Processing reverse logistics inventories

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ABSTRACT

Developed logistics systems have organized reverse logistics flows and are continuously analyzing product returns, tending to detect patterns in oscillations of returning products in certain time periods. Inventory management in reverse logistics systems depends on different criteria, regarding goods categories, formed contracts between subjects of supply chains, uncertainty in manufacturer's quantities of DOA (dead on arrival) products, etc. The developing logistics systems, such as the Croatian system, find reverse logistics issues overall, also regarding returned products inventory management, significantly complex, and do not provide systematic analysis. The paper discusses the problem of reverse logistics flow processing, detects current return quantities locked in inventories and suggests systematic application of analysis as the first step to organize inventories in unorganized reverse logistics systems.

1. Introduction

Different authors indicate primarily as basic characteristics of reverse logistics systems uncertainty and variability. These characteristics are caused by the impossibility of planning the quantities that are expected in the reverse flow and time periods in which the product will be returned. Although inventory management is complex even in the distribution flow, extreme complexity is reflected in the planning of reverse flow inventories. The mentioned two flows are not the same, but still interrelated, which is in the part related to inventory management proven by the fact that at times of certain seasonal periods, fairs and certain promotions within the distribution flow, i.e. during increased sales, after a certain time period, larger quantities of returning products appear, which proves that in order to improve the reverse system and the possibility of preparing for the processing of the returns it is necessary to connect these two flows by information technology.

The complexity in management which is also a characteristic of the reverse flow refers, among other things, also to the packaging of the return product, which is usually absent or damaged. Damaged packaging results in more complex transport, storage and handling, i.e. increases the level of complexity of organizing the logistics activities, and may result in potential damaging of the return product. In relation to inventory management, at the gatekeep-ing, the damaged packaging can also be the cause of the lack of data and necessary information related to the return product itself.

After receiving the product, reverse inventory management requires also further routing of goods into the channels in which the respective products will realize maximal possible value since otherwise the returns are accumulated. Defining of the channels such as secondary markets, outlets, etc. apart from being in the function of the new markets for the return goods, allows shortening of the disposition cycling time (time in which the return product stays in the system), and increases the possibility of non-occurrence of obsolete inventories in the reverse channel. Also, the value of the return goods fluctuates extremely and the pricing requires knowledge about the potential market and estimate at the level of individual products. The non-uniformity in processing usually results also in ageing of the product, higher logistics costs, and routing of the reverse inventories unnecessarily to the landfills.

Apart from this, the reverse systems are characterized also by non-uniformity, lack of legal regulations, and non-transparent costs [1][2][3].

2. Inventories of distribution and reverse logistics

The inventories are indirectly related to storage, and their quantity and volume in the distribution flow are de-

termined by the available capacities of the storage space, technical and technological equipment of the warehouse, number of qualified workers at the warehouse and the inventory management policy carried out by the company. The inventories alleviate and synchronize the disharmony between the internal transport, production, external transport and sales of the product, thus directly locking the financial means that are necessary for their purchase. Larger quantity of inventories understands greater financial means which at the same time increases the operating costs, and the amount of inventories in the company is affected by numerous factors which result from the conditions of the production process, supply and demand on the market, business conditions, etc.

Under inventories we understand the quantity of goods accumulated for permanent supply of production or personal consumption closer or further away in time and space [3]. In order to ensure the continuity of business it is necessary to constantly maintain an adequate quantity of inventories. Partial or delayed goods deliveries in the distribution flow will not only fail to satisfy the customer, but will cause their possible shift to other corporate subjects, which may result in permanent loss of business partners. In service organizations the loss of customers is very often progressively multiplied, particularly in those types of activities whose scope includes a large concentration of competition such as for instance retail chains.

The objective of distribution flow inventory management is not in keeping the level of inventories as high as possible in order to provide goods availability to the customers at any moment, but rather in following the desires and needs of the customers, analyse well the market and supply, thus adapting the level of inventories.

