

# Uncertain Supply Chain Management

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## Reverse Logistics: Design implications on the basis of product types sharing identical supply chain member motivations

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**ABSTRACT**

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Reverse logistics plays a very critical role in the overall strategy of a business and hence need to be very effective in meeting its objectives. Studies have come up with various insights to optimize reverse logistics arrangements within a specific industry or a sector, but presently there is no study which provides an approach to share knowledge drawn out of reverse logistics arrangements, across dissimilar industries and sectors. Such a study is significant because the response to a reverse logistics arrangement is not uniform in an industry or sector in all the countries, due to different market maturity levels, dissimilar consumer behaviour, and the state of the economy itself. Therefore, the purpose of this paper is to provide a guide for logistics planners through which they can utilize the learning outcomes that emerge from dissimilar industries or sectors within the same economy also. The research findings show that the reverse logistics arrangements can be categorised into various types on the basis of origin and reason for return. It is shown that the products with dissimilar characteristics can be grouped together into six types depending on the common supply chain member interests. Further, the reverse logistics arrangements change from one type to another as a product moves across its life stages. It highlights an approach using which the knowledge drawn from a reverse logistics type in one sector/industry can be applied to the same type in another sector/industry, by focusing on the product types, whose return share similar supply chain member interests. Logistics network planners can apply the insights that have emerged from this analysis to effectively design reverse logistics channels.

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## 1. Introduction

With the businesses spanning across the national boundaries and easy availability of information about product features, making a statement that companies compete only in the downstream segments of a supply chain would be partially true, because now the capabilities across the supply chain have to compete for achieving sustainability and competitive advantage. One such segment of a supply chain is returns management, which caters to returns, reverse logistics, gate keeping and avoidance (Rogers

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et al., 2002). Reverse logistics forms an important component of a business's strategic planning because it has cost implications for various members in the supply chain (Daugherty et al., 2005). Reverse logistics is not only critical for obtaining efficiencies on the supply side, but also on the demand side. It can shape a customer's purchase behaviour and decision. Therefore it has become a competitive necessity (Stock et al., 2006) and helps to develop a comparative advantage which further provides a plus point in market (Hunt, 2000).

Logistics industry has undergone various transformational processes in terms of complexity and scope (Fulconis, 2007). Furthermore, for making reverse logistics programs more effective and efficient, resource commitment is imperative. So the available resources need to be deployed in a manner, which leads to the advent of innovative capabilities (Richey, 2005). Therefore, various strategic and operational factors are considered to achieve such capabilities from a reverse logistics channel (Dowlatshahi, 2000). Many studies have considered the factors and drivers influencing a reverse logistics channel for various sectors. Also, attributes like profitability, brand recognition and customer relationship building have been analysed while suggesting frameworks for reverse logistics. In this paper we are providing an approach to share the learning drawn out of reverse logistics arrangements, across dissimilar industries and sectors. In the next section, we present the research questions that are considered for this study and are followed by the analysis on each of these research questions. The final section contains the conclusion and the applications of the findings.

## **2. Literature review**

The concept of reverse logistics has been acutely considered to deal with environmental concerns and in turn to protect the environment degradation by reducing the end waste (Ho et al., 2012). Companies today have come up with various methods to deal with these issues. In catalogue retailing, companies have adopted reverse logistics to recover the otherwise lost assets and deal with product returns in a more efficient manner (Autry et al., 2000). Management dimensions like operational performance, organisational integration and management reporting and control were found to have significant influence in managing retail reverse logistics (Bernon et al., 2011). Further, organizational integration achieved through collaborative initiatives among members in the apparel after market was also found to deliver the increased market knowledge, predictability and better margins as its benefits from a reverse logistics arrangement (Abraham, 2011). On one side (as it emerged from the analysis of automobile aftermarket) intangible aspects like trust and relationship commitment were found to have significant impact on the success of reverse logistics (Daugherty et al., 2003) and on another side (from the analysis of publishing industry in China, Hong Kong, and Taiwan) tangible aspects like the maturity of the logistics sector decides if it is advisable to process the returned goods or discard them directly (Wu et al., 2006). Above analysis highlights the fact that different business settings require different reverse logistics programs and hence there exists a scope to analyze this diversity on the basis of the underlying needs. Moreover the response of a reverse logistics channel is not uniform across all the countries because of different market maturity levels and the state of the economy itself. Therefore replicating a reverse logistics for a particular sector in a country by analyzing it in another is not always the best way forward. There must exist a provision to study and share the learning for a reverse logistics channel from within the same economy. Such cross sector sharing reflects from the analysis for the pharmaceutical industry that traceability as a capability can be leveraged by other sectors, which need to develop similar potential (Kumar et al., 2009). Furthermore, all the existing researches have studied the reverse logistics on the basis of, either the order fulfillment channels deployed or a sector in which a company operate. None of the studies has attempted to differentiate the reverse logistics types on the basis of origin of returns and reason for these returns. The analysis present further in this paper tries to build in this direction.

