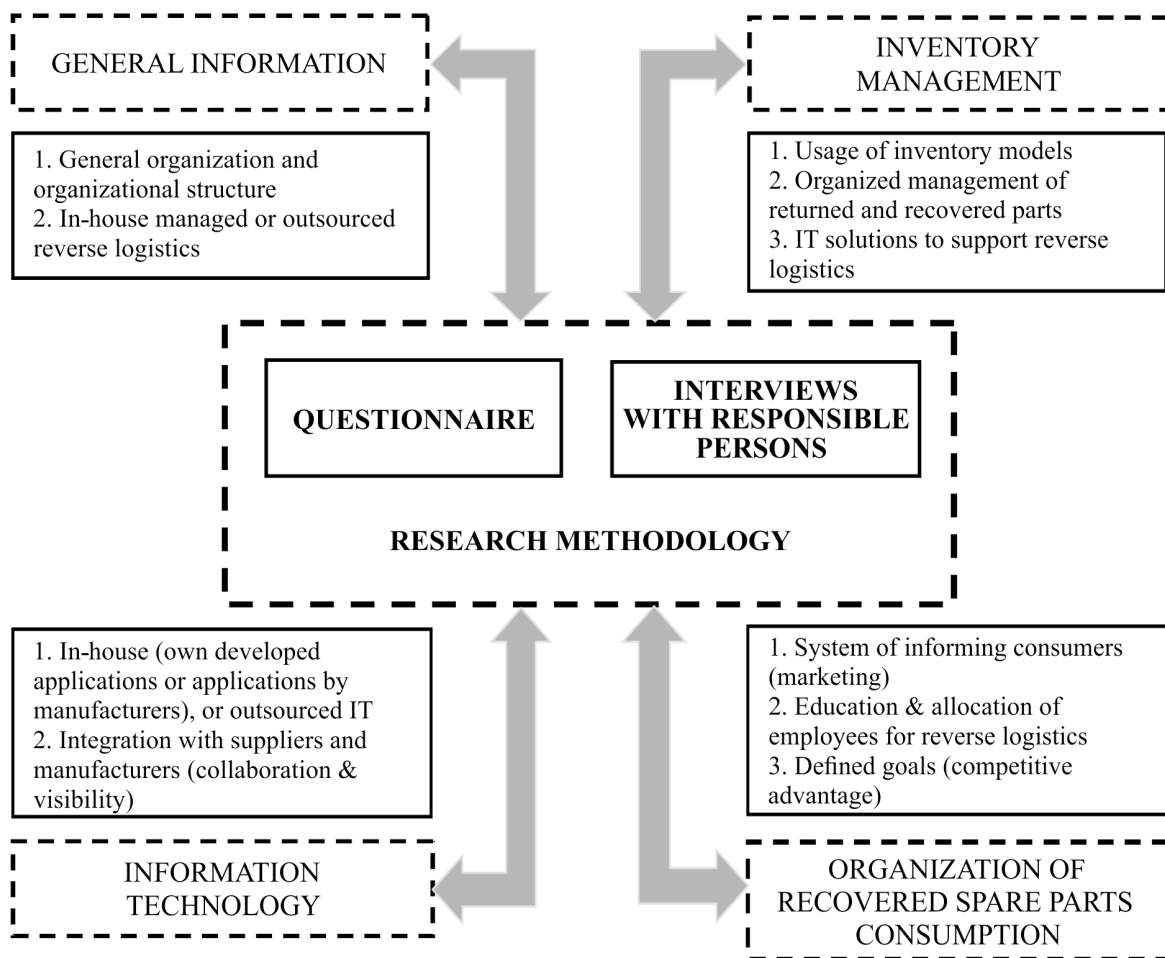


Figure 1 Schematic overview of research methodology

### 3 Research results

There are several key elements (points) of reverse logistics networks in the automotive industry that are important in realizing return flow of spare parts from consumers toward manufacturers. These are: service centre, local logistics centre, a regional logistics centre of spare parts, and manufacturing site.

Service Centre is a key location in the supply chain where the process of returning of spare parts (components) begins. In service centres technical activities of disassembly, cleaning, sorting and preparing parts for a dispatch to a local logistics centre are performed. Therefore service centres are crucial points for collecting parts in the context of spare parts reverse logistics realization. As a place of direct communication with customers (users of services – car owners), there are also key-places for promotion of environmental consciousness regarding usage of recovered products.

Local logistics centre acts as a collection point of spare parts from multiple service centres, with activities such as control, additional cleaning, proper packing and preparation of supporting documentation. In the local logistics centre consolidation and preparation of aggregate shipments to regional logistics centre is made. The research found that local logistics centre, consolidating spare parts from service centres in Croatia, is also located in Croatia.