Numerous studies related to the area of returns, have been carried out usually only in certain aspects of reverse logistics on the Croatian market, within the companies such as development planning or adjustment to new legal regulations. The analyses related to reverse flow inventories management are specific in the majority of cases for the developed logistics systems.

The returned goods move through the entire supply chain, and the return can be initiated from any level which include return from the end user, return from the retail location, return from retail chain, return from the supplier and return from the producer. The return may be initiated for various reasons such as return of excessive stocks, seasonal return, return due to a defect in production, etc. Routing of return between the supply chain subjects depends essentially on the formed business contracts.

Apart from the distribution flow, the inventory quantities may be found also in the reverse flow, where precisely due to lack of organization, substantial oscillations, uninsured reverse logistics channels and activities, they generate certain logistics costs. The planning of the quantities of inventories in the distribution flow affect directly the re-

verse flow where the type of inventory in the distribution, such as speculative, overstocked and seasonal inventories cause also the occurrence of larger quantities of return goods.

The mentioned inventories, after a period in which they could have been sold in the distribution channel, they are usually withdrawn from sales locations, and after or during the generation of logistics costs, such as storage, handling, etc. they become obsolete inventories, usually of the supplier. Due to the specifics of the very products, such as damage, lack of packaging, obsolete products, etc., efficient processing of return goods cannot be performed in an unorganized manner.

For the reverse flow inventories uniformed processing has to be ensured within a short disposition cycling time for the purpose of the non-generation of additional costs, and maximal addition of value to the returning goods or achieving the maximum possible market value [4][5][6].

3. Processing characteristics and seasonality of reverse logistics chain inventories

Performed studies on the Croatian market regarding reverse logistics included 19 different companies, i.e. retail chains of a major share on the market, suppliers, producers and distributers. Companies provided basis for conducting research and insisted on anonymity. Researched infrastructure included detecting processes, warehousing and data regarding reverse logistics and inventories in distribution flow.

After performed research it has been concluded that the Croatian reverse systems are characterized by routing the return through all levels of the supply chain in a way which from the organizational aspect, except in certain activities, is almost equal to the distribution flow. The described phenomenon is specific for the developing logistics systems in which the changes related to reverse flow management are just about to be introduced.

3.1. Processing of return goods

In retail chains the most complex reverse management is not the return of the end user, but rather management of return of seasonal, obsolete and overstocked inventories. All the researched retail chains in Croatia are organized in such a way that they have a network of retail locations of different categories and logistics distribution centre in which the goods intended for the distribution flow are temporarily stored, and distributed towards the retail locations. During research it has been noted that also the return goods (depending also on business contracts) from all the retail locations of the retail chain are routed into the logistic-distribution centres in order to store the seasonal stocks or return towards the suppliers or producers.

The research has confirmed that the quantity of returns in the recent several years has substantially increased, and

at the level of the logistic-distribution centres, depending on the retail chain and method of operation, the return goods are sorted even several times a week.

According to the performed studies, the goods are returned to the logistics distribution centres of retail chains for the following reasons:

– Return of seasonal goods;
– Return because of the reduction of inventories;
– Return because of date of expiry;
– Return of the end user (due to damage, servicing, etc.).

The decision on the goods that can be routed to return at all, in the majority of the studied retail chains comes from the main retail department at the company level, and is based on the regular control of the quality of distribution flow inventories. After having determined the quantities of the inventories that are on the verge of expiration date, seasonal range or potential formation of obsolete inventories, the competent department in compliance with the business contracts and in agreement with the suppliers forms the lists of products intended for return that can be performed within a certain time period, usually in a certain week in a month or in a certain month. If there are substantial quantities of return, and there is a possibility of big load of central warehouse, the department forms a schedule that includes the usually in-advance defined sales locations and terms in which the return can be performed and/or in detail defined terms for the return of a certain category of products. The mentioned planning of the return is shown in the flowchart in Figure 1.