Decision making for a reverse logistics channel need to be supplied with the details about the quantity of returns expected and profitability from the corresponding value recovery activities required

(Srivastava, 2008). The feasibility of a reverse logistic network from economic and sustainability perspective have been studied for various product categories and the relationship between a Product's Residual Value (PRV) has been considered vis-a-vis recovery options. It was found that low PRV is associated with second-class recovery options (recycling and energy recovery) and high PRV with first-class recovery options (reconditioning and remarketing). Time of recovery is not relevant in the former condition, but holds a significant relevance in the later condition. Accordingly PRV and recovery options were analysed as prerequisites for designing reverse logistics channels (Gobbi, 2011). The main drivers for establishing a reverse logistics channel are strengthening company's brand image (Guide et al., 2000), marketing benefits, erasing product's poor environmental/green image (Fishbein, 1998), customer service (Kapetanopoulou et al., 2011; Linton et al., 2000), regulatory pressure to comply with policies/legislation, and gaining competitive edge (Carter and Ellram, 1998). Further, major factors influencing industries in implementing reverse logistics channels were examined and classified under internal and external categories, respectively (Ho et al., 2012). In separate studies, various barriers to the successful development of reverse logistics have been studied; where, complications in the normal logistics operation (Kapetanopoulou et al., 2011; Mollenkopf et al., 2007), and objection to change leading to the implementation of reverse logistics (Ravi and Shankar, 2005) surfaced out to be the important ones. Apparently it emerges that the drivers and barriers, which decide the specificities for a reverse logistics channel are different for each sector and industry. But is it correct to assume that the knowledge of the drivers and barriers alone can lead to an effective reverse logistics design? For example, Daugherty et al. (2003) have pointed out that the trust and commitment between producers and consumers play an important role in the effectiveness of reverse logistics activities. The study (Daugherty et al., 2003) pointed out that although producers may not trust their customers, but they keep proper cognizance of their interests as they need consumers; whereas producers on the other hand are not convinced that consumers care about their interests. So, there exists an immense need to determine the scenarios where interests of both producers and consumers are aligned in the reverse logistics arrangement. Therefore, product types can be categorised on the basis of producer and consumer expectations from reverse logistics channels, which can increase the level of reciprocity in the relationship. This is another dimension that is analyzed further in this paper.

Product life cycle has also been found playing a critical role in determining the reverse logistic strategy. Various challenges at different stages of a product life cycle make the reverse logistic arrangement a dynamic entity, which underscores the importance of making adjustments in a reverse logistics network (Tibben-Lembke, 2002). Reverse logistic capabilities have been gauged from the perspective of considering resource commitments and contractual obligations aspects, which have positive influence on reverse logistics capabilities. Factors like cost saving emerging out of such capabilities were analysed for determining a reverse logistics channel (Jack et al., 2010). Further, it has been observed that the reverse logistics arrangements vary from product to product and the average capacity utilization of various arrangements (like rework facility) vary from low in initial years to high in subsequent years (Srivastava, 2008). Looking at the product life cycle of any product we can understand the kind of logistics changes that are required (Tibben-Lembke, 2002) and that return flow arrangements need to be modified with time (Toktay et al., 2004). Therefore, we must try to understand, how the reverse logistics type modifies over the life cycle of a product (i.e. reverse logistic life cycle of a product) during which the interests of both producer and consumer change.

