



**MÄLARDALENS HÖGSKOLA
ESKILSTUNA VÄSTERÅS**

A study on Reverse Logistics

Dhananjaya Reddy

**SCHOOL OF INNOVATION, DESIGN &
ENGINEERING (IDE)**

MASTER THESIS WORK (KPP231)

**MASTER PROGRAM IN PRODUCT AND PROCESS DEVELOPMENT-
PRODUCTION & LOGISTICS**

Supervisor: Sabah Audo

Abstract

In the competitive world of manufacturing, companies are often searching for new ways to improve their process, customer satisfaction and stay ahead in the game with their competitors. Reverse logistics has been considered a strategy to bring these things to life for the past decade or so. This thesis work tries to shed some light on the basics of reverse logistics and how reverse logistics can be used as a management strategy. This paper points out the fundamentals of reverse logistics and looks into what kind of decisions today's logistics managers have to take on a daily basis for the improvement of their logistics model. A growing concern has been developing to control rising global pollution, this paper also brings out some of the effects of reverse logistics decisions on the environment and vice versa. The thesis starts out by compiling the works of researchers and logistics experts in the field of logistics in the theoretical background section. Through a survey conducted in a few manufacturing firms in India, a small picture of the extent to which reverse logistics has penetrated the manufacturing world has been drawn.

Keywords: Reverse Logistics, Green Image, Corporate citizenship, Reverse Logistics activities, Returns

Acknowledgements

First of all, it has been a great experience studying here in Sweden at Mälardalens Högskola, Eskilstuna for the past 27 months. For which, I would like to thank Sabah Audo, Program Coordinator, Master Program in Product and Process Development-Production & Logistics and the Innovation, Design & Engineering department for giving me the opportunity.

Sabah Audo, along with being my thesis coordinator has taught 3 courses in this program, in which I hope, I have learnt a bit about production and project management. I would like to thank him for guiding me through my thesis work.

I would also like to thank all the members of the teaching staff at the department who have taught the courses in this program.

Thirdly, I would like to thank my friends in India, without whose help; I wouldn't have been able to complete this thesis.

Finally I would like to thank all the participants of the survey that was conducted for this thesis work, and for giving their insights on reverse logistics and logistics management.

Illustrations:

Tables and Figures

Figure 1: Reverse Logistics processes by Fleischmann & Dekker (2004).....	11
Figure 2: Six phases of life cycle by Tibben-Lembke (2002).....	28
Figure 3: Bar graph showing percentage of returned goods going in each reverse logistics activity for the respondent companies.....	37
Figure 4: Distribution of participants over the 5 levels of knowledge.....	39
Figure 5: Knowledge about the concept of reverse logistics among the participants.....	41
Figure 6: Distribution of leniency of return policy of the participant companies.....	43
Figure 7: Overall scores of the six common qualities for a supplier.....	44
Table 1: Reasons why a product enters the reverse logistics flow.....	14
Table 2: Five categories of remanufacture and refurbishment.....	21
Table 3: List of disposal options for the returned goods as given by Rogers & Tibben-Lembke (1998).....	23
Table 4: Classification of Reverse Logistics Activities based on the point of origin of goods in the reverse flow by Rogers & Tibben-Lembke (1998).....	24
Table 5: Problem Return symptoms by Dr. Richard Dawe.....	27
Table 6: Respondent Companies for the survey details.....	34
Table 7: Respondent company business channel.....	34
Table 8: Primary business of respondent companies.....	35
Table 9: Overall scores for the factors considered by customers while choosing their suppliers based on the responses to the survey.....	36
Table 10: Leniency level of the return policies of the respondent companies.....	36
Table 11: Percentage of returned goods going in each reverse logistics activity for the respondent companies.....	38

Table of Contents

1. INTRODUCTION.....	1
1.1 BACKGROUND.....	1
1.2 THESIS SPECIFICATIONS.....	1
1.2.1 AIM.....	2
1.2.2 OBJECTIVES.....	2
1.2.3 PROBLEM DELIMITATION.....	3
2. METHODOLOGY.....	4
2.1 THE SURVEY.....	4
2.2 INTERVIEW.....	5
3. THEORETICAL BACKGROUND.....	6
3.1 DEFINING REVERSE LOGISTICS.....	6
3.2 FUNDAMENTALS OF REVERSE LOGISTICS.....	8
3.3 OVERVIEW OF THE REVERSE LOGISTICS FLOW.....	13
3.4 RETURNS MANAGEMENT.....	14
3.5 REVERSE LOGISTICS ACTIVITIES.....	21
3.6 CLASSIFICATION OF REVERSE LOGISTICS ACTIVITIES.....	22
3.7 CHALLENGES IN REVERSE LOGISTICS.....	24
3.8 FACTORS CONSIDERED FOR RL NETWORKS CATEGORIZATION.....	26
3.9 EFFECTS OF PRODUCT LIFE CYCLE AND RATE OF RETURNS ON THE RL NETWORK.....	27
3.10 EFFECTS OF ENVIRONMENT ON REVERSE LOGISTICS.....	29
4. RESULTS.....	32
4.1 The respondents.....	32
4.2 What do they know about Reverse Logistics?.....	34
4.3 How do customers choose their suppliers?.....	34
4.4 How do returns affect the manufacturers?.....	35
4.5 What happens to the returned goods?.....	36
4.6 How well have the Reverse Logistics concepts penetrated the manufacturing industry?.....	37
5. ANALYSIS.....	40
6. CONCLUSIONS AND RECOMMENDATIONS.....	46
7. LIST OF REFERENCES.....	47
8. APPENDIX.....	48
A. The survey.....	48
B. Contacts.....	51

1. Introduction

This section of the paper will give the reader an idea of the fundamentals of the thesis project. The reader will be able to get a fair idea of what this paper is all about. In the following subsections one can understand the objectives and obstacles for this project.

1.1 Background

Competition can be seen in every field these days, and the manufacturing world is no different. Companies are always looking for newer and newer opportunities and defects in the system so they can be tackled. Logistics plays an important role in any manufacturing firm, as it involves the optimal use of man, machine and material. Reverse logistics is a small part of the total logistics of a company. Reverse logistics deals with the handling of the goods that are being returned to the manufacturer by the customer. It covers all the activities that determine the fate of these returned goods.

This thesis tries to understand the basic concepts of reverse logistics. It tries to give an idea of how various researchers and logistics experts have defined reverse logistics. It also covers some basic reverse logistics activities and how these activities affect the decisions that managers have to make on a regular basis in their company.

The ever growing manufacturing world and the advent of automation has resulted in mass production and increased the number of products released into the market. This exponential growth has resulted in the overuse of the natural resources thus increasing the amount of industrial waste. This thesis also sheds some light on what activities in the reverse logistics help companies to work towards green production and green logistics.

1.2 Thesis Specifications:

This thesis is a result of the numerous hours of lectures, course seminars, variety of courses, group and individual tasks in the field of production and logistics over the past two years at the Innovation, Design and Engineering Department at Mälardalens Högskola. This thesis gives me the opportunity to put together a study on the concept of Reverse Logistics. It also gives me the opportunity to show my skills as a Masters student, and showcase the skills I have learnt over

the past two years. This project mainly focuses on the concept of Reverse Logistics and what role it plays in the manufacturing world today.

1.2.1 Aim

The aim of this project is to understand the concept of Reverse Logistics and its role in the manufacturing industry. It also focuses on learning different aspects of the reverse logistics and how these aspects affect the decisions made by manufacturing firms. The study also tries to look at the environmental aspects of reverse logistics.

1.2.2 Problem Definition

Reverse logistics is a fairly new concept and not until recently have researchers and logistics companies tried to focus on its effects on the managerial decisions. Also in recent years customer satisfaction has been considered a very important aspect in the growth of any company and the focus on improving customer satisfaction has increased greatly. Recently researchers have found that reverse logistics can play an important role in improving customer satisfaction.

The main focus of this thesis would be to answer the following questions:

- What is the definition of reverse logistics?
- What are the principal steps involved in reverse logistics?
- What do companies do with the returned products?
- How do the returns affect the decisions made in manufacturing firms?
- How do environmental issues affect the reverse logistics decisions?
- And so on...

The literature review in this paper gives a clear picture about the concept of reverse logistics. The thesis makes an attempt to cover the works of various

leading researchers and logistics experts as much as possible. Further the questionnaire also has been formulated so as to get clear and well defined answers. Through the literature study, interview and survey conducted with logistics and supply chain personnel at a few companies, this thesis tries to understand and analyze the concept of reverse logistics.

1.2.3 Problem Delimitation

Reverse logistics has been found to play an important role in almost any manufacturing firm, regardless of size, product and geographical reach of the firm. The focus initially was to conduct the survey and/interviews in manufacturing firms within Sweden focusing on firms that manufacture FMCG and electronic goods. The reason for choosing FMCG and electronic goods was because FMCGs are consumed more frequently which increases the importance of logistics decisions to deliver them to consumers. And the reason for choosing electronic goods is because of the growth of electronic products in the market over past two decades, and the frequency with which newer products reach the market these days.

Unfortunately after waiting for almost 45 days for the replies to the conducted survey there was no response by even one of the 30 different manufacturing firms in Sweden. After which a quick decision was made to change the target group to the manufacturing firms in India. And by the time this decision was made there was very little time for choosing the companies and conducting survey and/or interviews. Somehow I managed to get 6 people from 5 different companies to respond to the questionnaire. Also some sort of an interview was conducted through telephone calls and chatting over the internet to get a better understanding of the responses given by them.