Since the research was oriented to post sales of automobile industry in Croatia, in communication with

the responsible persons in post-sales of individual companies it was found that the regional logistics centres are located in the EU, mostly in Austria and Italy. Those countries are relatively close to Croatia, suitable to organize collection of aggregate shipments of components from the local logistics centres in Croatia, as well as serve as distribution centres in later re-distribution of recovered components.

From a regional logistics centre spare parts are shipped to the manufacturer (original producer or company specialized for recovery). Processes of receiving, sorting, cleaning, examination and testing, recovery, packing and preparing components for shipment to customers are performed. However, inventory control and production planning including recovery of returned parts/components in manufacturing sites were not included in this research.

Leading European car manufacturers achieved significant progress in the last 20 years regarding recovery, both organizationally and technologically. Today they offer more than 50 product groups with more than 10 000 parts/components from the recovered parts program<sup>2</sup>.

<sup>2</sup> As an example is a recovered parts program of Volkswagen brand. Recovered parts are divided into six main groups: engine components, clutch and related components, axles, axle and brake systems, fuel injection systems, electrical systems and circuits, and components of the exhaust system.

**Table1** Questionnaire with answers

	VW Group	Mazda	FIAT	PSA Group
1. Is there an organized system of spare part returns aimed for recovery and reuse?				
a) yes	√	√	√	
b) no				
c) not for Croatia				√
2. What is the share of recovered parts consumption on an annual basis?				
a) < 10 %				√
b) 10 ÷ 20 %	√		√	
c) 20 ÷ 30 %				
d) > 30 %		√		
e) we do not keep track of this information				
3. Is there a goal of selling recovered original spare parts on an annual basis?				
a) yes, goal is > 10 %				
b) yes, goal is 10 ÷ 20 %	√			
c) yes, goal is > 20 %				
d) we do not have precisely defined goals		√	√	√
4. Do you use information technology to support the concept of returns and recovering spare parts?				
a) yes, we use our own developed solution			√	
b) yes, we use manufacturer's solution	√			
c) no		√		√
5. In your opinion, what are the main reasons for the development of recovered spare parts concept?				
a) economic, recovered spare parts are cheaper for customers	√	√		√
b) economic, sale of recovered parts is more profitable for manufacturers?				
c) environmental	√	√	√	
6. What do you consider as limitations in increasing recovered spare parts consumption in Croatia?				
a) insufficient information for customers	√	√	√	√
b) Service centre has no economic interest				
c) inadequately trained staff in service				
d) organizational and operational efficiency for specific tasks				
7. Is there a person in your organization responsible for the receipt, shipment preparation and dispatch of used spare parts back to manufacturer? *				
a) yes	√	√	√	
b) no				
c) yes, but person is responsible for other tasks too				√
8. Are recovered parts economically advantageous for customers?				
a) yes, cheaper around 10 %				
b) yes, cheaper around 20 %				
c) yes, cheaper around 30 %	√		√	√
d) yes, cheaper around 50 %		√		
9. Do the recovered spare parts installed by an authorized service centre retain the same warranty as original new spare parts?				
a) yes, that period is 1 year		√		
b) yes, that period is 2 years	√			√
c) yes, that period is 3 years			√	
d) no				

\* Participants corrected answers during interviews; all confirmed that there are persons responsible for recovered spare parts management, but not as exclusively primary task.

Developed programs of spare parts reverse logistics, recovery and re-installation (sale), provide economic benefits both to customers (cheaper products) and producers (lower inputs of energy, labour and material), as well as contributes to more positive relationship with the environment. For instance, only from engine components group recovered parts program, Volkswagen AG has saved up to date as much steel as would be needed to build 50 Eiffel Towers. Consequently, less material and energy needed for production leads to less CO<sub>2</sub> equivalent emissions [7].

The research found that three of four participants included in survey have an organized system of returns of spare parts back to the manufacturer. Only the PSA group responded negatively to this question, which means that

in Croatia at least one quarter of car users<sup>3</sup> have disadvantage regarding service of systematic/ organized recovered spare parts consumption. Consequently, and not surprisingly, the share of recovered parts in annual consumption of that group is the lowest of all the participants in the study, as can be seen from answers in the questionnaire. Such finding suggests correlation between systematic approach of organized spare parts reverse logistics programs and actual results – usage of recovered spare parts (Figs. 2 and 3).

<sup>3</sup>Share of PSA Group (Renault, Peugeot, Citroen) in Croatian market, data by Promotion plus 2011.