Thus, the current research seeks to develop on the above exploration and focuses on the following research questions:

RQ1. What are the various types of reverse logistics channels on the basis of 'origin of return' and the 'reason for return'?

RQ2. Can products be categorised on the basis of producer and consumer expectations from reverse logistics arrangements?

RQ3. How reverse logistics change along with the changing producer and consumer expectations over the product life cycle?

The methodology used in this research paper is qualitative in nature. Review of existing literature and secondary data is used to analyse the research questions and draw inferences for them. As part of the research, major manufacturing processes for various sectors are studied, to understand the possible 'origin of returns' in a supply chain. Also, the channel partnerships formed by major companies in each sector are analysed to arrive at the 'reasons for return' faced by these channel partners and how these reasons vary over the life cycle of a product. Further, a meta-analysis is done by considering the existing researches in the area of business analysis and consumer behaviour. This relates to the producer and consumer expectations from a reverse logistics arrangements, which is used to develop the different product categories. Additionally, the dominating factors demarcating various major consumer economies are studied to understand the specificities that businesses face in these economies and what measures companies have taken to sustain their businesses; which has helped to arrive at inter-economy dissimilarities between a company's reverse logistics strategies and likewise the intra-economy similarities between the reverse logistics strategies of companies in dissimilar sectors. The research has also considered the return management process of various companies operating across the globe and in various sectors.

### **3. Various types of reverse logistics channels**

Companies today have implemented supply chains which span across borders and time zones, and ensure the following objectives: reliability, traceability, protection from counterfeiting & theft, market reach, rapid response, etc. Return management is an equally critical component of a supply chain and has increasingly been recognized as affecting the competitive positioning of any company. Therefore companies form strategic goals and draft policies considering the reverse logistics channel during their business plan (Mollenkopf et al., 2007). Each reverse logistics arrangement meets a different business objective and accordingly the reverse logistics channels can be differentiated on the basis of underlying objective.

Various researchers have analyzed that reverse logistics performance and satisfaction have relationship with reverse logistics service and are influenced by industry, market size, firm size, sales volume, and logistics arrangements. Reverse logistics arrangements are industry and customer specific as they have to overcome challenges having specific operating characteristics (Autry et al., 2001; Marien, 1998; Blumberg, 1999). Specific analysis have been done to arrive at multiple frameworks, barriers, network designs, and improvements in reverse logistics for various industries (Daugherty et al., 2003; Wu et al., 2006; Chan et al., 2008, Kumar et al., 2009; Lau et al., 2009, Kapetanopoulou et al., 2011; Abraham, 2011). Multiple parties constitute a logistics setup, but each party has its distinguished concerns while operating to meet the overall business objective. So, for analyzing a reverse logistics arrangement the origin of return corresponds to the position of a particular member in the return channel and is driven by reasons which are specific to the operational viability of that particular member. Furthermore, origin and reasons for return provide specific characteristics to a reverse logistics network. On similar lines, figure-1 highlights various types of reverse logistics channels depending upon the origin of return and reason for return (Table 1 provides summary for figure 1). The origin of return is also a vital aspect in understanding the reverse logistics complexities because the issues faced by the member initiating the return are different from the perspective of the members involved in forward flow (Tibben-Lembke & Rogers, 2002). These two attributes, on one hand help to appreciate the existence of different types of reverse logistics networks within a sector and on the other hand, highlights the presence of similar reverse logistics network across different sectors.

