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Reverse logistics, concept, evolution and marketing challenges

Abstract

Reverse logistics is a research area focused on the management of the recovery of products once they are no longer desired or can no longer be used by consumers, in order to obtain an economic return through reuse, remanufacturing or recycling. In recent years, reverse logistics has become a matter of strategic importance in the context of the Supply Chain Management. In this chapter, an introduction to the concept and evolution of reverse logistics is provided, from a very basic approach related to the recycling channels to the current concept of closed-loop supply chain. Then, we describe some of the challenges for reverse logistics in the next years, especially those related with the marketing of the recovered products, namely competition issues in remanufacturing, the cannibalization problem, the purchase intention of consumers of remanufactured products, and their perceptions and willingness to pay for this sort of products. Research in reverse logistics from a demand/market perspective is nascent and there exist challenging opportunities to keep developing this topic.

Keywords: Reverse Logistics, Supply Chain Management, Remanufacturing, Marketing, Returned Products.

1. Introduction

Reverse logistics has attracted the attention of companies and academia in the last two decades. Some examples in the business world can be found in firms such as Apple, Canon, Caterpillar, Dell, Electrolux, Hewlett-Packard, or IBM which include reverse logistics practices in their operational processes. This growing interest is also evidenced by the increase in the level of related activities in leading sectors such as the transport sector, the consumer electronics sector, the textile sector, and the press and media, to name but a few (Verstrepen et al. 2007). In a similar vein, from an academic point of view, reverse logistics has been a topic of growing interest in recent years, as can be observed in the increasing trend of the number of published articles (Agrawal S et al. 2015), monographies and books. An example of this growing interest can be found in several literature reviews published very recently (Souza, 2013; Agrawal S et al. 2015; Govindan et al. 2015)

Reverse logistics is a research area focused on the management of the recovery of products once they are no longer desired or can no longer be used by consumers, in order to obtain an economic return through reuse, remanufacturing or recycling (Flapper et al. 2005). Some of the most relevant issues analysed have focused on aspects related to the analysis of the flow of goods from the consumer back to the producer or to the recovery entity (Thierry et al. 1995; Guide and Van Wassenhove 2001); the production planning and inventory management (Toktay et al. 2000; Yang et al. 2005); and coordination issues among different processes in the Supply Chain (SC) (Savaskan et al. 2004; Ferguson et al. 2006). Regarding gaps and new opportunities for research, issues such as the integration of different levels of decision-making and paying attention to multi objective problems (Govindan et al. 2015); development of models for forecasting

product returns and risk assessment of reverse logistics implementation (Agrawal S et al. 2015); and empirical research on consumer behaviour and the market for remanufactured products (Souza 2013), deserve to be mentioned.

In this chapter, an introduction to the reverse logistics concept and its implications and challenges for the SC is presented. To this aim, an overview of the evolution of this concept is provided as well as a brief review of the main contributions in this field. In section 2, we review the implications that the reverse logistics concept can generate for the SC, by analysing the main decisions made when implementing a reverse logistics system. In section 3, we describe some of the challenges for reverse logistics in the next years, especially those related with the marketing issues of the recovered products. As usual, we finally provide some conclusions and insights.

2. Reverse logistics: an overview

According to Thierry et al. (1995) and De Brito and Dekker (2004), the main reasons or drivers for implementing a reverse logistics system are the following:

- Economic reasons: They can be classified as direct and indirect reasons. Direct reasons are related to a more efficient use of raw materials, reduction of disposal costs and creation of added value from returned products. Regarding the indirect reasons, an image of environmentally responsible behaviour and improved customer relations could be two of them.
- Legal reasons: Because of environmental legislation, many companies are held responsible for the products they produce or distribute throughout their life cycles (Extended Producer Responsibility). This primarily involves that enterprises have to develop ways for recovering the End-of-Use (EoU) products in order to recover their value (reuse, remanufacturing, recycling) or to a proper disposal.
- Social reasons: Social awareness regarding the environment had led to increasing demands (from customers, stakeholders, non-governmental organizations, etc.) for environmentally responsible behaviour by companies. Most of these "social requirements" have focused on reduction of carbon emissions and waste generation.

The concept of reverse logistics has evolved over the years (De Brito and Dekker 2004), passing through varying stages until becoming consolidated. From a very basic approach related to the raw material recycling (Ginter and Starling 1978), to the big impulse given by contributions from the field of engineering and operational research in the nineties (see for example, Fleischmann et al. 1997), until these days in which it is a fully recognised subfield of supply chain management (Guide and Van Wassenhove 2009).

During all this period, several definitions have been suggested for the concept of reverse logistics, for example:

"…the term often used to refer to the role of logistics in recycling, waste disposal, and management of hazardous materials; a broader perspective includes all relating to logistics activities carried out in source reduction, recycling, substitution, reuse of materials and disposal" (Stock 1992).