The processing of return goods starts at the retail locations where the employees bundle the goods together by putting them into available adequate packaging, mainly not sorting the goods according to the in-advance defined criteria. Although it has been noted that the returned goods such as books or toys are packaged into the same packaging, very often, if the packaging allows this, in order to use the capacity, also the returned goods of completely different categories are packaged into the same packaging.

After being routed to the level of the central warehouse, the returned goods are re-sorted into boxes of different dimensions, according to pre-defined criteria. After having been sorted, the goods are combined on pallets, and as such routed in a pre-defined method to the suppliers, distributers or producers.

During studies, different dimensions of packaging in which the return is routed have been found, and the usually noted dimension is 0.60×0.50×0.40m. Although most often recorded, regarding its capacities the mentioned packaging is very often not suitable for the return of goods of larger dimensions or piece goods of specific dimensions. Over-dimensioned items do not provide proper closing of the packaging so that major damages during transport and loss of parts have been noted.
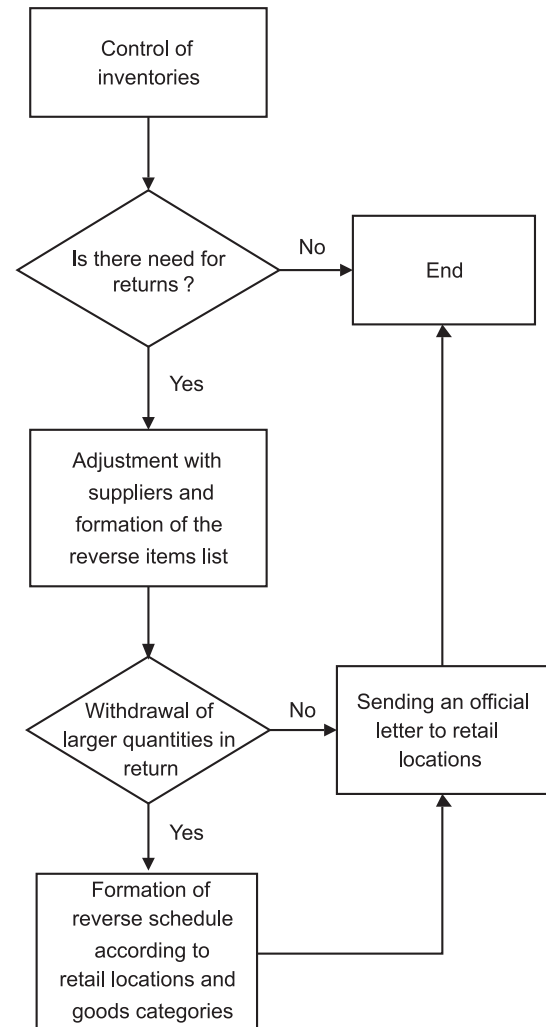

Fig. 1 Processes in the return planning phase

3.2. Return quantities

Extreme fluctuations in the reverse quantities are noted after seasons, i.e. depending on the primary activity of the retail chain and groups of goods in the sales range. During research it has been proven that the reverse seasonality in case of retail chains of consumer goods is the strongest in August, January and April. In the chains in which the primary activity involves electronic and electrical devices, the increase in the returned products is noted in January, beginning of July and after significant sports events. In bookstore chains the largest returns are noted also in January, end of April, end of August, and beginning of December.

Depending on the range, the same indicators i.e. fluctuations are noted also in the distribution, so that after the expected large quantities in distribution that are recorded at the beginning of December, March, June, etc. (depending on the activity), after a certain time period, the same product will return in different percentages through various levels of the supply chain.

Two different logistics distribution centres have been taken as examples and they include central warehouse of the retail chain of important share on the Croatian market and the logistics-distribution centre of the distributers, suppliers and producers of electric and electronic devices and consumer goods.