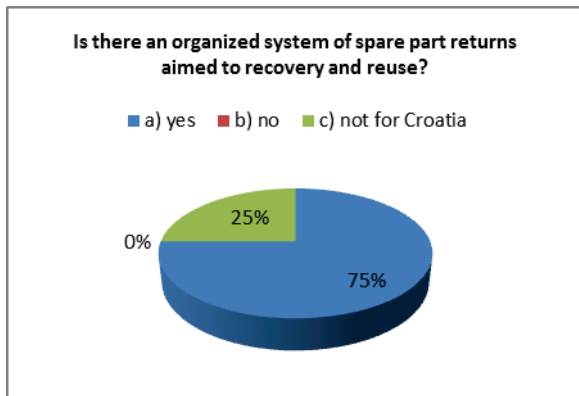


Figure 2 Organization of the reverse logistics of recovered parts

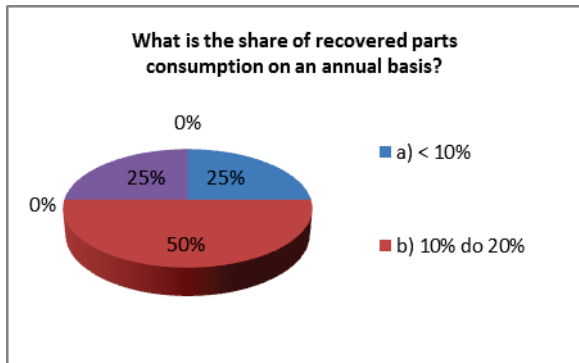


Figure 3 Organization of the reverse logistics of recovered parts and proportion of spending

From the results of the research questionnaire one can conclude that there is a lack of an overall strategy at the business entities that would define strategic, tactical and operational activities aimed at improving consumption of recovered spare parts. Automotive brands dealers have the data about the annual recovered spare parts share of consumption, but, as shown in Fig. 4, nearly 75 % do not have clearly defined objectives for recovered spare parts consumption. From the logistics aspects these facts are concerning. If there is no planning then also there is a general management lacking. Also, if there are no clear objectives, it is very likely there are no defined strategies to realize those goals. Unambiguous indicators for absence of appropriate strategy are also lack of IT support for recovered parts program (Fig. 5) and insufficient marketing of recovered parts program (Fig. 7).

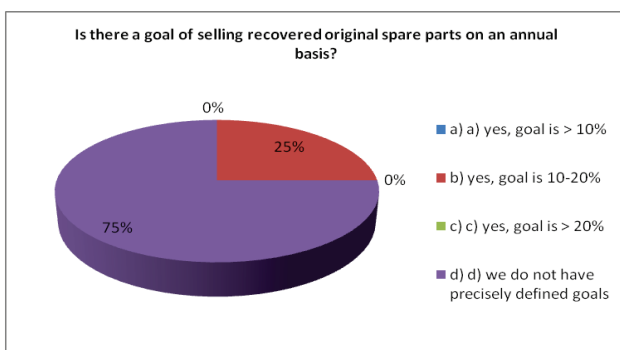


Figure 4 Market goals

Results of questionnaire and additional interviews also led to conclusion that spare parts sellers consider ecological benefits and economical benefits (cheaper parts) of consumers as the main drivers for the

development of the reclaimed spare parts concept (Fig. 6). It is interesting that recovered spare parts sellers do not consider recovering as direct economical benefit for producers. All participants in the study highlighted the issue of informing customers and service users as the main constraints to increase the consumption of recovered parts (Fig. 7).

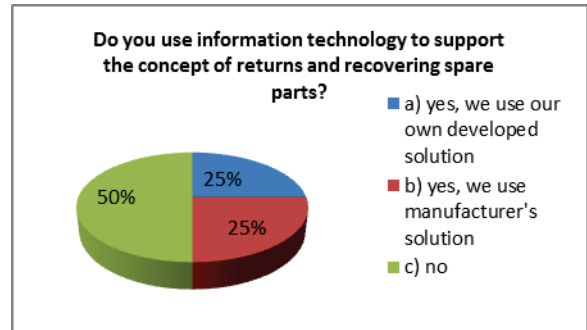


Figure 5 Market goals and support of information technology

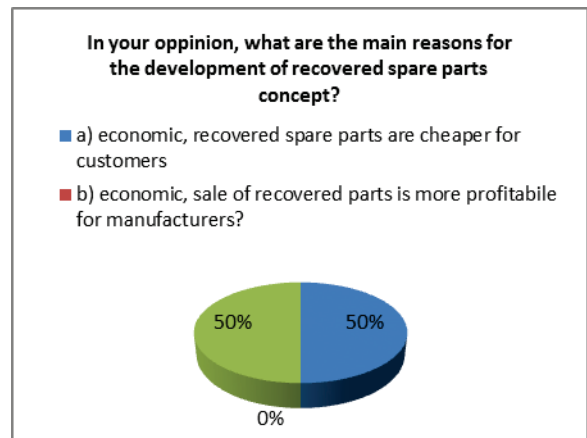


Figure 6 Motivation for the development of reverse logistics of recovered parts



Figure 7 Limitations for increasing consumption of recovered parts

Survey participants, in particular leaders of post sales, highlight economic benefits for the consumers and warranty requirements for recovered spare parts as key elements of competitive advantage. Responsible persons in the sales, especially the PSA Group's brands, Fiat and Mazda, are aware of the untapped opportunities of promotion and consumption of recovered spare parts. However, appropriate strategy with adequate marketing – communication with consumers - is missing. This is particularly important because of significant commercial

benefits of using recovered parts for the customers, while having the warranties of recovered parts identical to the warranties of original spare parts, shown in Figs. 8 and 9.

