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# IMPORTANCE OF REVERSE LOGISTICS SERVICES AS AN ANTECEDENT FOR BUILDING A GREEN SUPPLY CHAIN

## ABSTRACT

An important antecedent for building a green supply chain are customer requirements. For the time being, however, it is unclear how the demands for providing reverse logistics services contribute to green supply chain building. The aim of the research was therefore to specify the degree of importance of reverse logistics services compared to typical services provided by the supplier during order fulfilment. Based on the survey of purchasing managers' attitudes in 100 food companies, reverse logistics services were found to have a significant role in the portfolio of services evaluated. Return of defective goods was evaluated as the most important reverse logistics service. At the same time, it was found that the perception of the importance of the services provided is affected by the item purchased. Reverse logistics services are more important when purchasing chemicals than when purchasing the main raw material. Thus, primary research has shown that the greatest opportunity to build a green supply chain will arise when purchasing items that inherently show environmental hazards.

**Keywords:** Reverse logistics, green supply chain, logistics service, food industry, chemicals

## 1. Introduction

Currently, green supply chain management (GSCM) is gaining ground both in theory and managerial practice, combining environmental management and supply chain management (SCM) (Srivastava, 2007; Zhu et al., 2008; Yang et al., 2013). GSCM rep-

resents the integration of environmental thinking into SCM activities (Ahi, Searcy, 2013). Building a green supply chain (GSC) requires the application of an array of green practices. These are environmentally friendly activities that reduce environmental impacts and capture added value from these activi-

ties (Ryoo, Koo, 2013). At the same time, they contribute to lean manufacturing (Dües et al., 2013) and according to Ryoo and Koo (2013), they enable a firm to sustain competitive advantages. Many of these practices are applicable at the level of a single enterprise, others require the cooperation of several partners in the chain (Hofmann et al., 2012). Environmentally proactive manufacturers directly and positively affect environmental behaviour of their business partners (Green Jr. et al., 2012) and implement internal green practice with an extension to external supply chain partners (Zhu et al., 2013), thereby increasing the chances of their successful implementation (Yen, 2018). Greater or lesser involvement of business partners in joint efforts involves setting, coordinating, and achieving environmental goals that will lead to reduced environmental impacts (Green Jr. et al., 2012; Zhu et al., 2013; Yen, 2018; Vachon, Klassen, 2006). Developing external green collaboration improves the firm's green performance considerably (Ahmed et al., 2018).

One of the green practices that require a greater or lesser degree of cooperation between business partners in the chain is reverse logistics. According to the literature (Cox, 1999), reverse logistics cycle manages packaging as well as returns of defective or discarded products. Reverse logistics is a tool for developing the level of recovery and return of the used products (Shi et al., 2015), serving to reduce pollution and product waste through activities like refurbishing, repairing, remanufacturing, recycling, disposal and parts recovery (Zarbakshnia et al., 2019). Rogers and Tibben-Lembke (1999) define reverse logistics as designing, scheduling, and controlling the productive and beneficial flow of products that are at the end of life, inventory and information of the used products from consumer to producer so as to recover, recycle or dispose of the used products. However, reverse logistics should be considered for the entire life cycle of the product, including as part of the product design. The basic life cycle of a product encompasses the following stages: concept, design, manufacture, use, return, recycle and/or disposal in landfills (Guarnieri et al., 2016). The implementation of a reverse logistics network is a strategic decision. This decision seeks to achieve a single objective or multiple objectives of cost minimization, profit maximization, customer satisfaction, or environmental benefit (Shi et al., 2017; Abdulrahman et al., 2015; Bazan et al., 2015; Li et al., 2017).

As far as reverse logistics research is concerned, it has been conducted essentially since 1992 when Stock (1992) acknowledged reverse logistics as a topic of societal interest. The interest of researchers is mainly focused on the strategic management of the reverse logistics, especially the application of management methods and approaches to reverse logistics, the implementation of the reverse logistics system and the development of cooperation between business partners in the supply chain, especially with third-party logistics partners (Li et al., 2018; Liao, 2018; Agrawal et al., 2015; Ghadimi et al., 2019).

In research focusing on cooperation of supply chain partners in the implementation of green practices (including reverse logistics), it was found that environmental cooperation and monitoring between customers and their suppliers improves environmental and business performance (Green Jr. et al., 2012). Moreover, Gimenez and Sierra (2013) found that the effect on environmental performance is positive and synergistic and can also be enhanced by environmental assessment of suppliers. The positive relationship between green practices, green supply chain and environmental (and economic) performance has also been revealed in food retail research (Petljak et al., 2018).