As mentioned in the problem definition this thesis will focus on understanding the knowledge of the participants with respect to reverse logistics, and to what extent they have implemented reverse logistics concepts within their companies and how this affects their decisions. This thesis will not focus on performance

measurement of reverse logistics models followed by the participant companies since it requires a lot of data analysis to generalize the idea.

2. Methodology

The methodology followed to achieve the set objectives of this thesis is in two parts: survey and interview.

2.1 The survey

A thorough literature study on the topic of this paper: Reverse Logistics was conducted for a short period. Several articles were found on the topic over the internet. After getting somewhat of a fair idea about reverse logistics, a preliminary set of questions were formulated for the survey. Most of the questions were either taken directly or inspired by the questionnaire developed by Rogers and Tibben-Lembke (1998), for their paper *“Going Backwards: Reverse Logistics Trends and Practices”*. And one might even say that to a great extent this thesis has been inspired by the above mentioned paper.

The questionnaire was formulated to achieve the following objectives of the thesis:

- Understanding the level of knowledge of the respondents about the concept of reverse logistics
- The economical and customer satisfaction impact of returns in the past year.
- Return policies, if any.
- Decisions made to maintain the company environmental friendly.

As mentioned in the problem delimitation section it was difficult to choose the target group for the survey for this thesis. Initially the survey was targeted at the manufacturing firms in Sweden. But since even after waiting for almost a month and a half there were no response from any of the 30 companies. This led to choosing firms in India as the target group.

The questions were formulated in such a way that it would be easy to understand by the respondents and also it would not take much time to answer.

Almost all the questions in the survey are objective type, and all the respondents have to do was choose from the options. Since the target group had to be changed very late in the thesis, this led to a short period for collecting responses from the companies. But fortunately, the responses were collected quickly with the help of a few friends in India. In about one week since the decision to change the target group about 18 companies were contacted by me and my friends over the telephone and through email. And in about 10 days 6 responses were collected from 5 companies. Most of the respondents had filled the survey questions completely.

2.2 Interview

After receiving the responses to the survey for this thesis, interviews were conducted with the respondents to better understand their responses and also to get a better idea of their understanding of the concept of reverse logistics. The interviews more like discussions were conducted with the respondents over the phone and through online chats. These discussions were mainly along the lines of the survey questions, since some of them had failed to answer the survey completely. Further the purpose of this thesis was explained to the respondents in brief, so as to give them an idea of the objectives and goals of the thesis. This led to open up the discussion, and give the respondents an opportunity to throw light on their thoughts on supply chain and reverse logistics. Thus the results and analysis sections are based on both the survey and interviews or discussions conducted with the six respondents.

3. THEORETICAL BACKGROUND

This section will try to summarize the various definitions of the concept of reverse logistics as given by various companies, logistics experts and researchers. The primary steps involved in the reverse logistics process will be defined in this section. This section will also cover the role of reverse logistics and how developing a reverse logistics model for a specific product or group of products will affect the decisions taken by the companies. Also how different reverse logistics models affect the environmental liability of these companies has been explained in this part of this thesis. Finally an idea of the financial benefits and/or drawbacks involved in the reverse logistics process will be explained.

3.1 Defining REVERSE LOGISTICS

Reverse logistics, what is it? It sounds interesting, doesn't it? In simplest words it is the management of the path of the products from its end users back to the manufacturers. Below are a few ways of defining the concept of reverse logistics:

In the paper "Going Backwards: Reverse Logistics Trends and Practices", August 1998, Dale S. Rogers and Ronald S. Tibben-Lemke use the definition for Logistics given by The Council of Logistics Management to define Reverse Logistics. The definition for Logistics given by The Council of Logistics Management is:

"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 origin to the point of consumption for the purpose of conforming to customer requirements."

Therefore, reverse logistics according to Rogers and Tibben-Lembke is:

"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 go on to say that remanufacturing and refurbishing also may be included in the definition of reverse logistics. According to them reverse logistics also includes processing returned merchandise due to damage, seasonal inventory, restock, salvage, recalls, and excess inventory. It also includes recycling programs, hazardous material programs, obsolete equipment disposition, and asset recovery.

In his paper “Development and Implementation of Reverse Logistics Programs”, 1998, James R. Stock defines reverse logistics as,

“the term most often used to refer to the role of logistics in product returns, source reduction, recycling, materials substitution, reuse of materials, waste disposal, and refurbishing, repair and remanufacturing.”

Stock (1998) says product returns, product recalls, end-of-lease equipment, old/obsolete items being replaced, packaging materials are among the many items that come back and which require reverse logistics processing.

The European Working Group on Reverse Logistics, REVLOG (1998), defines 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.”

Ronald Kopicki in his book “Reuse and recycling: reverse logistics opportunities”, 1993, gives the definition of reverse logistics based upon the direction of flow as *“Reverse Logistics is a broad term referring to the logistics management and disposing of hazardous or non-hazardous waste from packaging and products. It includes reverse distribution...which causes goods and information to flow in the opposite direction of normal logistics activities.”*

Pohlen and Farris (1992) define Reverse Logistics in their article “Reverse Logistics in Plastics Recycling” as *“the movement of goods from a consumer towards a producer in a channel of distribution.”*

DHL, a renowned third party logistics company uses the following definition for reverse logistics taken from the book “Logistiksysteme: Betriebswirtschaftliche Grundlagen”, by Hans-Christian Pfohl, 2004: *“Reverse logistics can be defined as the application of logistics concepts to residues in order to create an economically and environmentally efficient residue stream by using all activities of spatiotemporal transformation, including changes in amounts and types.”*

3.2 Fundamentals of REVERSE LOGISTICS

Fleischmann and Dekker (2004) give the fundamentals of Reverse Logistics by analyzing the topic from four viewpoints:

- *Why are things returned? and why do companies get involved in reverse logistics?*
- *How Reverse Logistics works in practice?*
- *What is being returned?*
- *Who is executing reverse logistics activities?*

Why do companies get involved in reverse logistics activities?

In general companies get involved in reverse logistics 1) because they can profit from it; or/and 2) because they have to; or/and 3) because they “feel” socially motivated to do it. Furthermore Fleischmann and Dekker categorize these three driving forces as:

- Economics (direct and indirect)
- Legislation
- Corporate citizenship

Economics

Reverse logistics programs bring both direct and indirect gains.

Direct gains can be:

- In the form of raw materials for new products.
- Some parts of the returned product maybe recycled to manufacture new products, thus reducing the manufacturing cost.
- Value added recovery.

Indirect gains can be:

- Anticipating/impeding legislation
- Market protection
- Green image
- Improved customer/ supplier relations

Legislation

In many countries customers are legally entitled to return the product and legislation states that the companies are responsible for recovery as well. And sometimes companies themselves participate in recovery programs to keep or create a clean and green image.

Corporate citizenship

Many companies take responsibility for the safe disposal or recycling of their products to maintain the environment safe. Often companies get involved in recovery and recycling programs and turn create awareness among their customers as well.

Why are things returned?

Customers return the products for several reasons. Products once bought may be returned due to physical damage, some of them are returned because the customers are unhappy with the functionality of the product (expectations not met), sometimes customers return products because they discover an alternative product with better functionality after they have made the purchase, sometimes customers misuse the return policy and return it without any reason. These are only some of the major reasons for the return of a purchased product by majority of the customers.

How Reverse Logistics process works in practice?

The how viewpoint deals with how is value recovered from the products that are returned back to the manufacturer.

Recovery is actually only one of the activities involved in the whole reverse logistics process. First there is collection, next there is the combined inspection/ selection/ sorting process, thirdly there is recovery, and finally there is redistribution. Collection refers to bringing the products from the customer to the point of recovery. At this point the products are inspected, i.e. their quality is assessed and a decision is made on the type of recovery. Products can then be sorted and routed according to the recovery that follows. If the quality is (close to) “as good as new”, products can be fed in the market almost immediately through re-use, re-sale and re-distribution. If not, another type of recovery may be involved but now demanding more action, i.e. a form of re-processing.

The **Fig. 1** below gives the reverse logistics processes.