"The process of planning, implementing and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal" (Rogers and Tibben-Lembke 1999).

"…a process by which a manufacturing entity systematically retrieves previously shipped products or parts from the point-of-consumption for possible recycling, remanufacturing, or disposal" (Dowlatshahi 2005).

Although the conception of reverse logistics dates from 1970s (see, for example, Guiltinan and Nwokoye 1974; Ginter and Starling 1978), the denomination of this term is difficult to trace with precision (Table 1). During the seventies and eighties, the scientific literature refers to terms like reverse channels or reverse flows consistently associated with recycling operations, so the definition was inspired by the movement of flows against the traditional flows in the SC; at the beginning of the nineties, the first known definition of reverse logistics is published by the Council of Logistics Management; at the end of the 1990s, reverse

logistics is characterised by the recovery of the value of EoU products and the processes involved; in these days, a holistic view of the supply chain is proposed by considering, simultaneously, forward and reverse flows from a business perspective. From that moment on, management of both types of flows cannot be conceived separately, this is the so-called closed-loop supply chain (CLSC) management, that can be defined (Guide and Van Wassenhove, 2009) as the design, control, and operation of a system to maximize value creation over the entire life cycle of a product with dynamic recovery of value from different types and volumes of returns over time. In this sense, Guide and Van Wassenhove (2009) provide an interesting analysis about the evolution of the CLSC research and use five phases to highlight the evolutionary process of this research area: 1) the golden age of remanufacturing as a technical problem, 2) from remanufacturing to valuing the reverse-logistics process, 3) coordinating the reverse supply chain, 4) closing the loop, and 5) prices and markets.

However, the reverse logistics definition proposed by the European Working Group on Reverse Logistics, REVLOG, will be considered throughout this chapter. This research group defined reverse logistics as "*the process of planning, implementing and controlling backward flows of raw materials, in process inventory, packaging and finished goods, from a manufacturing, distribution or use point, to a point of recovery or point of proper disposal*" (De Brito and Dekker 2004).

Table 1. Evolution of the reverse logistics concept

PERIOD OF TIME	DESCRIPTION	MAIN CONTRIBUTIONS
1970s	Use of different terms ("reverse channels", "reverse flows") in conjunction with the recycling concept.	• Guiltinan and Nwokoye (1974) • Ginter and Starling (1978)
1980s	Emphasis on several terms as "backwards" and "forwards" in order to highlight the existence of flows with movements in the opposite direction of the traditional flows.	• Lambert and Stock (1981) • Murphy (1986) • Murphy and Poist (1989)
Early 1990s	First formal definition of reverse logistics (Council of Logistics Management).	• Stock (1992) • Pohlen and Farris (1992) • Kopicki et al. (1993)
In the late 1990s	Recognition of the important role played by "management" in the field of reverse logistics.	• REVLOG (1998) • Rogers and Tibben-Lembke (1999)
From the year 2000 onwards	Holistic perspective: joint vision of forward and reverse flows. Development of CLSC concept.	• Guide et al. (2003) • Lebreton (2007) • Guide and Van Wassenhove (2009) • Ferguson and Souza (2010)

Source: Compiled by authors based on Dekker et al. (2004) and Carrasco (2010).

As it was previously mentioned, the growing interest on this topic can also be observed in the number of reviews published (for example, Prahinski and Kocabasoglou 2006; Rubio et al. 2008; Guide and Van Wassenhove 2009; Ilgin and Gupta 2010; Souza 2013; Agrawal S et al. 2015; Govindan et al. 2015), that can be checked to obtain a more detailed view of this field. Nevertheless, we can highlight a set of papers that have undoubtedly contributed to the development of this research area:

- Thierry et al. (1995) can be considered as a seminal work on product recovery management. It provides a description of the product recovery options distinguishing among them according to the reprocessing process: repair, refurbishing, remanufacturing, cannibalization, and recycling.
- Fleischmann et al. (1997) is, with no doubt, one of the key papers on this topic. It is a thorough review of the main operational research models for reverse logistics focusing on three crucial issues: distribution planning, inventory management, and production planning.
- Rogers and Tibben-Lembke (1999) clearly identified the key role of logistics in commercial returns and documented many practices.

- Fleischmann et al. (2000) provides a characterization of product recovery networks, and classifying them in three categories according to the recovery process: bulk-recycling networks, remanufacturing networks, and re-usable item networks.
- Savaskan et al. (2004) introduces the concept of CLSC and presents different structures of remanufacturing networks in order to analyse the interactions between the forward and the reverse channel decisions.
- Guide and Van Wassenhove (2009) provides an overview of the evolution of CLSC from a business perspective. It highlights some research needs related to 1) the development of more sophisticated operational research models to gather the business perspective of the problem, 2) the need of becoming more familiar with CLSC practice, and 3) the opportunity to build relationships with other disciplines such as marketing or accountability.
- Souza (2013) is a recent overview of the most relevant studies developed in the field of the CLSC management. This paper focuses on those articles which analyse strategic issues (i.e., remanufacturing decisions by Original Equipment Manufacturer – OEM, network design, etc.) and tactical issues (e.g., used product acquisition and disposition decisions). For each topic, a base model with underlying assumptions and results is presented and the author's perspective on needed research areas is argued.