Dangelico and Pontrandolfo (2015) found that business performance is significantly influenced by the ability to develop environmental cooperation and to carry out environmental activities, not only with commercial, but also non-commercial entities. Moreover, it has already been revealed that the success of implementing green practices is significantly stimulated by integrations in the supply chain (Vachon, Klassen, 2006), application of environmental management in the companies involved in the chain (Wong et al., 2012), coordination of internal business processes of individual partners and implementation of an information system to support green activities (Ryoo, Koo, 2013). Also, differences in the expansion of green supply chain management in the B2B (business-to-business) and B2C (business-to-consumer) sectors have been examined as well as the conditions in which firms in the B2B sector implement environmental processes into their individual buyer-supplier relationships (Hoejmose et al., 2012).

Yen (2018) addresses internal and external antecedents to the application of green practices, specifically which of them affect the supplier-customer

collaboration and how. He develops the results of previous research (Caniëls et al., 2013) that suggested that the main drivers to engage suppliers in green activities are supplier readiness and customer requirements. The role of customers in the application of green activities has also been confirmed in research by Chavez et al. (2016). They discovered that customer pressure has a significant impact on the implementation of green initiatives, which in turn leads to a multiple increase in operational performance. However, so far no one has investigated to what extent customer requirements for providing reverse logistics services contribute to building a green supply chain. Therefore, primary research was carried out. It was based on the basic idea that if the requirements for reverse logistics services were found to be important, suppliers would be motivated to provide them. This will create an opportunity for building reverse logistics systems. Assuming at the same time that reverse logistics is a key activity in building a green supply chain (Liao, 2018), the importance of reverse logistics services will be directly linked to building a green supply chain (the high importance of reverse logistics services will increase the chances of building a green supply chain).

The aim of the research was to compare the importance of reverse logistics services with other services provided by the supplier during order fulfilment. The more important they are compared to other services typically provided during order fulfilment, the greater the opportunity for building a green supply chain. Customer attitudes to the importance of services, however, can vary significantly depending on the customer's position in the supply chain and on the type of industry. That is why the research focused on measuring attitudes only for B2B customers in an industry we had chosen, specifically on measuring the importance of services provided with the deliveries of raw materials to food companies. Food companies had been deliberately chosen because improving backflows in the food supply chain not only brings environmental and economic effects, but also social effects resulting from saving food resources.

## 2. Methodology

The starting point for the specification of the services included in the research was the literature (Christopher, 2016; Rabetino et al., 2015) and the

results of our research focused on the purchasing processes and the process of forecasting demand in food companies (Branska et al., 2017; Pecinova et al., 2017; Patak, Vlckova, 2012).

The following reverse logistics services are considered to have the greatest potential to reduce environmental impacts (i.e. the volume of waste of raw materials and packaging, but also the use of additional energy and raw material resources):

- Return of defective goods,
- Return of unused goods (by reason of incorrect forecast),
- Return of expired goods,
- Return of packaging.

In order to compare the perceived importance of reverse logistics services with the perceived importance of other services, usually provided during order fulfilment, the following services were examined:

- Consultation on delivery innovations,
- Fixed quantity ordering,
- Fixed period ordering,
- Automatic replenishment,
- Inventory availability information,
- Order status information,
- Flexible order sizes,
- Flexible delivery times,
- Short delivery times,
- On-time deliveries,
- In-full deliveries,
- Error-free deliveries.

Subsequently, it was determined in which purchasing operations the importance of the services would be examined. Since the biggest opportunity to build a green supply chain is generally with key suppliers, the first chosen situation was the purchase of the main raw material. It was a logical choice also because these are the most important items to buy in manufacturing companies. The other item for research was chemical products (chemicals). It is also of utmost importance for food companies –

these are usually cleaning and hygiene products that can significantly affect the quality and safety of food produced. The second important reason for the inclusion of chemicals in the research was the environmental aspect thereof – unused chemicals require a specific disposal method and so does the packaging in which they are delivered to companies.

The research was organized as a quantitative one using a statistical survey. A simple random selection technique was used to select respondents. The selection was based on the public database of Czech tax entities ARES, from which all the companies registered with the main business area “Production of food products” (corresponding to the CZ-NACE classification) were selected. The database of Czech food companies thus created was randomly sorted and, based on the order of the companies in the database, suitable respondents (purchase managers) were gradually approached and involved in the research (ensuring random sampling). First, the companies were approached by telephone with a request to participate in the research. If a company refused, it was replaced by the next one until data of 100 companies were collected. The required sample size was determined as a compromise between methodological requirements (sample error size, form of the statistical analysis) and available sources for data collection.