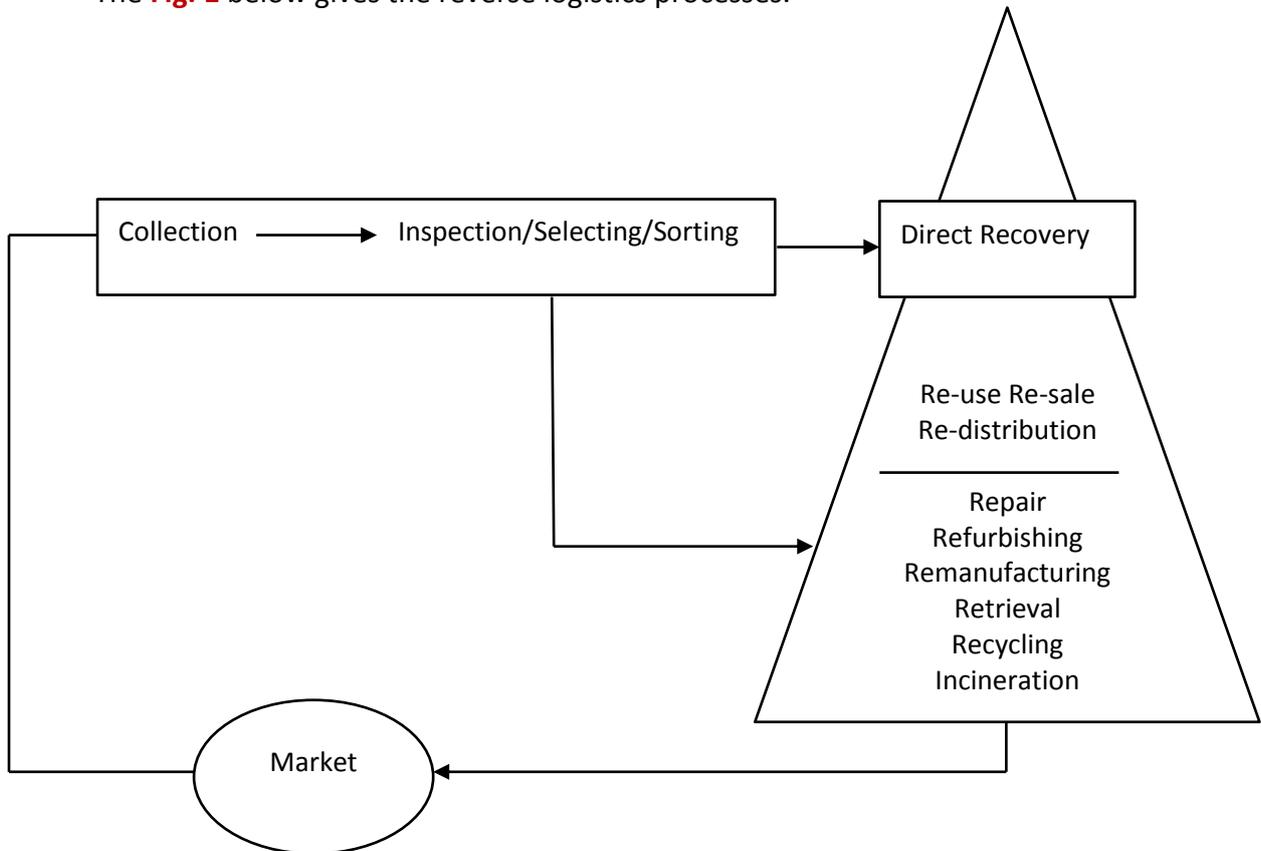


Fig. 1

Re-processing can occur at different levels: product level (repair), module level (refurbishing), component level (remanufacturing), selective part level (retrieval), material level (recycling), energy level (incineration).

What is being returned?

The third viewpoint on reverse logistics is obtained by looking at what is actually being returned. The three product characteristics that are relevant in this regard are:

- Composition
- Deterioration
- Use-pattern

Composition

Design engineers need to keep in mind the material composition of the products they design, which is called design for recovery. Not all parts of a product can be easily recycled or disposed, so design experts need to keep in mind not to use unrecyclable material as much as possible. How these parts are assembled or attached to each other also plays a factor in this regard, and so does the size of the product itself. The cost for recovery increases as the size of the product increases, because most of the times the recovery value is less than the cost for recovery.

Deterioration

Next there are the deterioration characteristics, which eventually cause a non-functioning of the product, but also determine whether there is enough functionality left to make a further use of the product, either as a whole or as parts. Often manufacturers have to deal with questions like whether the product will age during use. Will all parts age equally? Will the value of the products decline fast? Etc...

Use-pattern

Use-pattern of the product also plays an important role when thinking about recovery. Use-pattern depends on who the user is and how the user has used the product. Products like computers for e.g. could have been used by an individual or many individuals, like in an office or school or library, so this affects the reusability of the parts or whole product in various degrees. Books are another example for varied usage. Use-pattern is not just affected by number of users but also the duration of usage. In sum the following product categories can be given:

- Consumer goods (apparel, furniture, and a vast variety of goods)
- Industrial goods (military and professional equipment)
- Spare parts
- Packaging and distribution items
- Civil objects (building, dikes, bridges, roads etc...)
- Ores, oils and chemicals
- Other materials (like pulp, glass, scraps)

Who is executing reverse logistics activities?

The three main participants in the reverse logistics activities can be given as:

- Forward supply chain actors (supplier, manufacturer, wholesaler and retailer)
- Specialized reverse chain players (jobbers, recycling specialists etc...)
- Opportunistic players (such as charity organizations)

In any reverse logistics chain two or more of these players are always involved. Often, one or two of these participants play the major role while others act merely as intermediate junctions.

3.3 Overview of the reverse logistics flow

Once a product enters the reverse logistics flow, the logistics manager has to decide where the product has to be sent: either return to vendor, to the landfill, or to the secondary market.

There are several reasons why a product enters the reverse logistics flow. The **Table.1** below as given by Rogers and Tibben-Lembke (1998) shows some of them. There are, of course more reasons why a product will enter the reverse logistics system, but these are the most common.

Source	Reasons
Customer	<ol style="list-style-type: none">1. Product did not meet customer's needs.2. Customer did not understand how to properly use the product.3. Product was defective.4. Customer abuse of liberal return policy.
Retailer	<ol style="list-style-type: none">1. Product packaging outdated.2. Seasonal product.3. Product replaced by new version.4. Product discontinued.5. Retailer inventory too high (overstock, marketing returns, or slow-moving).6. Retailer going out of business.

Table.1

Often, two identical products will follow different routes to different destinations, depending on where in the distribution channel they enter the reverse logistics flow. One such example as mentioned by Rogers and Tibben-Lembke (1998), a book that is returned to a store by a customer may not end up at the same place as a book returned by the store to its supplier due to overstocking. Neither of these books may end up in the same place as the books returned by the distributor.

When a product has been replaced by a new version, a retailer may continue to sell the old version until it is gone, perhaps at a discount. The product may never

enter the secondary market. If the product does enter the reverse logistics flow, the firm may sell it to a liquidator for a relatively high price. This may be especially true when the new product represents only a minor, incremental improvement over an already popular product. On the other hand if the changes are significant, then the manufacturer may offer an incentive to sell of the remaining products. Often when this happens the retailer may take down the old product and sell it off to the secondary market.

When the product has not met the expected sales, manufacturers often find it difficult to sell them to the secondary market even at a greatly reduced price.

Returned Product Types

Rogers and Tibben-Lembke (1998) classify the retail products in a reverse logistics flow as follows:

1. Close-outs: first quality products that the retailer has decided to no longer carry;
2. Buy-outs or “lifts”: where one manufacturer buys out retailers’ supply of competitor’s product;
3. Job-outs: first quality seasonal, holiday merchandise;
4. Surplus: first quality overstock, overrun, marketing returns, slow-moving merchandise;
5. Defective: products discovered to be defective;
6. Non-Defective Defectives: products thought incorrectly to be defective;
7. Salvage: damaged items, and
8. Returns: products returned by customers.

3.4 Returns Management

Return management is the process of returning product as well as the transformation of the product back to reusable condition. Returns Management uses tools and systems to maximize profits in the process.

Rogers and Tibben-Lembke (1998) mention seven channels for disposing the products that have been returned to the manufacturer. They are:

1. Return to Vendor

2. Sell as new
3. Sell Via Outlet or Discount
4. Sell to Secondary Market
5. Donate to Charity
6. Remanufacture/Refurbish
7. Materials Reclamation/Recycling/Landfill

Based on the condition of the returned product, contractual obligations with the vendor, and the demand for the product, the manufacturer has one or more of the above options to dispose the returned product.

Return to vendor

Often the vendor offers incentives for large orders, and retailers buy products in bulk. If the product doesn't do well in the market the retailer returns the products to the vendor. Similarly if a customer returns a product because of a defect or claiming that it has a defect, the manufacturer would like to take it back so as to avoid such defects in the future, and also this way they can avoid non-defective defectives. Another reason the manufacturer would like to take back the product could be to avoid cannibalization of the parts and keep the brand name clean. Because often what happens is the product is sent to a secondary market where cheap parts are installed on the product and sold at a reduced price at a flea market or dollar store.

Sell as New

Some of the returned products are either unused or unopened; in such cases the manufacturer can repackage and sell it as new to the retailers or an outlet store, depending on the demand of the product. On the other hand some products like circuit breakers are not legally allowed to be sold once it has been returned even if it has been installed for a short period or never been installed at all.

Sell Via Outlet or Discount

If the product has been returned, or if the retailer has too large an inventory, it can be sold via an outlet store. Selling through outlet stores has a number of advantages like maintaining control over the products, and the knowledge of where the products are being sold. This helps firms in maintaining their brand

name. Often outlet stores offer a large margin than the retailers, because the ultimate goal here is to clear out inventory.

Sell to Secondary Market

When a firm has been unable to sell a product, cannot return it to the vendor, and is unable to sell it at an outlet store, one of its final options is to sell it via the secondary market. The secondary market consists of firms that specialize in buying close-outs, surplus, and salvage items, at prices as low as ten cents on the dollar.

Donate to Charity

The products that cannot be sold to the retailers or vendors, because they need slight repair or cosmetic changes, manufacturers may choose to donate them to a charity. In this case the manufacturer does not receive any money, but the image of the company will have a positive effect as a good corporate citizen.

Remanufacture/Refurbish

Before a product is sent to recycling the manufacturer has the option to see if it can be repaired or reconditioned by either replacing parts of the item or by making cosmetic changes, so that it can be sold to the secondary market where they will be sold as reconditioned goods or remanufactured goods. But it is also necessary to make sure the product has never been used by the returning customer, because no matter how well the refurbishing or reconditioning process is it cannot be sold in some markets.

Materials Reclamation/Recycling/Landfill

There are several reasons for sending an item to the landfill for example some goods cannot be resold in any form due to safety regulations. Another reason is when the manufacturer has found that there is no way to get any value from the returned item. The final option is to send it to material reclamation to take out the parts which can be recycled for material or the part itself. The other option is to recycle the material, like parts made out of plastic, metal etc...The last option is of course to send it to landfill. The items generally sent to landfill are considered as waste material, and which has no use to anybody. The manufacturer of course has to make sure to take necessary safety precautions

before sending it to the landfill like refining, cleaning, and separating hazardous and non-hazardous material.