Obviously, there exist other many papers that contributed to the development of this topic, although mostly based on these ones.

3. Reverse logistics in the supply chain context

The relevance of the reverse logistics concept in the SC context is increasing, and, actually, it is difficult to find examples of SC without the more or less important presence of reverse logistics (Corominas et al. 2015).

Successful implementation of reverse logistics activities demands making decisions related to different hierarchical levels: strategic, tactical, and operational. From a strategic point of view, the consideration of return flows into the SC requires to make decisions about the number, location, and capacity of the corresponding facilities (collection points, sorting and inspection facilities, recovery centres, etc.), the design of the network (independent from the forward network *versus* CLSC), and the technological processes to implement (transportation systems, inspection, classification and recovery technologies, etc.), among others. From a tactical point of view, decisions about the assignment of collected products to recovery centres, inventory management issues should be considered. Operational decisions are related to the collection and distribution routes, recovery options (recycling, remanufacturing, reuse), and waste management. Table 2 shows a summary of this sort of decisions according to the different activities developed in a reverse logistics system.

Table 2. Reverse logistics decisions

ACTIVITIES	STRATEGIC	TACTICAL	OPERATIONAL
COLLECTION	• Location, number and capacity of collection points • Lay-out • Process systems	• Assignment of End-of-Life (EoL) products to recovery centres • EoL inventory management • Transport means	• Collection batches • Collection routes • Load configuration
INSPECTION AND SORTING	• Location, number and capacity of inspection and sorting facilities • Training	• Inventory management for recoverable products • Assignment of tasks: disassembly, cleaning, restoring, etc.	• Recovery option decision: reuse, remanufacturing, recycling.

Source: Adapted from Rubio (2003).

Table 2. (Continued) Reverse logistics decisions

ACTIVITIES	STRATEGIC	TACTICAL	OPERATIONAL
RECOVERY	• Process systems: best available technologies • Markets for recovered products	• Inventory management for recovered products • Effects on Aggregate Production Plan	• Effects on Master Production Plan • Bill of materials
DISPOSAL	• Disposal systems	• Inventory management for non-recoverable products • Transportation means	• Waste management

Source: Adapted from Rubio (2003).

However, if we had to indicate a key decision in the implementation process of a reverse logistics system, it would necessarily be the reverse logistics network design (RLND). Alumur et al. (2012) highlight that reverse logistics network configuration is a complex problem that requires the determination of optimal localisations and capacities of collection centres, sorting centres, remanufacturing facilities and/or recycling plants. This way, RLND becomes a strategic issue in the context of the Supply Chain Management (SCM). Because of its relevance, a brief discussion about the design of a reverse logistics network is provided in the following lines.

Several contributions to this issue have provided a basic description of the Reverse Logistics Networks (RLN) by identifying commonalities among them and indicating critical elements in their design and implementation:

- Thierry et al. (1995) classify the RLN according to the recovery option given to the EoU product: 1) direct reuse –direct use and resell–, 2) product recovery management –repair, remanufacturing, refurbish, cannibalization and recycling–, and 3) disposal –incineration and landfill.
- Fleischmann et al. (2000) provide a classification based on the main characteristics observed in different business cases: 1) bulk-recycling networks –e.g., sand recycling, recycling of steel by-products, and carpet recycling–, 2) remanufacturing networks –e.g., copier remanufacturing, mobile phone remanufacturing and printed circuit board recovery– and, 3) re-usable item networks –e.g., reusable packages.
- Savaskan et al. (2004) analyse four different configurations according to their (de-)centralization degree in order to describe the interactions between the forward and the reverse channel decisions: centrally coordinated system, manufacturer collecting, retailer collecting and third-party collecting.
- Flapper et al. (2005) also describe diverse RLN by using business cases from different sectors (cosmetics, pharmacy, electronics and beverage, among others), paying special attention to other elements related to organisational, environmental, technical and economic aspects.

However, probably, the main consideration in RLND is the choice between an independent network for the collection of EoU products and a network integrated into the forward SC, resulting in a CLSC (Corominas et al. 2015). Anyway, both, an independent design (RLN) and a CLSC, are set around two critical activities, namely: (i) the collection of EoU and (ii) the recovery option (remanufacturing, reuse, recycling). Aras et al. (2010) provide a thorough analysis related to the design of RLNs with an approach aimed at identify the implications for the SCM according to 1) the right network structure (e.g., should a OEM use an existing retail network or a third-party firm to collect used products or collect directly from end users himself?), 2) the right collection strategy (for example, should the used products be picked-up from the end users or is it better to set up drop-off facilities for returns?, and 3) the role of financial incentives in the collection strategy (e.g., should financial incentives be given to promote the return of used products?, and how do financial incentives and the choice of the collection strategy influence the structure of the RLN?).