Data collection was carried out in written form using an e-questionnaire. In the first part of the questionnaire, the respondents were asked to evaluate the importance of 16 pre-specified services (see above), first in the context of purchasing the main raw material and then in the context of purchasing chemicals. Given the broad portfolio of services being evaluated, the respondents used a seven-point scale (where 1 = absolutely unimportant, 7 = extremely important) to evaluate importance. The survey also included questions related to the size of the company, the respondent’s competence in selecting the supplier and the respondent’s experience (length of practice as a purchasing manager or at a similar job position).

The research sample included 46% of small enterprises (with up to 49 employees), 40% of medium-sized enterprises (with up to 249 employees) and 14% of large enterprises (with 250 employees or more). The majority of the respondents declared having a direct influence on the choice of suppliers

of the main raw material and chemicals to the enterprise (92%), half of the respondents declared having worked as purchasing managers for over 10 years (52%). Therefore, the sample of respondents is considered to be sufficiently representative for generalizing the results (see the structure of the research sample in Table 1).

**Table 1** The structure of the research sample

Characteristics	Category	Frequency
Enterprise size	Small	46
	Medium-sized	40
	Large	14
Influence on the choice of suppliers	Direct	92
	Participation	8
Years of experience in the current position	Up to 5 years	29
	5 – 10 years	19
	More than 10 years	52

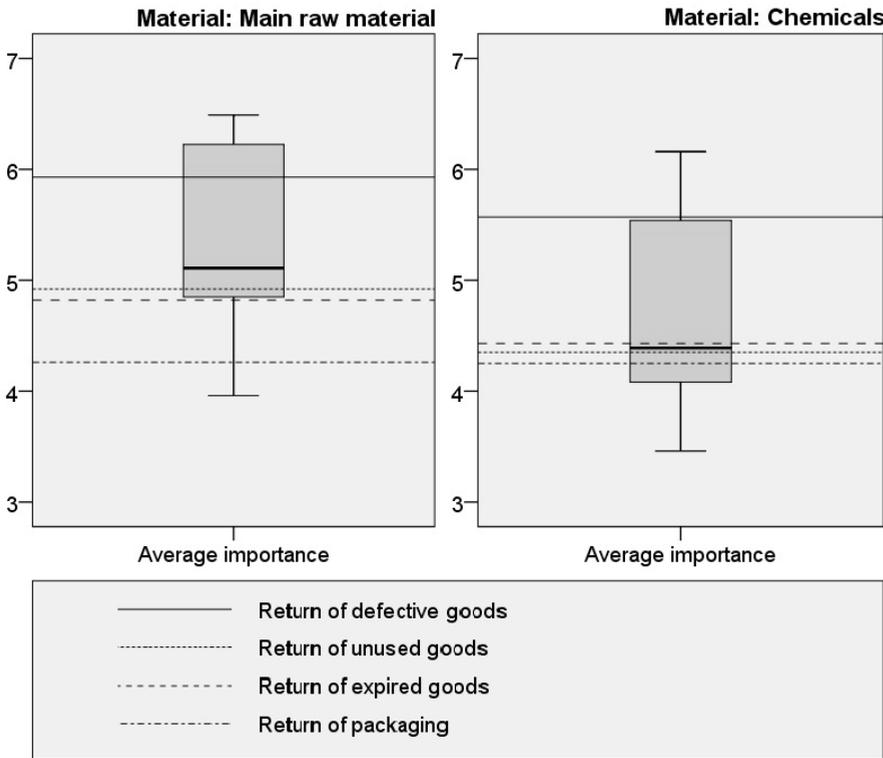
Source: Authors’ calculations

Data analysis was based on descriptive and inferential statistics using the IBM SPSS Statistics software. The average importance scores calculated from all individual responses were used to evaluate the importance of services. To compare the importance of reverse logistics services in the portfolio of all the services surveyed, a box-plot of average importance scores was chosen. Statistical significance of differences in the average importance scores of deliveries of the main raw material and chemicals was verified using a paired-samples t-test at the 0.05 level of significance.