Making the right choice

Any of the choices described above can be successfully applied individually or in combinations by the manufacturer. The alternatives range from high cost and high management maintenance to profitable and low management maintenance. Making the right choice requires the ability to define the expected outcome, use the correct technique or combinations of the techniques and tools for each situation, and then deliver the results as planned using the resources.

Often companies use software and web based tools that help locating, tracking, and managing products as they are returned. However these solutions only help to get the product returned efficiently. Product quality still needs to be ensured to prepare it for the resale options.

Outsourcing often generates more value provided a partner who has strategic value and can implement processes that fit the business need for the parent company is selected. The questions that need to be asked by the parent company can be along the lines of “How can you create a comprehensive returns management plan for our products that:

- helps to reduce the number of returns that must be dealt with from our customers,
- transforms inherently negative customer experiences into a valuable strategic asset, and
- generates profits from returns that were previously a loss?

In summary the critical points for returns management are:

- Prevent returns from occurring in the first place.
- Look beyond the immediate challenge: The questions you need to answer are “How do we create a comprehensive returns management plan that transforms inherently negative customer experiences into a valuable strategic asset?” “How do we reduce the number of returns that must be dealt with from our customers?”

- Develop a holistic solution that will address returns from multiple angles and will likely provide benefits that extend far beyond the area of reverse logistics.
- Returns management solutions must account for a variety of factors, such as business models, product type, and market geography. These should minimize or eliminate costs, or generate a profit. The most productive solutions are developed from a grounded approach that is based on business needs that are comprehensive and forward looking.
- Reach for profits from product returns; the options for getting real value are available for many product returns. These options should be evaluated by internal and external expertise to rethink the “as-is” process.

Below is a list of key reverse logistics management elements as given by Rogers and Tibben-Lembke (1998):

- Gatekeeping
- Compacting Disposition Cycle Time
- Reverse Logistics Information Systems
- Centralized Return Centers
- Zero Returns
- Remanufacture and Refurbishment
- Asset Recovery
- Negotiation
- Financial Management
- Outsourcing

Gatekeeping

Gatekeeping is the screening of defective and unwarranted returned merchandise at the entry point into the reverse logistics process. Good gatekeeping is the first critical factor in making the entire reverse flow manageable and profitable. Often in companies where the return policies are lenient consumers tend to abuse their privileges. Also customers sometimes do not read the instructions of the return policies correctly, which leads unnecessary trouble for the retailers and in turn the manufacturer. A good

gatekeeping process can help the manufacturer in keeping this to as low as possible.

Compacting Disposition Cycle Time

Just like gatekeeping shorter disposition cycle time is an important factor in managing returns. Often it is difficult for companies to determine which reverse logistics channel the returned product should be placed in. The sooner this is determined action can be taken that quickly. Companies are always thinking about shortening their production cycle times, but it is just as important for them to compact the reverse cycle time as well to gain money from the returned product.

Reverse Logistics Information Systems

The information surrounding the reverse logistics needs to be automated in order to have a better reverse logistics process. Not many companies have good information systems in place for doing so. At the same time putting the information together to be accessible is a difficult job.

Returns Transaction Processing

In general very few companies have mastered the technology of tracking their products in forward supply chain, and virtually none have achieved just below average technology in the reverse process. In this regard both the retailer and manufacturer have integrated their information systems to achieve some sort of a working tracking process.

Centralized Return Centers

Returns centers have existed for many years, but only recently the full use of centralized return centers has been achieved by manufacturing companies. In a centralized system all products for the reverse logistics pipeline are brought to a central facility, where they are sorted, processed, and then shipped to their next destinations. This system has the benefit of the reverse logistics flow customers, which often leads to higher revenues for the returned items. Also this process can help in determining the right reverse channel for the returned item.

Zero Returns

In zero return programs, the manufacturer or distributor does not permit products to come back through the return channel. Instead, they give the retailer or other downstream entity a return allowance, and develop rules and guidelines for acceptable disposition of the product. The zero return policy often tends to have a negative effect in customer satisfaction and in turn the brand image.

Remanufacture and Refurbishment

Thierry, et al. (1995) defined five categories of remanufacture and refurbishment. These five categories, shown in **Table.2**, are repair, refurbishing, remanufacturing, cannibalization, and recycling.

1. Repair
2. Refurbishing
3. Remanufacturing
4. Cannibalization
5. Recycling

Table.2

The first three categories: repair, refurbishing, and remanufacturing, involve product recondition and upgrade. Cannibalization is simply the recovery of a restricted set of reusable parts from used products. Recycling is the reuse of materials that were part of another product or subassembly.

Asset Recovery

Asset recovery is the classification and disposition of returned goods, surplus, obsolete, scrap, waste and excess material products, other assets, in a way that maximizes returns to the owner, while minimizing costs and liabilities associated with the dispositions. Asset recovery is a major operation in any company, and this one of the major ways of reducing waste, recovering revenue, and holding a green image in the society.

Negotiation

The price of a product is determined by the cost for the company to produce it and the brand value, and several other factors like marketing, etc...Similarly the value of the products that have been returned is also affected by several factors

like age, degree of use, which used it, etc...No matter what the condition of the returned good is the price is always negotiable, this may not be the same when products are moving in the forward supply chain.

Financial Management

The key to a successful reverse logistics process is good financial management. Most firms invest too much money in unnecessary and unwanted processes, without actually analyzing the requirements of their business. Firms need to research the right strategy for their business instead of following what everybody else is doing blindly. Because what works for one firm may or may not work another firm. Only after conducting analysis should they actually invest.

3.5 Reverse Logistics Activities

All the activities that a company carries out to collect the used, damaged, unwanted, or outdated products, as well as packaging and shipping materials from the end-user or reseller can be considered as reverse logistics activities. Once a product has been returned to the company, the firm has many disposal options from which to choose. Rogers and Tibben-Lembke (1998) classify some of these activities as in **Table.3**.

Among the many options firms have to do with the products returned, the first choice would be to return it to the supplier for a full refund. Often products that haven't been used can be sold to a different customer, or maybe sold through a different outlet store. And if the products are not of sufficient quality they may be sent to a salvage company which will export it to a foreign market. And if the product cannot be sold "as is" or if the firm can significantly increase the selling price by reconditioning, refurbishing or remanufacturing the product, the firm may perform these activities before selling the product. These operations may also be performed by a third party firm that specializes in the field of reconditioning/remanufacturing/refurbishing. Finally if none of these operations can be performed, then the manufacturer can try to find which components of the product can be reused to manufacture new products, and the rest can be sent to recycle or landfill.

Material	Reverse Logistics Activities
Products	<ul style="list-style-type: none"> Return to supplier Resell Sell via outlet Salvage Recondition Refurbish Remanufacture Reclaim materials Recycle Landfill
Packaging	<ul style="list-style-type: none"> Reuse Refurbish Reclaim materials Recycle Salvage

Table.3

Packaging materials on the other hand can often be recycled. Often manufacturers use reusable totes and pallets.

3.6 Classification of reverse logistics activities

Rogers and Tibben-Lembke (1998) classify reverse logistics activities based on whether the goods in the reverse flow are coming from the end user or from another member of the distribution channel such as a retailer or distribution center; and whether the material in the flow is a product or a packaging material as given in **Table.4**.

	Supply Chain Partners	End Users
Products	Stock Balancing Returns Marketing Returns End of Life/Season Transit Damage	Defective/Unwanted products Warranty Returns Recalls Environmental Disposal Issues
Packaging	Reusable Totes Multi-Trip Packaging Disposal Requirements	Reuse Recycling Disposal Restrictions

Table.4

Rogers and Tibben-Lembke (1998) also indicate that where products are inserted into the reverse flow, is a prime determinant in the resulting reverse logistics system. For instance, if a product enters the reverse logistics flow from a consumer, it may be a defective product, or, the consumer may have claimed it was defective in order to be able to return it. The consumer may believe it to be defective although it is in perfect order in reality. This category of returns is called “non-defective defectives”.

Depending on whether the product has reached the end of its useful life, the consumer may have returned the product for service or due to a manufacturer recall, or in some cases, so that the manufacturer can dispose of the product properly, or reclaim materials.

In the case of supply chain partners, the products may have been returned due to an over-ordered marketing promotion or because the product failed to sell as well as desired. Further, the product may have come to an end of its life, or to the end of its regular selling season, or in some cases the product may have been damaged during transit.

Since their research was based primarily in the US region, Rogers and Tibben-Lembke(1998) mention that packaging material does not play a big part in the reverse logistics activities as opposed to the actual products themselves. They also mention that this may differ in the case of European firms as they are keener on green logistics and are often known to use reusable plastic totes and knockdown cages.

3.7 Challenges in Reverse Logistics

Most challenges in managing reverse logistics can be traced to two broad categories-Process and Investment (*Two Steps Forward, One Step Back...*, Saty Chawla, May 2007).

Ill-defined processes

- Too many touch points-A high number of touch points significantly increases the chance that the condition of the product will deteriorate.
- Long cycle time-A high number of touch points in turn increases the cycle time which in turn increases the waiting time for the customer's return order. It also provides little time to recondition, repackage and resell the product.
- Missing feedback mechanism-Incompetent business intelligence leads to incompetent reverse logistics, and not being able to track the issues that affect the reverse logistics.

Neglect

- Out of focus-Previously management executives believed that making returns easier for the consumer increases the behavior of returning until it was found out to be profitable for the companies recently by researchers.