While network design for EoU products recovery is an active area of research in the SC literature, more research effort is needed (Akçali et al. 2009). In this vein, Alumur et al. (2012) highlight that RLN configuration is a complex problem that requires the determination of the optimal locations and capacities of the collection centres, sorting centres, remanufacturing facilities and/or recycling plants.

Nevertheless, the design of a RLN is based on three basic activities:

1. Collection of EoU products. According to Corominas et al. (2015), collection of EoU products can be considered the starting point of the system. The authors describe three different collection options

depending on whether the collection is made directly by the manufacturer or remanufacturer, through a network of distributors and retailers, or through third-party logistics providers. In general, at this stage, some important decisions have to be adopted: 1) strategic decisions –location and quantity of recovery facilities, capacity, technology which have to be used and design of recovery facilities–, 2) tactical decisions –transportation planning system or EoU inventory management–, and 3) operational decisions –planning of collection routes for EoU products and configuration of collection batches

2. Inspection and Classification. One of the main characteristics of the product recovery management is the uncertainty associated to the recovered products, in terms of quantity, quality and time (Thierry et al. 1995; Dekker et al. 2004). Most companies do not know how many products will be returned and, what the main conditions of these products will be so, they ignore if the quality of the returned products will be good enough to be properly recovered (remanufactured, recycled and reused). Furthermore, there is some uncertainty regarding the moment in which these products will be returned and, therefore, it is unknown if they will be on time to introduce them in the recovery process. In this way, these two activities (inspection and classification) will determine which the condition of the returned products is, so an analysis of location and capacities of sorting centres is required.
3. Recovery Process. It can be considered as the key element of a RLN due to, at this phase, the economic value of the returned product is recovered by using one of the following options:

    - Reuse. This is a recovery option which implies very basic activities to reconditioning the product (cleaning, minor repairs), that do not modify their structure or nature (see Carrasco-Gallego et al. 2012, for a detailed analysis). Some types of packaging and containers (pallets, returnable glass bottles, plastic containers, etc.) are the best examples of products to which this recovery option can be applied.
    - Remanufacturing. This option requires achieving additional activities, such as disassembly, inspection, repair, and assembly, in order to recover the value of the returned products and provide them similar characteristics (warranty, quality, performance, etc.) than the original products. In some cases, when it is economically and technically feasible, improvements of several technological modules of products are performed, in order to ensure that remanufactured products include technological levels analogous than the original ones. Numerous examples of remanufactured products can be found in the electronic sector: laptops, printers, mobile phones, etc.
    - Recycling. Throughout this last option, simply the economic value of the raw materials is recovered, so the returned product loses its identity. According to Ferguson and Souza (2010), this alternative could be especially recommended when materials can be separated economically by environmentally responsible techniques. Some examples of good candidates for recycling are: packaging material, glass, paper, plastic, aluminium, etc.

New opportunities for research in this stream can be considered, particularly those related to the empirical application that could be of immediate help to practitioners (Aras et al. 2010), or when combined with take-back legislation (Souza 2013).

4. Research challenges for the next years

In this specific area of research, most of the problems analysed in the literature have been approached from the *supply side* of EoU products, by analysing the flow of goods from the consumer back to the producer or to the recovery agent, e.g., collection, recovery value (reuse, remanufacturing, recycling), inventory management, production planning, etc. (De Brito and Dekker 2004). However, there has been little work from the *demand side* about how the recovered products are re-introduced into the market after the recovery process. Issues such as the marketing of recovered products, their acceptance by consumers, the existence of new markets for these products and how these markets can be developed, which marketing strategies are best suited for this purpose, or what type of consumer should be targeted are some of the main concerns in the analysis of the reverse logistics from a demand point of view (Michaud and Llerena 2011; Jiménez-Parra et al. 2014; Agrawal V V et al. 2015). There is a broad consensus that one of the challenges for CLSC research in the coming years is the need to examine in depth its relationships with the market and consumers (Guide and Van Wassenhove 2009; Atasu et al. 2010; Subramanian and Subramanyam 2012; Souza 2013), so in this section a brief description of the main challenges of research for reverse logistics from the *demand side* is provided.

According to Subramanian and Subramayam (2012), recent reviews of CLSC research have highlighted the need for an empirical treatment of market factors. In this sense, Guide and Van Wassenhove (2009) also claim for more interdisciplinary research with marketing and accounting areas to validate assumptions that many of the CLSC models are based on, in order to "keep the business model perspective rather than optimizing an isolated part of the problem". As Atasu et al. (2010) recognise "the marketing aspects of remanufacturing are largely unexplored by academic research", so this can be a good moment for beginning to explore some of those aspects.