Figures 2 and 3 show the quantities of the returns in May 2013 directed to the retail chain logistics-distribution centre. After the retail locations and distribution centres were informed at the end of April 2013 by the main retail department of the company that in May the returns towards certain producers and suppliers is planned, of exactly defined goods categories, and even products themselves, in certain time periods (the first return until the 15th in the month, the second after the 15th), the distribution centre received such goods from the retail level through the entire month. Because of the organization methods, sorting the returns in the fourth week of the month, all the returned goods upon receipt pass the first phase of the process which includes forming of a commission, checking the documentation, and sorting the goods after being received, where the goods are sorted in order to determine the condition, accompanying documentation and the quantity. The return goods after the preliminary check in the first phase are allocated a temporary storage location within the warehouse intended for the goods in distribution. During the first three weeks in the month the return goods are collected, and in the fourth week all the warehouse workers, after having completed their tasks regarding distribution, are delegated to sorting the returns and storage or locations for the delivery of goods towards suppliers and/or producers.

The categories of goods being returned to the level of the distribution centre are usually items that are withdrawn from sales, obsolete items, excessive quantities, withdrawal of product due to the change of supplier, return of seasonal goods, etc. During the research, the return included products such as CDs, DVDs, tobacco utensils and products, picture postcards, and greeting cards, toys, technical goods, etc. In the observed time period, a total of 55,300 products was received. The largest quantities of return are reflected in the first period of the month of May in items such as greeting cards and picture postcards, DVDs, and various toys, whereas picture postcards, CDs and DVDs are more demanding regarding sorting. Although the mentioned items belong to the goods of the same category, the fact is relevant that one goods category can involve dozens of suppliers. Each of the supplier requires different methods of routing the returns, and the fact that often the return items within a certain goods category are very similar and distinguished only by inconspicuous details, make the sorting task for the warehouse workers even more complicated.

The observed time period does not belong to the category of peak periods in the return such as the periods following Christmas, Easter, etc. but rather represents the expected quantity of returns in an interval of one month to the regional distribution centre. The quantities of returns in the mentioned period are presented in the following graphs (Figure 2, Figure 3).

During studies at all retail chain central warehouses it has been highlighted that certain products and goods categories have a tendency of larger quantities of returns, which is usually the result of excessive supply of inventories for the purpose of shelf availability, and in some cases the quantity of returns exceeds even ten times the quantity of the retail chain distribution flow of inventories. The indicated data are presented on the example in Table 1.

The example of fluctuations at the level of logistics distribution centre of distributers, suppliers and producers of electronic devices and consumer goods is presented in Figure 4 where returns in February, March and April 2013 were monitored. The overall volume of returns is presented in m^3, and it may be noted that in April the total volume of returns was significantly higher than the volume in February. The number of boxes refers to the packaging in which the returns is combined and routed to the logistics-distribution centre from different levels of the supply chain, and the largest number of boxes was also recorded in April when a total of 5,652 were received. The number of items in the document refers to the number of different types of product, whereas the total number of products refers to the quantity of the products themselves. The studies have confirmed that in March the maximum quantity of products was received, i.e. 16,229 items, almost double the quantity of products received in February and April of the same year.

Table 1 Quantities of the returns in May 2013 and current situation of the same items on stock of the regional distribution centre

Product	Inventories in distribution	Inventories in return
CD	1,130	10,685
Tobacco utensils	889	4,226
Tobacco products	3,242	23
DVDs	141	1,445
PC games	29	33
Technical goods	186	367
DVDs	681	1,619
Toys	2,105	127
Toys	1,692	618
MP4	25	10
Techn. goods accessories	1,356	413
Picture postcards	4,994	27,818
Newspapers	23	6
Stationery	126	10
USBs	67	19
Greeting cards	978	7,881