- Dispersed view-The existence of multi-channel returns leads to price differences, missing item-data or simply a lack of cross-channel visibility of purchases.
- Limited visibility-Often there is little or no information given to retailers by the firms about the inventory in their returns pipeline which leads to bad planning.

Retailer-Manufacturer conflict

Rogers and Tibben-Lembke (1998) mention another one of the difficulties in managing returns as the difference between manufacturers and retailers. According to them the retailer and manufacturer may disagree on any one of the following:

- Condition of the item
- Value of the item
- Timeliness of response

Usually when retailers send back products to the manufacturer, they believe the products to be in pristine condition, and that any damages must have occurred during transit or must be manufacturing defects. On the other hand the manufacturer may suspect the retailer of abusing return privileges because of poor planning, or of returning product damaged by the retailer. Further, the manufacturer and retailer must agree upon the value of the returned item. While the retailer may expect a full credit for the return, the manufacturer may think otherwise.

Both retailers and manufacturers want to get rid of the excess inventory because each one has an issue with it. While the retailers would like to return it at the end of a quarter to reduce inventories, the manufacturers can be slow to recognize returns as a subtraction from sales.

Sometimes the retailer simply deducts the cost of the items from an invoice. Often, that invoice is not the same one for the goods being returned.

These conflicts have to be resolved by mutual understanding to develop a better partnership, as one cannot survive without the other.

Problem Return Symptoms

Dr. Richard Dawe of the Fritz Institute of International Logistics identified six symptoms of problem returns. The **Table.5** below gives those six problem return symptoms:

Symptoms
<ul style="list-style-type: none">• Returns arriving faster than processing or disposal• Large amount of returns inventory held in the warehouse• Unidentified or unauthorized returns• Lengthy processing cycle times• Unknown total cost of the returns process• Customers have lost confidence in the repair activity

Table.5

3.8 Factors considered for the RL networks categorization

Marco Serrato gives the categorization of reverse logistics network in his paper based on two factors that determine the structure and characteristics of every RL system which are the length of the product's life cycle and the variability in the rate of returns in any particular period.

The length of the product life cycle varies across products and industries (Rogers and Tibben-Lembke, 1999). Often it is difficult to identify where a real product is in its life cycle once it moves past the introductory and growth stages, which means firms have to look for demand turning points. This can be done when the company tracks the history and marketplace, and forecast.

The stage of the product in its life cycle also affects the rate of return, which makes it difficult to forecast the returns.

3.9 Effects of product life cycle and rate of returns on the RL network

Marco Serrato gives the relationship of the product life cycle and rate of returns with reverse logistics network in his paper *“Characterization of reverse logistics networks for outsourcing decisions”*. This section will summarize his thoughts.

Most products either fail in the early stages of the product life cycle or fail to maintain a stable growth. The rate of returns depends inversely on the length of the products life. For example, in the computer market the introduction of new components accelerates the demise of computer models previously introduced, as the manufacturer must introduce new models (just as its competitors are doing) that will reduce the sales of the existing models (Tibben-Lembke, 2002).

Serrato refers to the six phases of the product life cycle to understand the reverse logistics flow. The six phases of the life cycle as given by Tibben-Lembke (2002) in his paper *“Life after death: reverse logistics and the product life cycle”* are: development, introduction, growth, maturity, decline and cancellation. **Fig. 2** shows the expected sales volume during these stages.

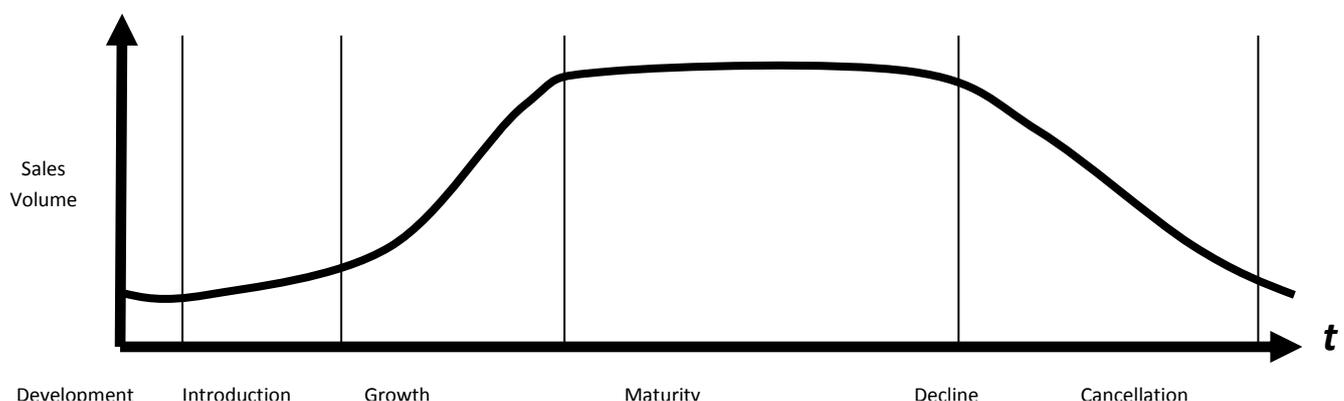


Fig. 2

The major issues that define the volume of the units returned through the RL system for a product model (such as a specific model number of a particular product) during these six phases are:

Development phase

It can be expected that there will be no returns at this stage, because the new product will have very minor changes from the current product, and clients who like the current product will obviously like a revised version.

Introduction phase

Firms can expect to begin making plans for dealing with the products that will eventually be returned at this stage. With the revised version of a current product, firms can forecast the returns based on the trends for the current product.

During the introduction stage, the company must also begin dealing with the flow of the returned products. Because a new model is often a minor modification of the existing product, production difficulties in adapting to the new mode should be minimal. The minor modification also means demand for the new model would be expected to be very similar to demand for the previous model. In the case of a new model of a popular product, sales may be high from the beginning or start small and grow quickly, as customer demand for an established, known product is transferred to the new product. In these cases, Tibben-Lembke (2002) suggests that the product will skip the introduction phase.

Growth phase

Growth phase means the sales increase exponentially and so does the returns. This however may not always be true. As more customers are attracted to the product, these new customers may be less knowledgeable about the product, and the rate of “non-defective defectives” may increase. This in turn will also increase the variability of the rate of returns.

Maturity phase

As the sales of the product reaches maturity the rate of returns can also be expected to reach a stable phase. In retrospect, the volume of returns in any period is related not with the volume of sales in the same period, but actually with the historical sales in the previous periods. Although the sales volume may have reached a stable phase, the rate of returns may actually increase in the consecutive periods.

Decline phase

Often it is difficult to determine the end of this stage of the cycle, and the reverse logistics has to work till the end of this phase. As the sales begin to decline the price of the product in the secondary market also start to decline, and hence these secondary market firms will be interested in purchasing the product.

Cancellation phase

The volume of returns will continue to decrease before stopping altogether at this stage of the life cycle. Even if the product has sold well, at the end of its life, retailers may send any unsold product back.

Variability in return rates affects the reverse flow greatly. Variable return rates means the supply in the reverse flow varies, and it is difficult for any firm to keep up with. Inventories have to be maintained all the time, and inventory is bad for any company.

3.10 Effects of environment on reverse logistics

Now that we have a basic idea of Reverse logistics, in this section of the paper we will see what role reverse logistics has in the manufacturing world, how the reverse logistics activities affect various decisions in a company, and what impact

these activities and decisions have on the environment. As mentioned in the early parts of this section many manufacturing firms often get involved in improving their reverse logistics either they are forced by law to keep track of their returned goods and dispose them safely or they are self-motivated to maintain a green image among their customers. Whatever may be their motivating factor, in future their logistics decisions will be greatly impacted by environmental effects. Rogers and Tibben-Lembke (1998) list out a few reasons why this is true:

- Increase in landfill costs over the years.
- Many products can no longer be landfilled because of environmental regulations.
- Economics and environmental considerations are forcing firms to use more reusable packaging, totes and other materials.
- Environmentally motivated restrictions are forcing firms to take back their packaging materials
- Many producers are required by law to take back their products at the end of their useful lifetime.

Disposing of unwanted products is becoming a more closely monitored activity. To a great extent this is true for most nations in the world. It can be seen that often companies based in the US and European nations that have facilities or have outsourced manufacturing jobs to countries like India, China and Thailand where the labor is cheaper still monitor how these offshore sites deal the waste material that is generated at these sites. Also they propose a certain standard for the outsourcing firm which has to be met. The exponential growth in the landfill costs in the US and Europe can be attributed to the regulations affecting landfills say Rogers and Tibben-Lembke (1998). The restrictions focus on the protection of human health and the environment as a result of which many facilities have closed.

Another area of increasing regulation is the determination of what items can be placed into a landfill. There is an increased regulation on what can be

placed in landfills throughout the Europe and US. Often in the regions where the manufacturer is not forced by law to take back their products when they reach the end of life, they are also not allowed to place them in landfills. This forces the manufacturers to collect their products.

All these reasons have contributed to the increase in reusable material for packaging and transportation. This has contributed to the increase in the field of design for reusability. Often companies think about reusable material and components for their products in the development and design stage of the product.

4. RESULTS

As mentioned earlier the questions for the survey were designed to get an understanding of the concept of reverse logistics as understood by the manufacturers and the logistics experts working in the companies. In this section of the paper an attempt has been made to present the answers given by the respondents in a tangible form, to give an idea of their perception of the concept of reverse logistics. In the next section i.e., **Analysis**, analysis of the responses and correlating them with concepts in the theoretical background section is shown. Also, it should be noted that in this section only the responses as given by the participants through survey alone will be discussed. A more detailed analysis of those responses along with the discussions carried out with the participants is given the Analysis section of this report.