**Table 1**

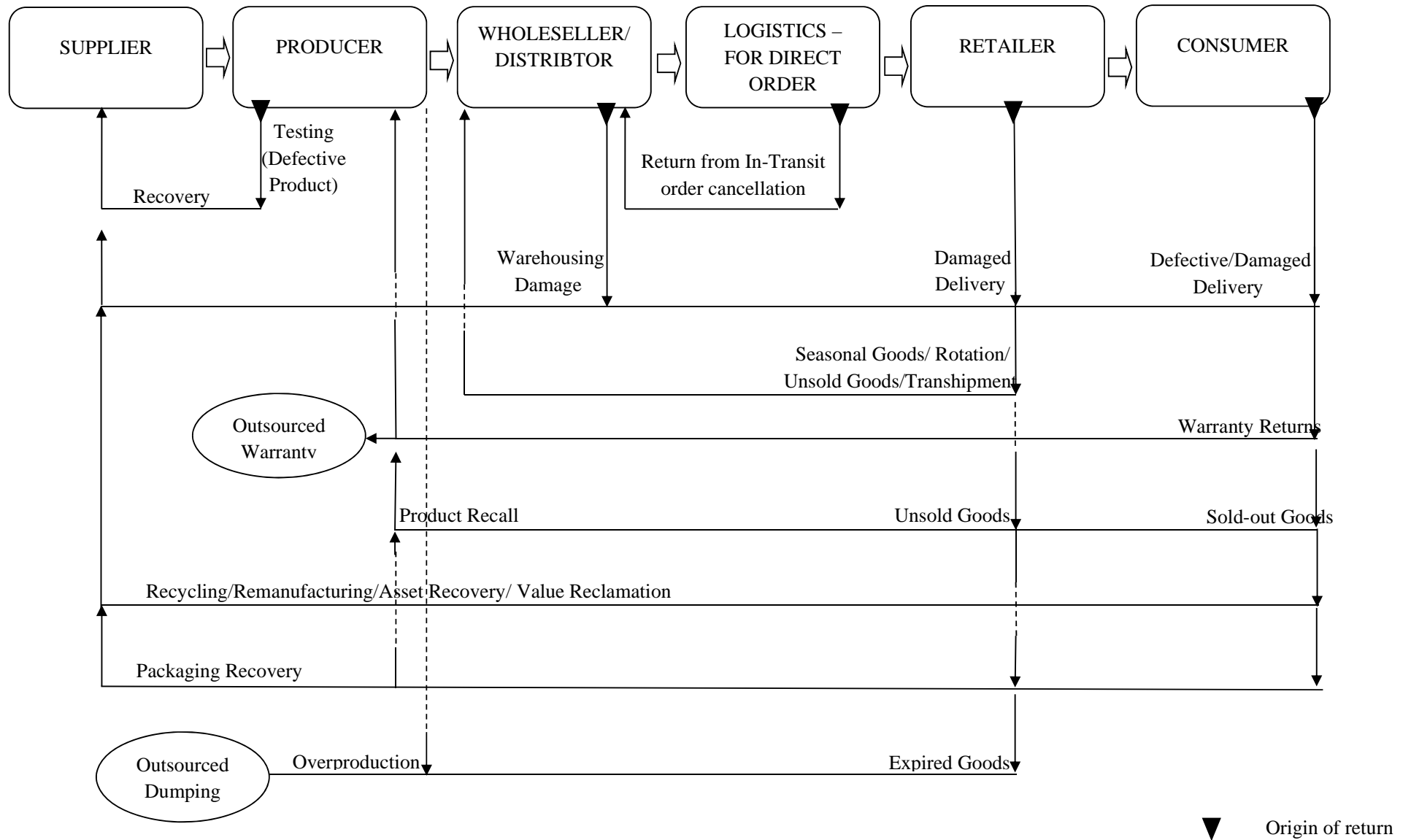
Summary: Types of Reverse logistics channels depending upon the origin of return and reason for return