Although a more detailed review can be found in Subramanian and Subramanyam (2012) and Agrawal V V et al. (2015), we here provide a classification of the main contributions focused on analysing some particular marketing issues in the context of the CLSC research, by grouping them by sub-topic, namely competition in the remanufactured product market, cannibalization, purchase intention, willingness to pay (WTP) for remanufactured products, as well as issues related to the perception of consumers of these types of products (Table 3).

4.1. Competition

Is one of the first research issues focused on the market as a key element that can have an effect on the performance of the CLSC, for which Majumder and Groenevelt (2001), Debo et al. (2005) and Atasu et al. (2008) can be considered as basic references in the study of this topic and its implications for the different participants in the remanufactured product market. In this sense, for example, Atasu et al. (2008) suggest that direct competition between OEMs may have a significant impact on the profitability of remanufacturing. In particular, they argue that remanufactured products may help the OEM compete for more price sensitive consumers, who would otherwise be interested in demanding low price original products from other OEMs. Furthermore, the authors state that *"remanufacturing is more beneficial under competition than under monopoly even in the absence of the green segment"* (price sensitive consumers). Debo et al. (2005) suggest that manufacturers that also have remanufacturing operations may benefit from managing both new and remanufactured products. They propose the idea of selling new products below unit costs in order to generate a supply of remanufactured products, on which the profit is made. Additionally, from these authors' point of view *"a decrease in the unit remanufacturing cost may lead to an increase in the new product sales volume, to supply remanufactured products in response to increased demand for them"*. In the same vein, Majumder and Groenevelt (2001) study price competition between an OEM and a local remanufacturer (third-party remanufacturer, 3PR), and the effect of different strategies on the competitive prices and quantities in the market, as well as the players' profits. From a methodological point of view, this can be considered as a quantitative sub-topic which has been mainly analysed by using optimization techniques and game theory approaches. Maybe, other methodological approaches closer to the business perspective (case studies, lab experiments) could be a right complement to the classical operational research methods used in these studies. Recent research papers related to this topic are considering new elements of interest for future research in this sub-topic, such as how the product quality level and the benefits of remanufacturing depend on the party (OEM or 3PR) doing the remanufacturing (Örsdemir et al. 2014); or which mode of cooperation between OEM and 3PR, outsourcing or authorisation, is the most appropriate (Zhou et al. 2016).

4.2. Cannibalization

In the context of the CLSC, "*cannibalization"* occurs when the purchase of a remanufactured product displaces the sale of an original product (Atasu et al. 2010). According to Guide and Li (2010), many sales managers are reluctant to introduce remanufactured products because they fear that original product sales can be cannibalized by remanufactured products. Actually, cannibalization has been considered as one of the main concerns of marketing and sales managers to implement remanufacturing activities. However, there is little real knowledge about the effects of cannibalization on the marketing activities and many times all the managers' concerns are based on personal experience or conventional wisdom, rather than on empirical evidence (Atasu et al. 2010; Guide and Li 2010). In this sense, Atasu et al. (2010) point out that remanufacturing does not always cannibalize original product sales and if so, the additional profits of

remanufacturing can overweight the cannibalization costs. For that reason, these authors remark that several important aspects, such as composition of the market (types of consumer segments: functionality-oriented, newness-conscious and green consumers), the proper use of the price strategies, the competition, and the supply of remanufacturable products over the product life cycle, must be perfectly understood. For this same issue, Guide and Li (2010) use a novel procedure in order to determine the consumers' WTP for remanufactured products and, at the same time, to assess the effect of cannibalization of new product sales. Specifically, they performed an analysis of online auctions for a particular category of products (power tools) intended for both Business-to-Consumer (B2C) market and Business-to-Business (B2B) market, and they found that the risk of cannibalization was minimal in the B2C market, while in the second case (B2B market), there was an evidence of potential cannibalization. These novel approaches based on lab experiments are welcomed, because more empirical research is needed (Souza 2013). This sub-topic of research is usually focused on the analysis of one particular product, so further research should continue to explore the effects of cannibalization for other products in both consumer and commercial settings (Guide and Li 2010).