	Techni cal goods	DVDs	Toys_1	Toys_2	MP4	Tech. goods access ories	Picture postca rds	Newsp apers	Station ery	USB	Greeti ng cards
Return in the period from 1-15 May (pcs)	367	1619	127	618	10	413	27818	6	10	19	7881
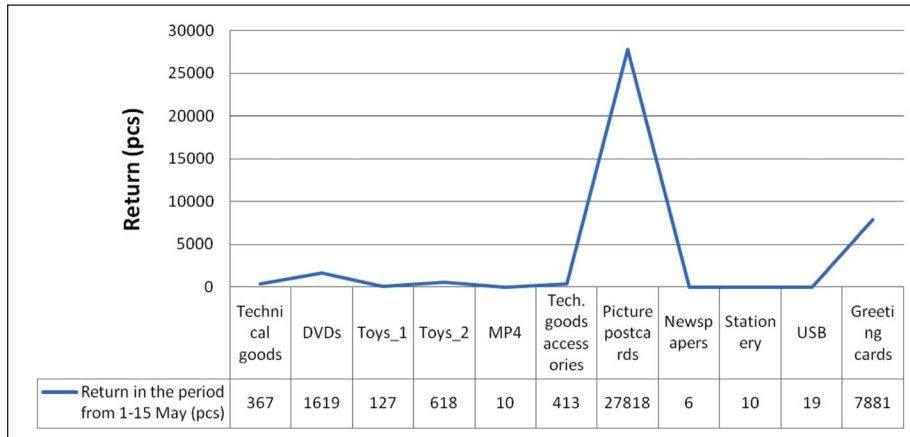
Fig. 2 Graph of return directed to central warehouse of a retail chain in the time period from 1-15 May 2013

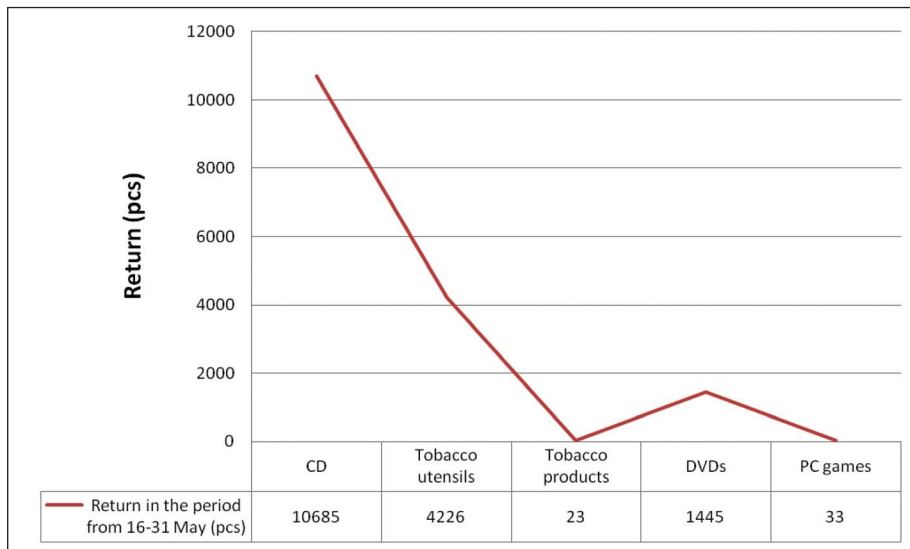|	CD	Tobacco utensils	Tobacco products	DVDs	PC games
Return in the period from 16-31 May (pcs)	10685	4226	23	1445	33

Fig. 3 Graph presenting commercial return directed to central warehouse of a retail chain in the time period from 16-31 May 2013