### 3. Results

The research results can be divided into two parts. The first part of the results describes the position of reverse logistics services in the portfolio of all the services surveyed related to the deliveries of the main raw material and chemicals to food companies. To compare the importance level, box-plots of average importance scores were chosen, in which the position of reverse logistics services is indicated by dashed lines (see Figure 1).

**Figure 1** The position of reverse logistics services in box-plots of average importance scores for main raw material and chemicals



Source: Authors' calculations

Both box-plots show the high importance of the return of defective goods service, which significantly exceeds the importance of other reverse logistics services. However, when comparing box-plots, we can also notice a change in the position of reverse logistics services in the portfolio of all the services surveyed (reverse logistics services have a more prominent position in the portfolio of all services in the case of deliveries of chemicals). The biggest change was observed with the return of expired goods service (in the case of the main raw material it is in the fourth quartile of services, while in the case of chemicals it is in the second quartile of services). In contrast with the case of the main raw material, return of defective goods ranked among the four most important services in the case of chemicals (along with in-full deliveries, error-free deliveries, and short delivery times).

The second part of the results focuses on identifying differences in the importance of services depending

on the type of item purchased. Already in Figure 1, there was a noticeable drop in the position of box-plots in the case of deliveries of chemicals. In addition, a comparison of the average importance scores for individual services in Table 2 shows that chemicals saw a significant decline in average importance for 15 of the 16 services surveyed. In ten cases it was a significant decrease in importance, in five cases this decrease was at the limit of significance (P-value close to 0.05). With the exception of reverse packaging, services related to the deliveries of chemicals are perceived to be less important than those provided with the delivery of the main raw material. For both types of purchased inputs, a group of services with a high perceived importance can be identified, namely in-full deliveries, on-time deliveries, error-free deliveries, flexible delivery times, short delivery times, flexible order sizes, and return of defective goods.

**Table 2 Differences in average importance scores for services provided with the main raw material and chemicals**

Element of collaboration	Average Importance Score			Paired t-test	
	Main raw material	Chemicals	Difference	t-value	P-value
Reverse logistics services:					
Return of defective goods	5.93	5.57	-0.36	-1.96	0.05
Return of unused goods	4.92	4.35	-0.57	-2.89	<0.05
Return of expired goods	4.82	4.43	-0.38	-1.89	0.06
Return of packaging	4.26	4.25	-0.01	-0.06	0.95
Other services:					
Consultation on delivery innovations	4.59	3.92	-0.67	-3.11	<0.05
Fixed quantity ordering	4.88	3.92	-0.96	-3.54	<0.05
Fixed period ordering	5.05	4.11	-0.94	-4.55	<0.05
Automatic replenishment	3.96	3.46	-0.50	-1.82	0.07
Inventory availability information	5.17	4.14	-1.03	-4.89	<0.05
Order status information	4.89	4.05	-0.84	-4.28	<0.05
Flexible order sizes	6.06	5.41	-0.65	-2.94	<0.05
Flexible delivery times	6.23	5.51	-0.71	-3.48	<0.05
Short delivery times	6.22	5.65	-0.56	-2.83	<0.05
On-time deliveries	6.35	5.38	-0.98	-5.07	<0.05
In-full deliveries	6.49	6.16	-0.33	-1.76	0.08
Error-free deliveries	6.33	5.93	-0.40	-1.97	0.05

Source: Authors' calculations

#### 4. Discussion of results

The research results confirmed some of the findings of the previous research and also yielded new findings. Regardless of the purchased item, typical transaction services, i.e. services providing on-time, in-full, error-free and flexible deliveries with short delivery times (Christopher, 2016) were logically regarded as the most important. Such services are the basis that customers would normally expect as they have a major impact on reliable deliveries and consequently the ability to meet similar requirements with other customers in the supply chain. Surprisingly, return of defective goods also ended up in the group of the most important services. This is probably related to customers' demand for perfect order, which has an immediate impact not only on the environmental, but especially on the economic success of the customer. The assessment of the importance of this service thus probably reflected the

respondents' interest in their own environmental as well as economic success. Other reverse logistics services have ranked among the less important services, but they occupy an important position in this group. Therefore, the demands for reverse logistics services will naturally motivate suppliers to provide them. Thus, the conclusions of previous research can be elaborated to the effect that customer requirements for reverse logistics services contribute to building a green supply chain.