Type of Reverse Logistics (Span)	Origin of Return	Reason for return	References
Producer - Supplier	Producer	Recovery/Production waste management	(Sarkis et al., 2004), (Moczygemba and Smaka-Kincl, 2007), (Basaran, 2013)
Logistics – Wholesaler/Distributor	Logistics	In-transit order cancellation	(Smith, 2005)
[Consumer, Retailer, Wholesaler/Distributor] - Supplier	[Consumer, Retailer, Wholesaler/Distributor]	Un-acceptance by downstream members	(Autry et al., 2001), (Potdar and Rogers, 2012)
Retailer – Wholesaler/Distributor	Retailer	Resistance to stock Unsold goods	(Lonn et al., 2003), (Boronico and Bland, 1997), (Donnelly et al., 2012)
Consumer - Producer	Consumer	Warranty returns	(Autry et al., 2001), (Teng et al., 2005)
[Consumer, Retailer] - Producer	Consumer, Retailer	Product recall	(Autry et al., 2001), (O'Rourke IV, 2006), (Souiden and Pons, 2009), (Donnelly et al., 2012)
[Consumer, Retailer] – [Producer, Supplier]	Consumer, Retailer	Cost optimization	(Autry et al., 2001), (Breen, 2006), (Srivastava, 2008), (Gobbi, 2011)
[Consumer, Retailer] – [Producer, Supplier]	Consumer, Retailer	Regulatory/Policy pressure	(Wu et al., 1995), (Prendergast, 1995), (Sarkis et al., 2004)
[Retailer, Producer] – Dumping Firm	Retailer, Producer	Regulatory/Policy pressure	(Wu et al., 1995), (Sarkis et al., 2004), (Chandrashekar and Dougless, 1996), (Moczygemba and Smaka-Kincl, 2007), (Kumar et al., 2009)

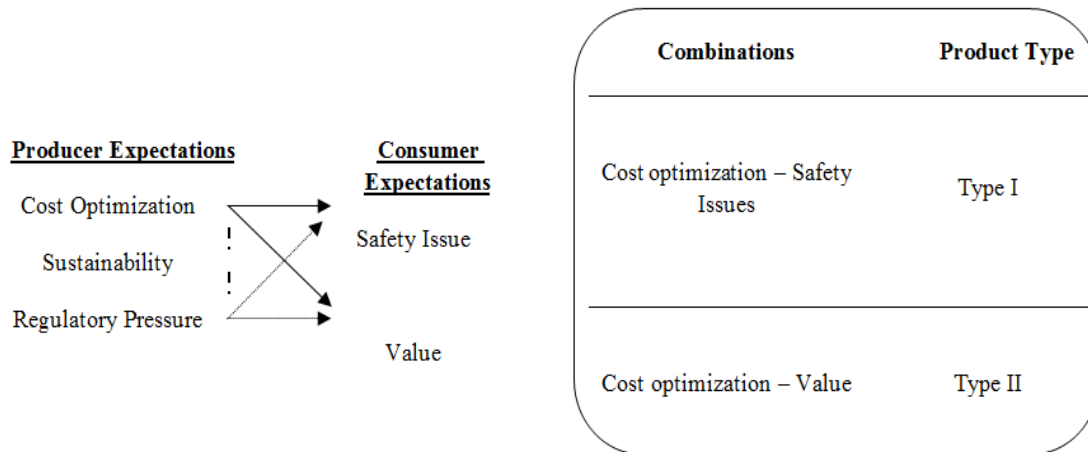
Therefore similar reverse logistics network structures across sectors can be looked into to reach for the characteristics, which are specific to a particular market/country and can be used to reach for relevant insights.

#### 4. Categorizing product types on the basis of producer and consumer expectations from reverse logistics

The reverse logistics activities can help producers to reduce the warranty cost by aiming at effective classification of warranty returns and to find the responsible party in a supply chain which has caused the problem (Teng et al., 2005). Increased profitability is another aspect, which value recovery activities can achieve if the quantity of returns crosses a certain quantity (Srivastav, 2008). Resource commitments and contractual obligations have positive influence on reverse logistics capabilities, which can lead to cost savings (Jack et al., 2010). Environmental aspects were also recognized as an important force shaping the economy and contemporary business practices (Murphy and Poist, 2003) and form a vital constituent of corporate social responsibility, which further provides a competitive advantage (Defee et al., 2009). Further, from the analysis surrounding the drivers and benefits for each of the member involved in the supply chain, we can broadly group a producer's expectations from a reverse logistics channel into the following three categories (a) Cost Optimization - residual value, asset recovery, reducing liability; (b) Sustainability - environmental consideration, increasing customer loyalty, increasing brand image, customer satisfaction, warranty/service, product recall; (c) Regulatory Obligation - waste management, safe disposal. Similarly, consumer's expectations from a reverse logistics channel can be grouped into the following two categories (a) Safety Issues - product recall, defective product replacement, warranty return, safe disposal; (b) Value Salvation - profitable disposal. Both producer and consumer expectations have been depicted in the figure 2, along with the various product types under which a product can be classified depending on these expectations from the reverse logistics channel supporting that product.