4.3. The purchase intention for remanufactured products

A third set of contributions in this issue are those focused on the *"purchase intention"* of remanufactured products, and particularly on the purchase intention of consumers of remanufactured products (Wang et al. 2013; Jiménez-Parra et al. 2014; Gaur et al. 2015). Wang et al. (2013) develop a research model that examines the purchase intention of remanufactured automobile spare parts in China, describing how perceived risk, product knowledge and perceived benefits would affect consumers' attitude and intention towards remanufactured products. They employ a model based on the Theory of Planned Behaviour (Ajzen 1985, Ajzen 1991) to explore the influence of attitude, subjective norm and perceived behavioural control on the purchase intention of remanufactured products. In addition, the model also includes perceived risk, product knowledge and perceived benefit as explanatory variables for purchase attitude and intention. As main results of that research, it can be highlighted that purchase intention is mostly influenced by purchase attitude and there exists a negative correlation between product knowledge and purchase intention, so the more consumers understand remanufacturing processes the less likely they are to purchase remanufactured products. This last surprising finding is explained by Wang et al. (2013) by using the argument that consumers do not trust the remanufacturing process and so they do not perceive the quality equivalent between remanufactured products and original ones. Jiménez-Parra et al. (2014) conduct a research aimed at describing the purchase intention of consumers of remanufactured laptops in Spain, by using a model also based on the Theory of Planned Behaviour. They consider that purchase intention can be influenced by four variables namely attitude towards the purchasing, subjective norm, motivations, and marketing mix variables. Similarly to Wang et al. (2013), they find that a favourable attitude towards remanufactured products positively influences the purchase intention, so it could be assumed that there exists a segment of consumers who are favourably inclined to buying remanufactured products –in that case, remanufactured laptops– and that promotional actions of firms in the sector clearly should be directed at them. Moreover, this study shows that motivations play a significant positive role in the purchase intention. Overall, the respondents showed that price and environmental issues constitute positive motivations for their intention to purchase a remanufactured laptop, as it has also been noted in other studies (Guide and Van Wassenhove 2001; Atasu et al. 2010; Agrawal V V et al. 2015). Regarding marketing issue, Jiménez-Parra et al. (2014) point out: *"OEMs and remanufacturers could orient their marketing policies towards actions aimed at identifying consumers with a more favourable attitude towards these products. Their marketing campaigns could be directed not only at these consumers themselves but also at their closest social circles, which we have found to be an important referent in the intention to purchase"*. In their study, Gaur et al. (2015) analyse the most relevant drivers of consumer purchase intentions for remanufactured products to the India-born consumers residing in the USA, in order to confirm if being relocated to a society where remanufactured products are fostered can change consumer's perceptions towards them. To this end, the authors develop an active diagram in which the decision-making process of consumers' purchase intentions for remanufactured products is showed. The results suggest that personal factors (i.e., attitudes and beliefs, individual personality and environmental consciousness) have a positive influence on the consumers' decision making and purchase intentions. Furthermore, the findings confirm that contextual factors (i.e., societal norms, price, promotion activities, service quality and brand image) are relevant drivers of consumer behaviour as well. Societal norms, price and service quality have a positive influence on purchase

intention for remanufactured products. Additionally, in the same way that in Subramanian and Subramanyam (2012), the authors find that the brand image of the OEM, significantly affect the consumer purchase intention. In this sense, respondents of the Gaur et al.'s study claimed that *"if a good brand offers a remanufactured product, then they would purchase those without any hesitation"*. And, similarly to Atasu et al. (2010) and Jiménez-Parra et al. (2014), Gaur et al. (2015) emphasize the importance of promotion activities to enhance consumer WTP remanufactured products and point out the existence of different consumer segments ("green consumers" and "functional conscious consumers") interested in demanding these kinds of products, because they value them equally than original (new) ones. This set of papers is characterised by the use of methodologies and techniques not usual in the context of the research on reverse logistics, such as structural equation models and surveys. Although all these papers make a valuable contribution to this sub-topic of research, some aspects should be considered in the future. We must mention the need to describe the characteristics of the purchase intention in a more general way, and not only for a very specific remanufactured product (laptops, automobile spare parts). In this sense, studies focused on describing the purchase intention of consumers in a wider segment of the market (for example, not just laptops but electronic products) would be welcomed. Moreover, the use of student samples (Jiménez-Parra et al. 2014; Gaur et al. 2015) is arguable, and can be considered as a serious limitation of this kind of studies. Actually, some journals discourage this type of submissions (Bello et al. 2009).

4.4. The willingness to pay for remanufactured products

Remanufactured products are usually considered as products to be aimed at a segment of consumers with lower WTP, since they value remanufactured products lower than original ones, likely because of the quality perceptions that consumers have about them (Hazen et al. 2012). Consumers' perceptions and *"WTP"* for remanufactured products is an inevitable question when studying product acquisition, remanufacturing, and market competition (Guide and Li 2010). Therefore, this is a relevant issue in the research on CLSC from this *"demand side"*. Michaud and Llerena (2011) use experimental auctions to describe consumers' WTP for remanufactured products, finding evidence that consumers tend to value the remanufactured product (in this case, a single-use camera) less than the original one, unless they are informed about their respective environmental impacts. Moreover, the results suggest that these consumers are not willing to pay a premium for the remanufactured product as can be observed for other kinds of products (organic foods, for example). Ovchinnikov (2011) describes how a company makes remanufacturing decisions and provides a study of consumer behaviour based on an estimation of the fraction of consumers that, for a given price difference, would switch from the new to remanufactured product. Some remarkable findings of this paper are that consumers would be more willing to pay for remanufactured products if they had a clear information about terminology used in this market (refurbished, returned, rebuilt, remanufactured, etc.) and about product's history (why was it returned, when, where?). Because of this absence of information, consumers tend to use price as a way to judge product quality, so a low price would be indicating a low product quality, and only a few consumers switch from new to remanufactured product. Essoussi and Linton (2010) analyse the consumers' WTP for recycled products considering seven different types of products (paper, single use cameras, toner cartridges, tyres, auto parts, cell phones, and printers), as well as the switching behaviour of consumers from recycled to new products due to price differences. These authors find that consumers' WTP premium price for recycled products is product specific and there exists a tremendous variation in both relative price and switching range for different types of products. For example, in this case, consumers were more willing to pay premium prices for recycled paper and single use cameras than for toner, cell phones and auto parts. Research papers included in this sub-topic employ methodologies usual in the areas of management and marketing such as surveys, focus group or conjoint analysis. Differences found in the WTP for different products lead us to suggest that more research is needed in order to understand the consumer behaviour of remanufactured products across industries. In addition, issues such as information about recovered products (recycled and remanufactured), the effects of branding and the image of OEM and 3PR on WTP could be elements to consider for further research.