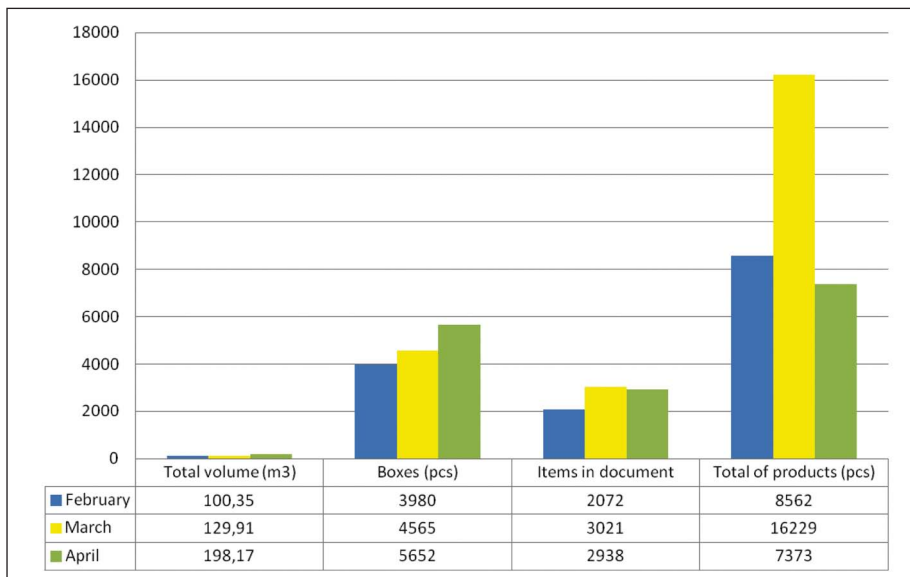|	Total volume (m3)	Boxes (pcs)	Items in document	Total of products (pcs)
February	100,35	3980	2072	8562
March	129,91	4565	3021	16229
April	198,17	5652	2938	7373

Fig. 4 Graph presenting incoming reverse goods of distributers and producers

During one month on the average 2,677 different types of products were returned to the logistics-distribution centre, whereas in the observed three-month period 2013 there were 32,164 products received in a total of 14,197 boxes.

4. Optimization aspect of reverse logistics inventories

Complete prevention of generating returns is impossible. It is rather necessary to make organizational improvement of the found reverse systems on the Croatian market. For the reverse flow management, each subject shall develop an individually adapted system in which the return goods at the level of a logistics-distribution centre, within a very short period of time will be routed to the contractual location or to the markets where it shall realize the maximal possible value. This is crucial for the suppliers, where the return goods are very often accumulated and because of the defined contracts with the producers these cannot be returned or the cost of return would very quickly exceed the value of the product.

On the Croatian market, during the research, it has been noted that the return goods are often stored as the goods in the distribution flow and move non-uniformly through the supply chain subjects, which should be completely reduced. For the return goods it is necessary to define the procedures, activities and channels of reverse logistics, not storing it, but rather only temporarily placing it until further processing. During temporary storage the goods should also be categorized in order to define the priorities in further routing. The categorization is necessary due to the large number and diversity of products, and important details on the condition of the product which are very difficult to follow, and which have a significant impact on the results of organized routing.

Profiling of reverse inventories can be performed by ABC analysis which is an analytical method of a wide scope of application and represents a method of classifying the items of operation into groups out of which each is characterised by different meaning in relation to the whole, according to which the handling of goods is also determined. The analysis is based on the Pareto principle, and it is performed by classifying the operation items into three basic groups: A, B and C, by applying the criteria that characterise their business significance.

The profiling of return product is done in compliance with the in-advance defined rules, procedures and conditions, and the method of operation, and depending on the types of products that enter the reverse system.

Profiling can be based on different approaches some of which are:

– according to product value;
– according to product value decrease;
– according to further dispatch into certain channels;
– according to type of product;

– according to physical characteristic;
– according to time of delivery;
– according to frequency of return and delivery, etc.

Since one of the highest business risks in reverse flow is the decline in the value of the return product, which may cause not only the impossibility of making income, but also a substantial cost in management, the categorization may be set in such a way that 80% of risk of decline in product value causes 20% of storage units, where the return product categories are characterized by:

A – the decline in value within a month,
B – the decline in value in three-month time,
C – the decline in value in a six-month period,

which yields that all the return products of A category characterized by extremely fast decline in value, are considered the highest risk in management and they need to be continuously controlled and stored also adequately, and in the shortest time, if possible, routed to the secondary markets. The return products of B category are characterized by medium intensity of the decline in value; they need periodical control, whereas the products of C category need minimal control and they are characterized by very low decline in the value.