The survey targets at answering 6 basic questions:

- Which companies are affected by reverse logistics?
- What do they know about reverse logistics?
- How do customers choose their suppliers?
- How do returns affect the manufacturers?
- What happens to the returned goods?
- How well have the reverse logistics concepts penetrated the manufacturing industry?

In the following parts of this section these questions have been explained based on the responses to the survey.

4.1 The respondents

Around 40 people in the manufacturing and supply chain division of about 20 companies were contacted for the survey. The **Table.6** below gives the names of the respondent companies with some details about them.

Company	Primary Product	Position of the respondent
Ashok Leyland	Automotive	1. Deputy Manager (Product Development)
Hewlett-Packard	Electronics and Computers	2. Deputy Manager (Purchasing)
Textron India Pvt. Ltd	Automotive	3. Purchase Engineer
Accenture	Consulting	4. Supply Chain Executive
SunMax Engineering Works	Automotive spare parts	5. Supply Chain Manager
		6. Production Manager

Table.6

Through the second question in the survey it was found that most of the respondent companies were involved more than one business channel. The

Table.7 below gives the classification of the respondent companies.

Company	Business channel
Ashok Leyland	Manufacturer, Wholesaler
Hewlett-Packard	Manufacturer, Wholesaler, Service provider
Textron India Pvt. Ltd	Manufacturer, Wholesaler
Accenture	Service provider
SunMax Engineering Works	Manufacturer, Wholesaler

Table.7

As it can be seen from the **Table.8** below an attempt to involve companies from different manufacturing fields to participate in the survey for this thesis to get a better picture of reverse logistics. The **Table.8** gives the primary business product of the respondent companies.

Company	Business
Ashok Leyland	Automotive
Hewlett-Packard	Electronic and computers
Textron India Pvt. Ltd	Automotive
Accenture	Consulting, Service provider
SunMax	Automotive spare parts

Table.8

4.2 What do they know about Reverse Logistics?

The very first question of the survey gives the respondents an opportunity to define reverse logistics in their own words. Most of the respondents seem to have a fair idea of what reverse logistics means. To summarize their response to this question, reverse logistics can be defined as all the activities that help the manufacturers to get the products from the end users back to the company smoothly to remanufacture, reuse or dispose safely. Further when the respondents were contacted for discussions through the phone and online chat, it was seen that they had a little bit of experience in this field, but never really realized until now that their company and manufacturers in general are involved in the reverse logistics business. Also it was found that their response to this question was given by searching for the definition on the internet, since they had never actually heard the term. The respondents further explained that although they had never heard about the term reverse logistics, they and their company with or without the knowledge of the term still had performed some or all the reverse logistics activities.

4.3 How do customers select their suppliers?

It is a difficult task for customers when they have to decide which supplier to choose. Customers look for different characteristics in their supplier. A list of some of the common factors that customers consider when choosing their supplier were given, and the respondents were asked to rate the importance of each of these factors to their customers according to them on a scale of 1 through 7. The **Table.9** below gives the overall scores for each of these factors.

Factor	Participant						Overall score
	P1	P2	P3	P4	P5	P6	
Cost reduction	6	7	5	5	6	6	35
Price	5	6	5	3	4	6	29
Quality of Service	6	6	7	7	6	4	36
Return Policies	4	3	2	5	4	4	22
Speed of Delivery	5	4	5	5	5	5	29
Variety of products	3	3	2	3	3	4	18

Table.9

Often customers choose products that have liberal return policies, because customers prefer the option of returning the product in case they don't like it after they have used it for a short while. Manufacturers on the other hand do not like the idea of returns and hence have to device return policies lenient enough to attract customers but strict enough to avoid goods being returned for no apparent reason. The respondents were asked to score between 1 for very strict and 7 for very liberal return policy in their company. The **Table.10** below gives the scoring as given by the 7 respondents.

Participant	Strict						Liberal
	1	2	3	4	5	6	7
P1			3				
P2				4			
P3			3				
P4			3				
P5				4			
P6					5		

Table.10

4.4 How do returns affect the manufacturers?

It is necessary to understand the effect of returns on the cost, so the respondents were asked to mention the percentage of returns based on their sales for the past year. The percentage of returns ranges to between 5 and 10% for the respondents.

Similarly it is also necessary to understand whether the customers are satisfied after they have returned the product for a replacement, and also to understand how quickly the returned goods can be converted to cash. According to the

responses that were received the average returns processing cycling times for the primary product of the respondent companies, ranges between 2 weeks and 6 weeks.

4.5 What happens to the returned goods?

Once the product has been returned and brought to the collection center, the manufacturer has several options to choose to get value out of the returned product. In the survey a few of those options were picked out and the respondents were asked to estimate the percentage of goods represented by each of the options mentioned in the survey. The bar chart in **Fig.3** below represents the distribution of the each of the options for the six participants.

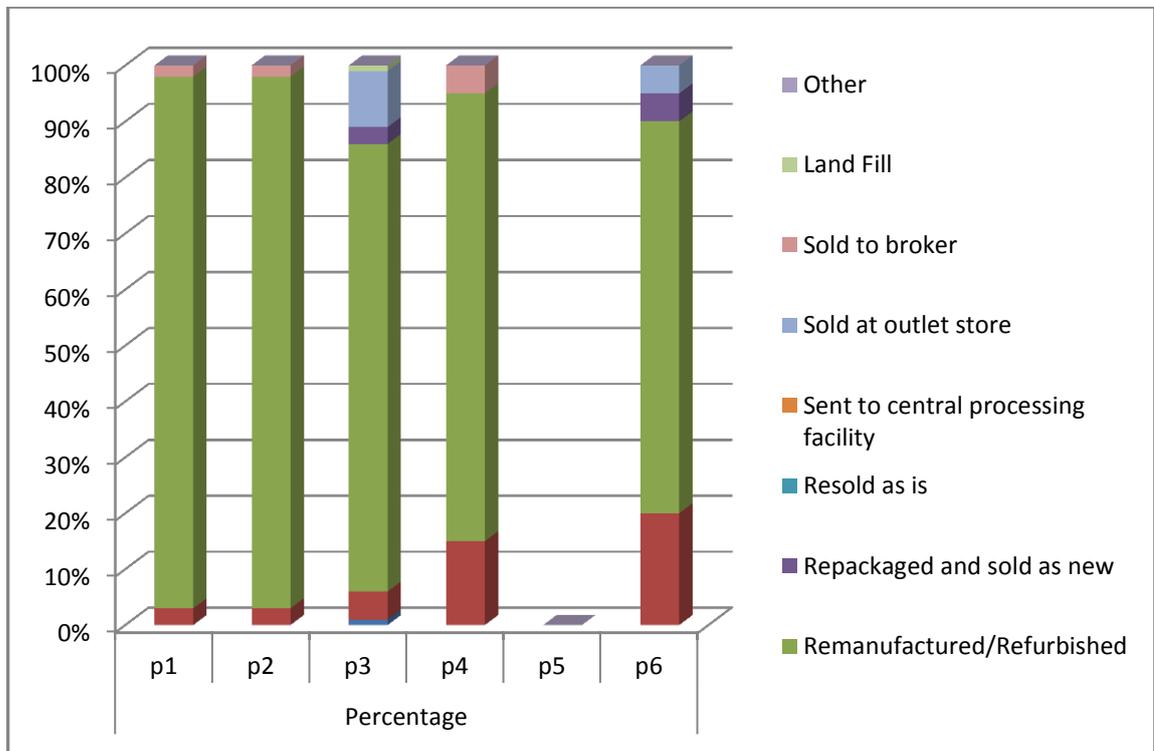


Fig.3

The **Table.11** gives the responses for the 6 participants associated with the bar chart above.

Activities	Percentage associated with each activity					
	Participants					
	P1	P2	P3	P4	P5	P6
Donated	0	0	1	0	0	0
Recycled	3	3	5	15	0	20
Remanufactured/Refurbished	95	95	80	80	0	70
Repackaged and sold as new	0	0	3	0	0	5
Resold as is	0	0	0	0	0	0
Sent to central processing facility	0	0	0	0	0	0
Sold at outlet store	0	0	10	0	0	5
Sold to broker	2	2	0	5	0	0
Landfill	0	0	1	0	0	0
Other	0	0	0	0	0	0

Table.11

4.6 How well have the Reverse Logistics concepts penetrated the manufacturing industry?

In order to understand the benefits of a good reverse logistics process, the participants were asked to list them out according to their experiences as a supply chain and/or logistics expert. The list below summarizes the benefits of a good reverse logistics process as given by the participants:

- Optimal use of material
- Increased profits
- Better customer satisfaction
- Green image
- Smaller returns inventory

Through the literature study it can be seen that although the reverse logistics costs do not make a significant part of the total cost for the company, by reducing the reverse logistics cost the company can make a small reduction in the total cost. According to the participants' replies reverse logistics cost represents about 5 to 10% of their total logistics costs.

To find out the level of knowledge about reverse logistics among the participants of the survey they were asked to choose between 5 options that represent 5 different levels from naive and maverick. The **Fig.4** gives the distribution of the participant companies over the 5 levels.