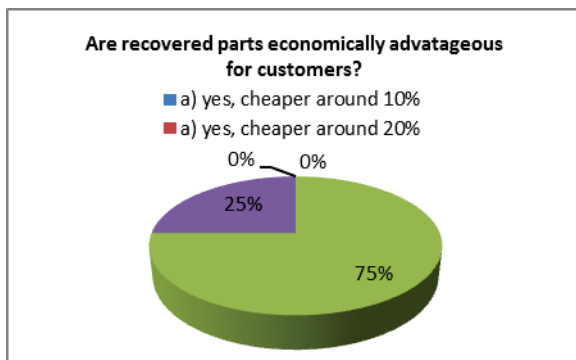


Figure 8 Economic advantage of using recovered parts

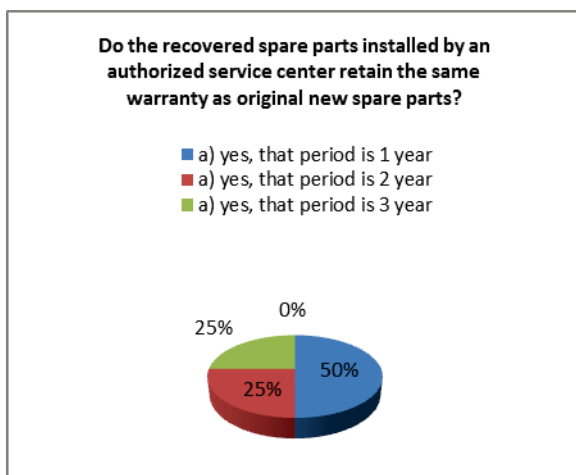


Figure 9 Economic advantage of using recovered parts and warranty terms

On the other hand, inertia at the local level for changes regarding recovered spare parts is somehow expected, and could be explained by given local market specificities in Croatia. Spare part retailers usually expect solutions defined/proposed by higher levels of the supply chain - foreign manufacturers of spare parts. In the implementation of global strategies, local specificities in the acceptance of certain communications are often forgotten. Those can have a decisive impact on the market success.

#### 4 Conclusion

The global automobile and spare parts manufacturers are at a high level of organizational, technological and environmental awareness and consciousness regarding the consumption of recovered spare parts. They seek to distribute that standpoint through the supply chain down to customers. However, there is a perceived inertia at some representatives of automotive brands in terms of informing consumers about the opportunities offered by the program of recovered spare parts manufacturers. The results of the study indicated that only one representative of car brands on the Croatian market included in the survey has defined objectives of recovered spare parts consumption. The difference was observed for representatives of leading German car brands on the

Croatian market – Volkswagen, with developed annual spending plan for recovered spare parts (in 2011 planned spending was 13 % of the total consumption of spare parts installed in vehicles through authorized service network).

Based on interviews with managers, the overall opinion is that there is insufficient use of IT solutions provided by car manufacturers for managing spare parts inventory. Those solutions could be used for better management of recovered parts through the supply chain. Also based on interviews with responsible persons from post sales awareness can be seen of the need to increase sale of recovered spare parts. They all agree about investing more resources in customer awareness and education of employees, emphasizing economic and environmental advantages of recovered spare parts consumption. Since the program of recovered spare parts spending offers significant savings for end users, with recovered spare parts 30 % cheaper than the original factory replacement parts, in the future efforts in developing communication strategies to customers need to be done. There are no employees whose primary job is managing the reverse logistics and management of recovered spare parts. Therefore, not enough attention is paid to developing specific employee training for this segment of work. However, if the case is opposite, there is a question of their utilization and efficiency, which is practically unmanageable without defined goals and results measurement.

Based on the results of research it is possible to conclude that the majority of survey participants leave management of recovered spare parts - this important segment of business - to inertia and that it happens spontaneously. The need for a strategic shift in postsale of the automobile industry business in Croatia is required. With new logistics approach that takes into account planned objectives of recovered spare parts consumption, implementation of supporting information technology, education of employees and consumers, it is possible to ensure changes in the reverse logistics and inventory management of recovered spare parts therefore to provide advantages for the end-users as well as all other participants in supply chain.

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