**Fig. 1.** Types of “Reverse logistics channels” depending upon the origin of return and reason for return



**Fig. 2.** Product types on the basis of Producer and Consumer expectations from reverse logistics

**Product Type I** – For cost optimization a producer expects to, either reduce his liabilities or harvest residual value from the goods returned. Liabilities may arise on account of warranties promised or supplying defective goods to the end consumer. Cost optimization for warranty returns is obtained by planning appropriately where measures like outsourced repairs are often considered, and for avoiding the costs associated with a recall on account of a defective product the recall burden constitutes recall-insurance, employee training, labour expense, communication and public relations, etc and is influenced by attributes like scale, type and scope of recall.

On the other hand the consumer expects safety from the product usage. A safety hazard can be on account of the product's functioning, potential threat due to un-warned usage scenario, toxicity of components used, etc. A consumer will either seek a warranty repair or defect fixation via a product recall. In either of the case the product goes back to the consumer in the end and consumer expects assurance and removal of any further safety issues. Also, there exists another possibility where the consumer simply wants to dispose the product at its end of life so as to avoid contaminating the environment and seeks support from the producer.

A newly introduced product like Toyota vehicles (<http://www.forbes.com>), which may get recalled due to certain unresolved issues; or a well established product bought by a customer falling within a warranty period qualifies for Type I. Also, drop-off facilities for the disposal of household hazardous waste managed by a third party like a government agency (CalRecycle- California's Department of Resources Recycling and Recovery, <http://www.calrecycle.ca.gov>; Hamilton County Recycling and Solid Waste District, <http://hamiltoncountycle.org>), which can later supply the salvaged material back to producers can also be considered for Type I. In this category, mostly the last mile recovery (LMR) is supported by the consumer himself.

**Product Type II-** In this type a consumer is not only interested in disposing the product but also expects a fair payment for the returned good, because in these scenarios the usage of the product may have ended but the value held in the product on account of material is clearly visible. For example, old brass wares, apparels with silver or gold threads like old zari sarees, etc, which can lead to establishing of resale markets as part of reverse logistics arrangements (<http://forbesindia.com>, <http://articles.economictimes.indiatimes.com>).

**Product Type III-** The ultimate objective of a producer may not always be cost optimization but sustenance of the business via eco marketing. Therefore even by bearing some extra cost a producer may want to avoid losing customer goodwill, damage to brand and reputation. These efforts pay in long term by winning customers trust and loyalty, which helps to generate repeat business and positive recommendations from the existing customers. Ben & Jerry's "Lick Global Warming" campaign falls under Type III (<http://www.washingtonpost.com>, <http://www.canadapost.ca>, <http://www.lickglobalwarming.org>).

**Product Type IV-** Producer may not achieve cost efficiency but is ready to pay consumer for disposing off with their old product either to entice them into buying a new product or to build brand name. Such expectations on producer's side coupled with consumer's interest in receiving some value in return lead to product-exchange-offers. In such arrangements the LMR cost is saved and quantity or return is insured. "HP Planet Partners Recycling Program" and "Nokia's Take-Back and recycling campaign" fall under Type IV (<http://www.hp.com>, <http://www.nokia.com>, <http://articles.economictimes.indiatimes.com>).

**Product Type V-** End consumers like educational institutes and laboratories using radioactive materials need a safe disposal provision and the supplier on the other hand is obligated by regulatory pressure to facilitate the disposal (<http://www.nrc.gov>, <http://www.epa.gov>). Fear of safety on part of consumers may also force a producer to arrange for product return arrangements (<http://edition.cnn.com>, <http://www.huffingtonpost.com>, <http://articles.economictimes.indiatimes.com>).