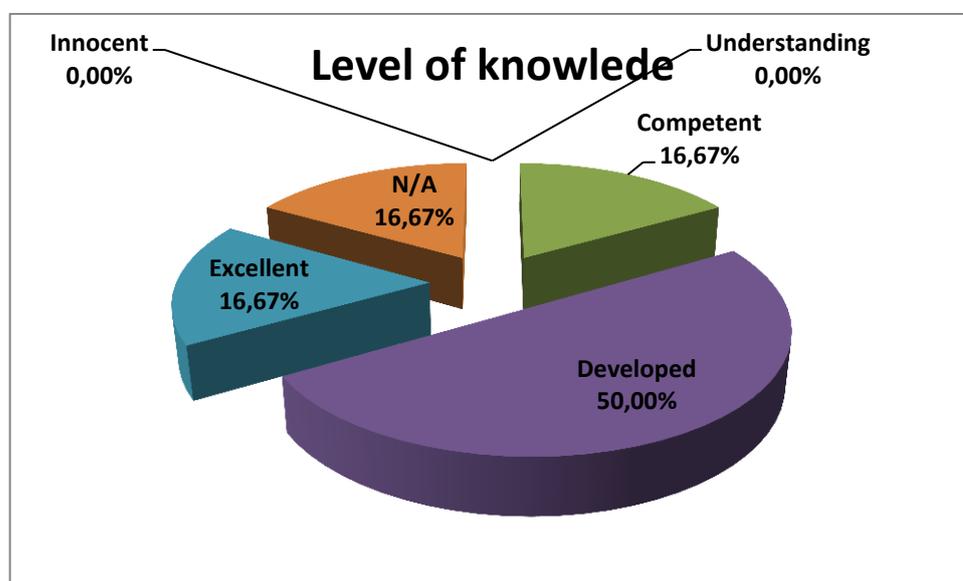


Fig.4

Maintaining a green image for any company is important, and safe disposal of waste material makes them a good corporate citizen. At a time when landfill costs are high and governments imposing strict rules for waste disposal, it has become difficult for the manufacturers of today. The participants were asked to list out a few measures they take to ensure safe disposal of waste material in their company. They are as follows:

- Cleaning and refining solid and liquid waste before dispatching for dumping grounds.

- Making sure to do business with companies that follow standard safe waste disposal procedures.
- Ensuring the partner firms are certified by environmental safety organizations.
- Trying to recycle as much as possible to reduce usage of hazardous material.
- Always follow the rule reduce-reuse-recycle.

Often companies get certifications from different organizations for various reasons like for example to get competitive edge over their rivals, create green image among their customers, and some certifications are a mandate by law. The participant companies were asked if their companies were certified by any such environmental safety organizations. The following list gives the certifications received by some of the participant companies:

- ISO/TS 16949(Ashok Leyland)
- ISO 14001(Ashok Leyland)
- ISO 11469(Hewlett-Packard)
- ISO 14001(Textron India)

The survey conducted in this survey does not target on any one size of the company, instead was targeted at companies of all sizes. The list below gives the approximate number of employees working at each of the 5 firms:

Ashok Leyland-550

Hewlett-Packard-2000

Textron India Pvt. Ltd-1800

Accenture-5000

SunMax Engineering Works-100

5. ANALYSIS

In this section the responses given by the participants to the survey have been analyzed in a detailed manner. The analysis is also based on the conversations with the participants that were conducted after the survey was done. Also an attempt to correlate the participants' responses to the theoretical background has been made to understand the thoughts of the respondents on the topic.

Since this thesis is based upon a survey and discussions, the number of responses collected plays a very important role and so, as many companies as possible were contacted to collect a decent amount of data to analyze and generalize some of the concepts. Unfortunately only six responses were collected and I have tried to analyze them as effectively as possible.

As explained in the results section the participants had never heard of the term reverse logistics, which led them to search it over the internet to find out what exactly the term meant. The responses to the survey given by the participants were based upon what they learnt through the internet. During the discussion the participants explained that although they had never heard of the term, once they understood the concept they found that they had performed at least some of the reverse logistics activities in their company.

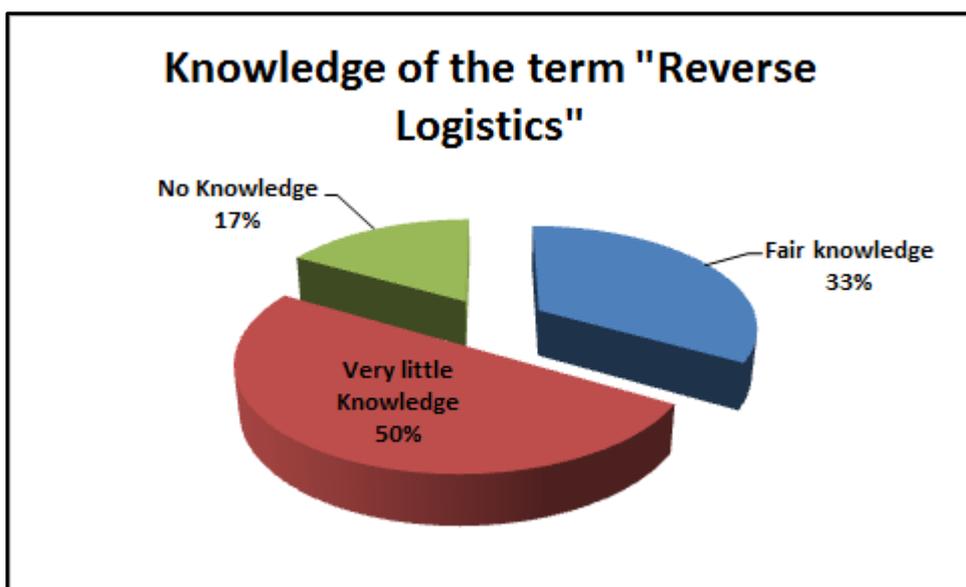


Fig.5

The **Fig.5** above gives the distribution of participants who had a fair knowledge about reverse logistics as opposed to those who had very little or no knowledge whatsoever.

From the **Fig.5** it can be seen that the share is pretty even. Since the number of participants involved in this survey is very small, it cannot be fairly judged whether this would stand true for the whole of the manufacturing world. But since all the participants admitted during the discussion that they had performed some or most of the reverse logistics activities in their company, it can be said that reverse logistics activities happen on a daily basis in every manufacturing company, and it does play an important role.

One of the objectives of this thesis was to find out how far has reverse logistics reached as a strategy and to find out whether reverse logistics plays an important role all through the manufacturing world or does it have an impact only on a company of a certain size, type of product etc... This led to the decision of contacting companies of all sizes and different primary products. It can be seen from **Table.7** and **Table.8** that 4 out of the 5 firms are manufacturing firms out of which 3 of them belong to automotive industry and one of them is among the leading computer manufacturers in the world. Only one of the responding firms belongs to the service industry and they also are involved in the supply chain consulting. This variety gave us the opportunity of taking perspectives from a multifaceted group of individuals. During the discussion it was found though that although all these companies have performed reverse logistics activities, they believe that reverse logistics plays an important role where products are consumed more frequently, and where interaction between producers and consumers is more frequent. I also had the same opinion after conducting the theoretical study, but since the last minute change in the target group didn't give much time to contact more FMCG and electronics companies where the above mentioned frequency can be seen, whatever little information was collected has been used efficiently to complete this thesis project.

Returns for any manufacturer are inevitable, so the only option for them is to device a return policy strict enough to reduce returns. Formulating return policies can be a tricky task, because a return policy very strict will make the customers to think twice before choosing them as the supplier, on the other hand a very lenient return policy will lead to too many returns. The **Fig.6** below shows the leniency of return policies of the participant companies.

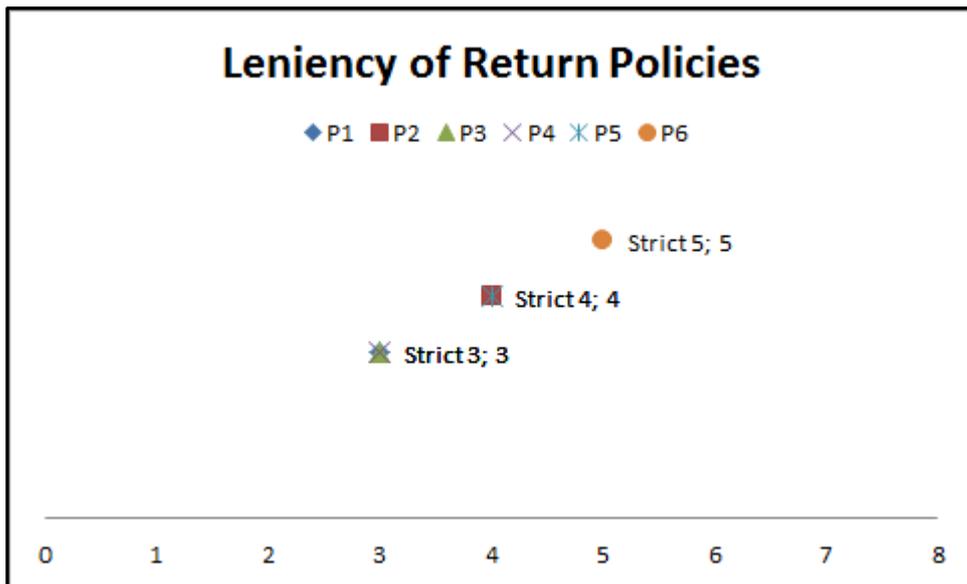


Fig.6

It can be clearly seen that the values vary very close to the midpoint in the scale given in the survey, through which it can be said that manufacturers have to give a trade off when formulating return policies, or else they will lose their customers to the competitors.

The returns according to the respondents, in their respective companies, vary between 5 to 10% of their total sales. The amount of returns depends on many factors like defects, quality, features, competition, return policies and the product itself according to the participants.

The **Fig.7** below shows the overall scores of the factors considered by the customers when choosing suppliers according to the participants. It can be seen that cost reduction and quality of service are the two most important factors which customers consider while choosing suppliers. Speed of delivery is the third

most important factor according to the responses given by the participants. A good reverse logistics process will increase the speed of delivery which in turn will improve the quality of service.