In compliance with the categorization it is necessary to harmonize also the organization of business in the part of sales that will continuously, depending on the operating mode, ensure timely routing of return products into reverse logistics channels.

If required by the operating method, also a double ABC categorization may be performed, the example of which is presented in Table 2. Double ABC categorization allows ranking of two categories into one, such as the decline of the return product value and the delivery frequency, where e.g. AA return products are those that show the highest tendency of sudden decline in value, their delivery frequency being very high, whereas CC products have very poor, gradual decline in value, and the delivery frequency is also low.

Table 2 Profiling return using double ABC categorization

	Higher delivery frequency		Lower delivery frequency
Sudden decline in value	AA	AB	AC
	BA	BB	BC
Gradual decline in value	CA	CB	CC

Apart from this, temporary storage of products should be in compliance with the physical characteristics of the goods and in compliance with rational usage of the storage space. When being stored, the same as in the case of storage in the distribution flow, the return products should be

protected against deterioration, pollution, spoilage and theft, and the storage needs to be provided at a location of adequate quality and level of equipment of the storage space, as well as using adequate handling method.

Also, because of extreme complexity of reverse management, i.e. uncertainty and variability, it is possible to form the procedure of announcement of return. The announcement of return by the business partners is a subject of administrative nature, and it is not complex for implementation, but rather needs to be set in compliance with the operating method requested by the business partner.

In the mentioned way one can prevent the entry of goods whose quantity does not match the delivery notes, of goods that lack the obligatory data, where the time period of return has been prolonged, etc. The forms for the announcement of return can be filled in via interface for which the partners can have a licence, i.e. certain rights, and the concept can be agreed upon in detail in compliance with the ownership and operating method.

5. Conclusion

Studying the issues of reverse logistics even in the developed logistics systems is still considered an area that has to be continuously researched with the aim of optimising the entire supply chains. The characteristics of reverse systems of different logistics markets, in their basic structure, do not differ substantially, whereas the issue and the methods of reverse flows are substantially different, and need to be considered individually. The specifics of the formed contracts and methods of organizing corporate subjects in the supply chains affect the quantities of the return products.

The research results have primarily highlighted that the supply chain subjects do not keep detailed register about the returned quantities and reasons for increasing quantities of returned inventories, and do not carry out detailed analyses regarding the reverse flow. As in the majority of logistics systems, the reverse flow is considered as a flow of secondary importance, but still in some cases the returned goods at a monthly level exceed the value of several thousand euros.

The studies have also confirmed that the return inventories usually accumulate at the supplier where they generate substantial logistics costs, whereas by proper directing a profit (or saving) could be achieved. In case of certain suppliers a return on a monthly basis in the amount of almost EUR 40.000 has been recorded, whereas in case of the suppliers of electronic devices the inventory value of returned goods exceeded EUR 130.000.

On the Croatian market there is need to organize the reverse flow by the supply chain subjects who continuously tend towards optimization and reduction of costs, and by the end users who, according to research, on the average continuously buy 35% of products on discount, out of the totally purchased products. The pricing of products on the secondary market, according to research of the foreign authors, amounts to 30% – 40% of the price of the new product, and the prices as such are very attractive to the users and there exists market for them.

Defining of the routing channels for reverse flow inventories is of great importance, and the stimulation to purchase products at the end of life and the possibility of replacing old, used products by new ones, is ecologically acceptable and has economically favourable effect. This has been recorded on the Croatian market, but usually in the form of temporary activities of the supply chain subjects, whereas the combination of such strategies can result in completely new form of operation on the market.

All activities and reverse logistics channels, and routing methods, return product categorization, purchase of reverse logistics services have to be formed with the aim of minimizing the disposition cycle time, and it is also necessary to continuously optimize the quantities of distribution flow inventories, so as not to affect generating the return quantities.

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