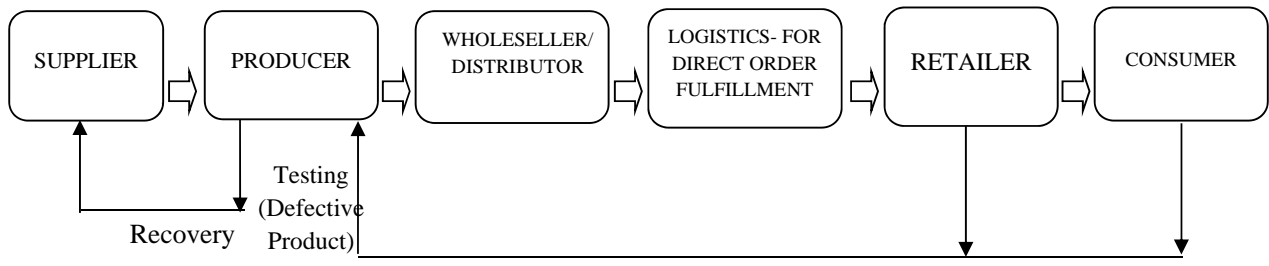
**Product Type VI-** The nuclear fuel cycle clearly demonstrates the Type VI products, where the disposal is a regulatory obligation for the producer and holds value for the consumer as they get enriched fuel at reduced price (<http://www.world-nuclear.org>).

## **5. Changes in reverse logistics along with changing producer and consumer expectations over the product life cycle**

From a particular product, expectations of a customer keep on changing as the product grew old, and also as the product matures in terms of number of buyers in the market and the options available from the competitors. Along with the change in customer's expectations the reverse logistics arrangement also needs to change, both for meeting customer's interests and the business objectives from producer's point of view. The impact on the reverse logistics arrangements because of a product life cycle depends on the following scenarios: if the products start representing a new class of product, a new form of an existing class, or a new model of an established product forms (Tibben-Lembke, 2002). Therefore the logistics life cycle needs to be considered in conjunction with a product life cycle (Ryan, 1990), which not only helps to sustain the business but also provides an ample time to plan for the corresponding rollouts, like bringing up changes in product costing methods by implementing life cycle costing, etc. Figure 3 explains how reverse logistics arrangement changes along with the changing producer and consumer expectations over the various phases in a life cycle of product. The explanation considers the life cycle of a laptop to demonstrate the relevant changes in the type of reverse logistics channels required according to the changing expectations of both producers and consumers.