4.5. Consumer perceptions of remanufactured products

Hazen et al. (2012), Subramanian and Subramanyam (2012), Agrawal V V et al. (2015), and Wang and Hazen (2015) discuss about different aspects of the "*consumer perceptions of remanufactured products"*. For example, in their study, Hazen et al. (2012) conclude that ambiguity inherent in the remanufacturing process (overall age of the product, components used, quality levels, performance, etc.) provokes a consumers' perception of lower quality and reduces their WTP for these items. In a similar way, Subramanian and Subramanyam (2012) evaluate several factors that can explain purchase price differentials between new and remanufactured products, and find evidence that seller reputation and the remanufacturer identity can contribute to reduce the uncertainty about the quality of remanufactured products. Based on a previous research (Wang et al. 2013), Wang and Hazen (2015) further develop the consumer perceptions of remanufactured products. They build a model rooted in Prospect Theory (Kahneman and Tversky 1979; Tversky and Kahneman 1992) in order to analyse how consumer knowledge of remanufactured products – in terms of cost, quality and green attributes– affects Chinese consumers' perception of both risk and value associated with the purchase of these types of products (in this case, remanufactured automobile spare parts). The results confirm that knowledge about product quality has the most effect on consumers' perceptions (risk and value) of remanufactured products. As noted in previous studies (see for example, Michaud and Llerena 2011, Ovchinnikov 2011), *quality* is an important product attribute that consumers bear in mind when they make buying decisions, so they could even reject the remanufactured product if they hesitate about its quality level. In the same vein, both *cost knowledge* and *green knowledge* have significant impacts on consumers' perceptions of remanufactured products so, as Wang et al. (2013) and Jiménez-Parra et al. (2014) suggest, the authors recommend OEMs developing marketing strategies focused on those attributes (lower price and "environmentally friendly") which are the most important ones to consumer segments willing to buy remanufactured products. Conversely, in their study, Agrawal V V et al. (2015) investigate how remanufactured products (i.e., consumer's perceptions of these products) and the identity of the remanufacturer (OEM or 3PR) can influence the perceived value of an OEM's new product, by using behavioural experiments. According to the main results, the authors suggest that remanufactured products by the OEM may reduce the perceived value of new products and remanufactured products by the 3PR may increase the perceived value of new products. In line with previous comments, for this sub-topic more research is required to examine how the effects of information, knowledge, and the identity of the remanufacturer (OEM vs 3PR) influence the consumer perceptions across different brands, product categories, and markets.

Table 3. Reverse logistics from a demand perspective

TOPIC	AUTHOR/S	DESIGN-METHODOLOGY-APPROACH	RESULTS-INSIGHTS	OPPORTUNITIES FOR FURTHER RESEARCH
COMPETITION	Majumder and Groenevelt (2001)	Game Theory	Behaviour of OEMs when faced with competition from local remanufacturers	• Quality level of remanufactured products • Different cooperation modes between remanufacturing competitors • More qualitative methodologies
	Debo et al. (2005)	Dynamic Optimization	Address the integrated market segmentation and production technology choice problem in a remanufacturing setting	
	Atasu et al. (2008)	Optimization	Competition, market growth, and the proportion of the green segment have a significant direct impact on the remanufacturing decision	
CANNIBALIZATION	Atasu et al. (2010)	Research Paper (Qualitative)	Remanufacturing does not always cannibalize original product sales. Remanufacturing can create additional value to OEMs	• Effects of cannibalization on consumer products • Effects of cannibalization on commercial products • Empirical research