Fig.7

This shows that a good reverse logistics process can help in improving the quality of service to the customers. It can also be seen that return policies do not play a big role in choosing suppliers as long as the service is on par.

The returns processing cycle time plays an important role in the customer-supplier relation, because both the parties would like the returns processing cycle time to be as short as possible. The customer for the obvious reason of getting the product as quickly as possible back to the manufacturer, either to get a refund, replacement, or repair. Whereas the supplier would like to keep the returns processing cycle time short because the supplier would like to get value out of the returned product as quickly as possible to reduce the inventory costs, and balance their records. As for our respondents the returns processing cycle time varies between 2 and 6 weeks depending on the products. It is pretty obvious that the processing cycle time varies from product to product and company to company, because each company follows a different reverse logistics strategy and there is no standard strategy that works for all.

As mentioned earlier the objective of a short reverse processing cycle time from a manufacturer's perspective is to get value from the returned product as quickly as possible. And once the product has been received at the collection center, the manufacturer has several options to choose from to obtain value from the returned goods. Some of the most common options for obtaining value out of the returned goods have been mentioned in the theoretical background. The bar graph in **Fig.3** shows the distribution of the returned goods between each of the listed reverse logistics activities for the participating companies. It should be noted that the values in the **Table.11** as given by the respondents is only an estimate. From the table it can be seen that a big chunk of the returned goods go through remanufacturing and refurbishing. And the rest of the returned goods go through the other lines in the reverse logistics process in varied percentages. P5 in the table and bar graph represents the consulting firm and hence has no values filled in. Depending on the type of product and reusability of its components, and also many other factors like composition of the material used in the product these number may change, and hence these results don't hold true for the whole manufacturing world. But it can be said that the options mentioned in the survey are the most common ones chosen by most of the manufacturing firms to obtain value from the returned goods.

Although the participants have never heard of the term reverse logistics, once they learnt about it they believe that their firms have good reverse logistics processes prevalent in their companies. As seen in the pie chart in **Fig.4** 50% of the participants believe that their reverse logistics process can be considered as developed which means there is a growing focus on warranty recovery, increasing efforts to implement newer techniques are being made in their company and that they meet local and global environmental legislature. 16.67% believe that their reverse logistics process is excellent, which means that they have a world class reverse logistics process, they have minimized the warranty cost, they fully comply with the environmental legislature and that they have been able to recover revenue from waste materials. And another 16.67% believe their reverse logistics process is competent which means they have a strong

reverse logistics process and they are striving towards making it better on a regular basis.

From the responses to the question 10 in the survey it can be seen that all the respondents feel responsible to keep the environment clean, and all of them are striving to have a green image. And with the depleting resources and the rising cost is driving these companies to develop new strategies to improve their competitiveness in the manufacturing world and reverse logistics will play an important role in this regard.

The question that whether reverse logistics can be used as a strategy to stay competitive can be answered by looking at the opportunity of reducing cost to the company in the logistics department. Although according to the respondents reverse logistics cost make up only about 5 to 10% of their total logistics costs, it can still be considered an area of opportunity to reduce the overall cost for the company.

As a good corporate citizen it is necessary for the manufacturers to take responsibility in the safe disposal of their wastes and reuse as much of the waste material as efficiently as possible. It can be seen from our participants' responses that they are making efforts in this regard; by ensuring they clean and refine their waste before disposing it, and making it a mandate for their business partners too.

6. Conclusions and Recommendations

This project has tried to put together the basics concepts of reverse logistics and the benefits of having a good reverse logistics process. It was a tedious job to gather the information necessary to complete this project starting from collecting the data for the theoretical background, going through numerous articles to find the right kind of information, understanding the concepts, formulating the survey, getting the right people to respond on time, and finally analyzing the gathered data. After all this drama it can be seen that a majority of the manufacturing firms have no idea of what reverse logistics means. However, digging deeper it can be seen that reverse logistics processes and activities happen on a daily basis in the manufacturing world with or without the knowledge of the participants. During the discussions with the participants of the survey it was found that many of the reverse logistics strategies are in place in these firms, it's just that they are not aware that the activities that they perform on a regular basis is collectively known as reverse logistics.

It can be seen that reverse logistics does play an important role for the manufacturing firms to stay competitive. Also that having a good reverse logistics process in place leads to reduction in cost, optimal use of resources, better customer satisfaction and improved customer loyalty, reduction in returns process time, and creating a green image.

It is further recommended for these companies that they pay more attention to the reverse logistics processes as the cost for reverse logistics is around 5 to 10% of the total costs for logistics which is a small percentage but nevertheless an opportunity for improvement. And it is important for any company to try to continue improving their process if it has to survive for a long period in the market.

7. List of References:

- [1] Chawla, Saty, 2007, "Two Steps Forward, One Step Back...", p2-p3
- [2] Cope, David, 2006, "The increasing importance of reverse logistics in technology",
- [3] de Brito, Marisa P.; Dekker, Rommert; April 2003, "A Framework for Reverse Logistics", p1-p21
- [4] Dekker, Rommert; Fleischmann, Moritz; Inderfurth, Karl; Van Wassenhove, Luk N., 2004, "Reverse Logistics: Quantitative Models for Closed-Loop Supply Chains", Springer-Verlag, ISBN 3-540-40696-4
- [5] Fleischmann, Moritz, 2000, "Quantitative Models for Reverse Logistics", p5
- [6] Rogers, Dale S.; Tibben-Lembke, Ronald S., 1998, "Going Backwards: Reverse Logistics Trends and Practices"
- [7] Serrato, Marco; Ryan, Sarah M.; Gaytan, Juan, 2003, "CHARACTERIZATION OF REVERSE LOGISTICS NETWORKS FOR OUTSOURCING DECISIONS", p7-p12
- [8] Stock, James R., 1998, "Development and Implementation of Reverse Logistics Programs", Business Briefing: Global Purchasing and Supply Chain Strategies
- [9] Thierry, Martijn; Salomon, Marc; Van Nunen, Jo; Van Wassenhove, Luk, 1995, "Strategic Issues in Product Recovery Management", CALIFORNIA MANAGEMENT REVIEW, Vol.37 NO.2, p117-p120

8. Appendix

A. The survey:

Name:

Position:

Company:

Please answer all the questions in the below survey.

1. Have you heard about the term reverse logistics? If yes, what do you understand by it?

2. In which of the following channel positions do you operate? Check all that apply.
 - Manufacturer
 - Wholesaler
 - Retailer
 - Service Provider

3. What is your primary business?
 - Building, Materials, Hardware and Garden Supply
 - General Merchandise
 - Electronics and Computers
 - Food
 - Automotive
 - Chemical
 - Paper and Forest products
 - Apparel and Accessory
 - Furniture, Home Furnishings and Equipment
 - Drugs, Health & Beauty Aids
 - Warehousing
 - International logistics third party
 - Other, please specify _____

4. On a scale of 1 to 7, with 1 being very unimportant and with 7 being very important, rate the importance to your customers of each of the following in their decision to use you as their supplier:

Factor	Least Important							Most Important
	1	2	3	4	5	6	7	N/A
Cost reduction								
Price								
Quality of Service								
Return Policies								
Speed of Delivery								
Variety of products								

5. How strict or liberal are your return policies: Please respond between 1 and 7, where 1 is very strict and 7 being very liberal.
6. What is the percentage of returns based on the sales for last year?
7. What is the returns-processing cycle time for the products handled in your company?
8. Of the products that are returned by your customers, please estimate the percentage of goods represented by each of the following:

Activities	Percentage
Donated	
Recycled	
Remanufactured/Refurbished	
Repackaged and sold as new	
Resold as is	
Sent to central processing facility	
Sold at outlet store	
Sold to broker	
Land Fill	

Other, please specify _____	
-----------------------------	--

9. Choose one of the following which one are you (your company) when it comes to your knowledge about reverse logistics and the level of implementation in your company:
 - a) Innocent(No reverse logistics, no understanding of the benefits and need)
 - b) Understanding(Non-existent, or poorly developed reverse logistics but learning the importance)
 - c) Competent(Solid reverse logistics capability)
 - d) Developed(Increasing efforts to implement newer techniques, growing focus on warranty recovery, meeting environmental legislature)
 - e) Excellent(World class reverse logistic, minimizing warranty cost, full environmental compliance, revenue from waste materials)

10. Can you list out the benefits of a good reverse logistics process from your experience in your company?

11. What percentage of your total logistics costs do your Reverse logistics costs represent?

12. What kind of steps do you take to ensure the safe disposal of waste material?

13. Is your company certified with any environmental safety organizations or do you choose a third party for safe disposal or waste material?

14. How many people have you employed at this facility?

Dhananjaya Reddy

Masters in Product and Process Development-Production & Logistics

Mälardalens Högskola, Eskilstuna, Sweden

B. Contacts

Anand Babu. C

Deputy Manager (Product Development)

Ashok Leyland, Chennai, India

Anandbabu.C@ashokleyland.com

Mobile-+919789865988

Arthanareeswaran. B

Deputy Manager (Purchasing)

Ashok Leyland, Chennai, India

Arthanareeswaran.B@ashokleyland.com

Rupesh Kumar

Purchase Engineer

Hewlett-Packard, Bangalore, India

Rupesh.kumar@hp.com

Shaiju John

Technical writer

Textron India Pvt. Ltd., Bangalore, India

sjohn@textron.com

Prem Kumar

Production Manager

SunMax Engineering Works, Coimbatore, India

Mobile-+919488140088