The research results showed that the type of item purchased affects the level of perceived importance of each service. The services provided with the deliveries of the main raw material are perceived as more important than those provided with the deliveries of chemicals used mainly for the cleaning and hygiene needs of the food companies. This is probably because the purchase of the main raw material affects customers' commercial interests much

more. For customers who are in the position of a manufacturer, it is much more important to have an error-free supply system for the main raw material as this ensures that the plan for production and deliveries to their own customers is met. While possible problems with deliveries of chemicals may increase the complexity of operations management, they usually do not require operations to stop and do not jeopardize the fulfilment of terms of contracts. The service is equally important with the purchase of chemicals only if the packaging material is returned. Based on the knowledge of the purchasing process in food companies, it is estimated that the main reason for this finding may be the level of hazard of the item purchased. As the process of eco-friendly disposal of packaging waste with chemicals can be not only more demanding but also more expensive, the customer will appreciate the possibility to return the packaging material to the supplier. It can therefore be estimated that the importance of an environment-friendly service is assessed from both an environmental and an economic point of view.

Finally, it is also clear that reverse logistics services have a different position in the portfolio of all services, depending on the item concerned. In the portfolio of all the services surveyed, reverse logistics services are more important in the purchasing of chemicals. It can therefore be expected that there is a greater opportunity for building green supply chain between food enterprises and manufacturers of consumer chemical products as their suppliers. However, it can be estimated that the environmental impact of implementing or improving reverse logistics for chemicals will not be as significant as in the case of improving the return flow of the main raw material that is purchased in incomparably larger volumes. However, experience with reverse flow management of chemicals will create a knowledge base to manage the return flows of other items, especially that of the main raw material. Making use of this experience will then be a prerequisite for further reducing the environmental burden.

## 5. Conclusion

The primary research was designed to specify to what extent customer requirements for providing reverse logistics services contribute to building a green supply chain. To achieve this goal, the importance of services provided in connection with the purchase of the main raw material and chemicals in the food industry was examined.

In the portfolio of reverse logistics services, it is return of defective goods that is of utmost importance for customers. If the supplier seeks to strengthen relationships with its customer through reverse logistics services, it is necessary to focus primarily on complaint management. From the point of view of the purchased item, this conclusion is even more important when purchasing consumer chemical products than the main raw materials. Other reverse logistics services are also important for customers. They have ranked among the less important services, but they occupy an important position in this group. Therefore, it can be concluded that there is an opportunity to implement or improve reverse logistics systems for supplies to food companies, which is essential to building a green supply chain. However, it cannot generally be assumed that this opportunity is greater for supplies of the main raw material. Rather, it can be estimated that it is greater when purchasing an item that, by its very nature, poses environmental hazards.

There are some opportunities for further research. Given that the importance of services provided in connection with the purchase was examined in a selected segment of industrial customers, it would be beneficial to carry out the research in another (preferably significantly different) industry. This would make it possible to assess whether there are any sector-specific differences. It would also be appropriate to conduct research with other members in the supply chain. This would make it possible to discover in what part of the chain there are the greatest opportunities for building a GSC through reverse logistics practices.

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## **VAŽNOST POVRATNIH LOGISTIČKIH USLUGA KAO PREDUVJETA IZGRADNJE ZELENOG LANCA OPSKRBE**

### **SAŽETAK**

Važan čimbenik u izgradnji zelenog lanca opskrbe su zahtjevi kupaca. Zasad, međutim, nije sasvim jasno kako zahtjevi za povratnim logističkim uslugama doprinose izgradnji zelenog lanca opskrbe. Stoga je cilj istraživanja bio utvrditi stupanj važnosti povratnih logističkih usluga u usporedbi s uobičajenim uslugama koje dobavljač pruža pri ispunjavanju narudžbe. Provedena je anketa kako bi se ispitali stavovi direktora nabave u 100 prehrambenih poduzeća, a rezultati pokazuju da povratne logističke usluge imaju važnu ulogu u portfelju ocijenjenih usluga. Prema stavovima ispitanika, vraćanje neispravne robe najvažnija je usluga povratne logistike. Nadalje, utvrđeno je da na percepciju važnosti pruženih usluga utječe vrsta kupljene robe. Povratne logističke usluge važnije su pri nabavi kemikalija nego pri nabavi sirovina. Prema tome, primarno istraživanje pokazuje da se najbolja prilika za izgradnju zelenog lanca opskrbe pruža kad se nabavlja roba koja sama po sebi predstavlja rizik za okoliš.

**Ključne riječi:** povratna logistika, zeleni lanac opskrbe, logističke usluge, prehrambena industrija, kemikalije