Table 3. (Continued) Literature on CLSC from a marketing perspective

TOPIC	AUTHOR/S	DESIGN-METHODOLOGY-APPROACH	RESULTS-INSIGHTS	OPPORTUNITIES FOR FURTHER RESEARCH
CANNIBALIZATION	Guide and Li (2010)	Experimental Lab- Field Auctions	Explore the potential for market cannibalization of original product sales by remanufactured versions	
PURCHASE INTENTION	Wang et al. (2013)	Structural Equation Model	Purchase intention of consumers of remanufactured automobile spare parts	• To explore the purchase intention of consumers in a wider market segment • Studies based on representative samples of consumers.
	Jiménez-Parra et al. (2014)	Structural Equation Model	Purchase intention of consumers of remanufactured laptops	
	Gaur et al. (2015)	Grounded Theory (Qualitative)	Purchase intention of consumers of remanufactured products who have been relocated to a society where remanufactured products are promoted	
WILLINGNESS TO PAY (WTP)	Essoussi and Linton (2010)	Survey	Consumers' WTP premium price for recycled products is product specific and perceived functional risk appears to have a statistically significant impact on consumer purchase decisions	• To explore the WTP in different products and industries, in order to a better understanding of the different results observed • Analysis of information as a determinant of the WTP • The role of branding and OEM image
	Michaud and Llerena (2011)	Experimental Auctions	Consumers tend to value the remanufactured product less than the conventional. No evidence that consumers are willing to pay a premium for the remanufactured (green) product. Information as a key factor for marketing strategy	
	Ovchinnikov (2011)	Focus Group. Conjoint Analysis. Survey	Consumers would be more willing to pay for remanufactured products if they had a clear information about terminology used in this market and about product's history	
CONSUMER PERCEPTIONS OF REMANUFACTURED PRODUCTS	Hazen et al. (2012)	Structural Equation Model	Ambiguity inherent in the remanufacturing process provokes consumers' perception of poorer quality and reduces their willingness to buy remanufactured items	• To explore the effects of information and consumer knowledge across different brand, product categories and markets.
	Subramanian and Subramanyam (2012)	Regression Analysis	Seller reputation and remanufacturer identity are key factors on quality perception of consumers of remanufactured products	

Table 3. (Continued) Literature on CLSC from a marketing perspective

TOPIC	AUTHOR/S	DESIGN-METHODOLOGY-APPROACH	RESULTS-INSIGHTS	OPPORTUNITIES FOR FURTHER RESEARCH
CONSUMER PERCEPTIONS OF REMANUFACTURED PRODUCTS	Wang and Hazen (2015)	Structural Equation Model	Influence of consumer knowledge (quality, cost and green attribute) of remanufactured products on perceived value and perceived risk associated with purchase decisions	• To explore the influence of OEM vs 3PR remanufactured products on the consumer perception across different products and markets.
	Agrawal V V et al. (2015)	Behavioural Experiments	The perceived value of remanufactured products and the identity of the remanufacturer can influence the perceived value of new products	

Although they may seem many references on this topic, certainly they are just a very little percentage over the total of published work on CLSC, in spite of the fact that some of the most cited authors in this area are claiming for more research in issues as consumer behaviour and the market for remanufactured products (Guide and Van Wassenhove 2009; Atasu et al. 2010; Souza 2013).

Of course, there are still many issues to be analysed –for example, those relating to the potential commercial activities and marketing policies that firms might implement according to the purchasing preferences showed by respondents. Nevertheless, this investigation should be considered as a first step in this process of connecting Marketing with Reverse Logistics, in what we trust will be a fruitful relationship.

Conclusions

Reverse logistics is a research topic that has evolved during the last two decades but, at the present time, it can be considered as a well consolidated topic of research, with hundreds of papers published since 1995 in the most prestigious scientific journals. Reverse logistics is not only an interesting issue for researchers, but also for companies and professionals who are considering the recovery of EoU products as a business opportunity, so they are taking into account these activities in their strategic processes of decision making.

Reverse logistics has several implications for the SCM but, probably, the most challenging is related to the design of the RLN. For this reason, a description of the basic activities related to the design process has been examined: collection, inspection, and recovery process. In spite of the relevance of the literature about the design of RLNs, new lines of research are still open.

The interest of academia and professionals about activities related to CLSC, reverse logistics, and remanufacturing has provided a better understanding of the characteristics, the processes and the implications that the recovery of EoU and EoL products have on the business activity. In spite of this fact, there are some concerns that require our attention; for example, those related to the strategic aspects of the CLSC, and particularly those issues related to the potential commercial activities and marketing policies that firms could establish. In this sense, a review of the literature reverse logistics from a "demand side" was conducted in order to highlight new opportunities for research in this field. Issues regarding competition in the remanufactured markets, cannibalization, purchase intention of remanufactured products, WTP for them, and consumer perceptions of remanufactured products have been investigated in the last years. However, there still exist relevant questions and issues about the relationships between reverse logistics and the markets that need to be analysed. Quoting Souza (2013, p. 31) 'Research in consumer behavior and the market for remanufactured products is nascent, so a more comprehensive understanding of the market for remanufactured products is needed across different industries'.

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