a) During new product introduction - Initial Stage

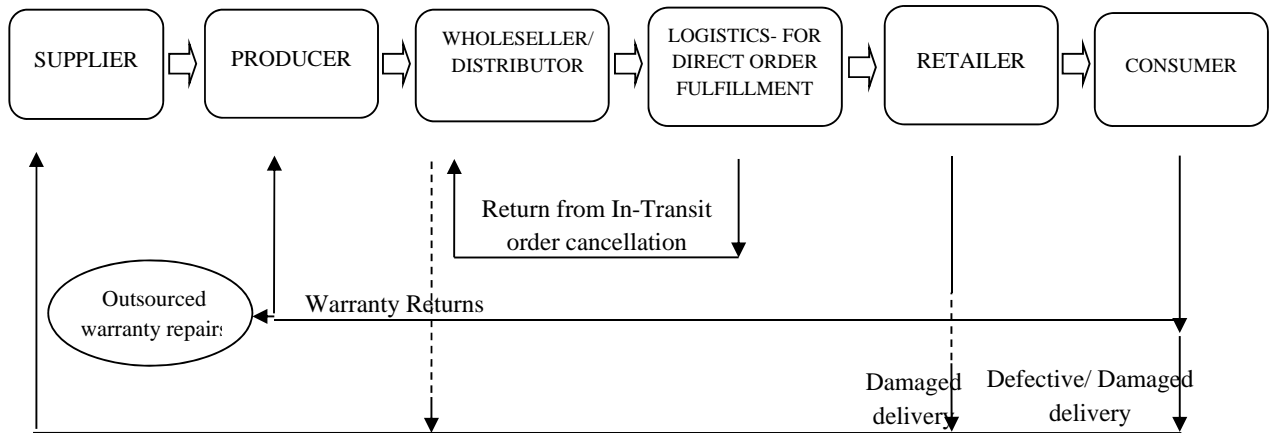




Product Recall

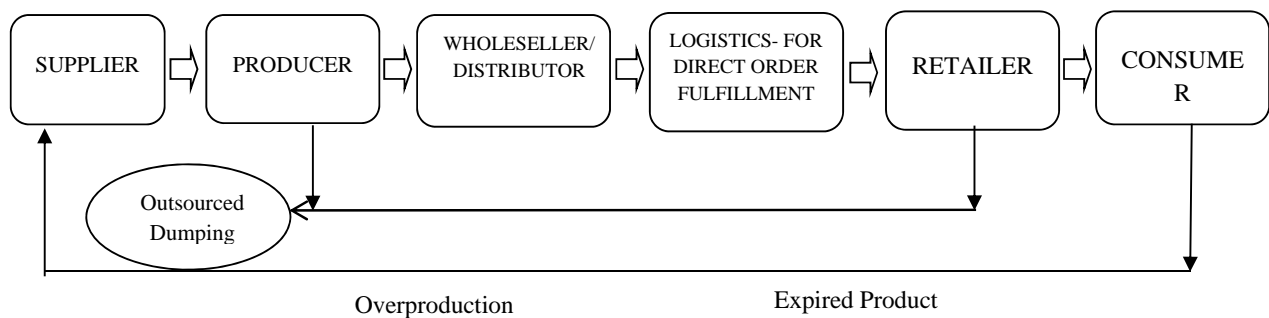
Classification of product types using expectations of both producer and consumer – **Type I & III**

- b) Till the product is pulled out of market (follows with a time lag from the day of introduction of a new product in the market) – Growth and Maturity Stage



Classification of product types using expectations of both producer and consumer – **Type I & III**

- c) Towards the product’s end of life – Decline Stage



Recycling/Remanufacturing/Asset Recovery/ Value Reclamation

Classification of product types using expectations of both producer and consumer – **Type II, V, & VI**

**Fig. 3.** Changes in reverse logistics along with the changing producer and consumer expectations over the product life cycle

**6. Conclusion**

A company is an integrated system inclined towards serving customers (Blois, 1992) and therefore must consider customer’s expectations from reverse logistics capabilities during the life cycle of a product. For meeting these objectives a producer must stay relevant by constantly evolving a reverse logistics channel. But for that an approach must exist, so that a producer can leverage on the insights

about customer's response to any changes to a reverse logistics channel. Moreover, such an approach becomes relevant because different markets/economies are at different maturity levels and have their own peculiarities, which hinders the exact replication of reverse logistics arrangements in different market/economy. Therefore, network designers need to first understand the type of reverse logistics channels that come into picture during the reverse logistics life cycle of a product on the basis of the point of origin of returns and the reasons for these returns. Subsequently, knowledge gained from a different sector within the same economy can be used to work for a similar reverse logistics type. The six product types analysed in this paper present the selection criteria to choose a reverse logistics channel from a different sector on the basis of similar producer and consumer interests from the returns arrangement. The study can prove to be a useful tool for logistics planners seeking to either, expand a company's operations to a different country, or remodelling an existing reverse logistics arrangement over the life cycle of a product. It establishes an approach to benchmark a reverse logistics arrangement, which aims to tackle specific consumer expectations, with the successful solutions existing in another industry for the similar consumer expectations. The study therefore presents an approach using which the knowledge drawn from a reverse logistics type in one sector/industry can be applied to the same type in another sector/industry, by focusing on the product types, whose returns share similar supply chain member interests. The study will also increase the success of a reverse logistics arrangement because it provides an approach to leverage upon the consumer response to an existing reverse logistics channel within a similar market.

The insight provided by this research has been arrived at by studying the various sectors in an economy; with an intention to validate the approach's relevance for all kind of companies in these sectors. Therefore the three research questions provide a general structure for designing a reverse logistics arrangement. Future research can be done to demonstrate the application of the study for a specific sector, which can help us to appreciate the specific benefits reaped by various entities involved in a supply chain. Separate scenarios can be made by considering the dissimilarities faced by a company between different consumer economies and additionally, the study can seek to verify the applicability of market specific solutions available from the reverse logistics arrangement in a different industry to the industry under analysis within the same economy.

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