**KAUNAS UNIVERSITY OF TECHNOLOGY**
**MECHANICAL ENGINEERING AND DESIGN FACULTY**

**Divya Selvarajan**

# INVESTIGATION OF INFLUENCE OF SUPPLY CHAIN OPERATIONS ON GLOBAL LOGISTICS

Final project for Master degree

**Supervisor:**
Assoc. Prof. Dr.Rasa Mankutė

**KAUNAS, 2016**

**KAUNAS UNIVERSITY OF TECHNOLOGY**

**MECHANICAL ENGINEERING AND DESIGN FACULTY**

**PRODUCTION ENGINERRING DEPARTMENT**

I APPROVE:

Head of Department: _____

(Signature) (Date)

Assoc. Prof. Dr. KazimierasJuzėnas

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Final project for Master degree

**INDUSTRIAL ENGINEERING AND MANAGMENT DEPARTMENT**

**(code: MEM –(3/9))**

**Project made by:**

Divya Selvarajan

_____

(signature) (date)

**Supervisor**

Assoc. Prof.Dr.Rasa Mankutė

_____

(signature) (date)

**Reviewer**

Dr. R.Rimašauskienė

_____

(signature) (date)

**KAUNAS, 2016**

**KAUNAS UNIVERSITY OF TECHNOLOGY**

**MECHANICAL ENGINEERING AND DESIGN FACULTY**
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Divya Selvarajan

Industrial engineering and management, ME M-(3/9)

# INVESTIGATION OF INFLUENCE OF SUPPLY CHAIN OPERATIONS ON GLOBAL LOGISTICS

## DECLARATION OF ACADEMIC HONESTY

12 January 2016

Kaunas

I confirm that a final project by me, **Divya Selvarajan**, on the subject "Investigation of influence of supply chain operations on global logistics" is written completely by myself; all provided data and research results are correct and obtained honestly. None of the parts of this thesis have been plagiarized from any printed or Internet sources, all direct and indirect quotations from other resources are indicated in literature references. No monetary amounts not provided for by law have been paid to anyone for this thesis.

I understand that in case of a resurfaced fact of dishonesty penalties will be applied to me according to the procedure effective at Kaunas University of Technology.

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# KAUNAS UN IVERSITY OF TECHNOLOGY
# FACULTY OF MECHANICAL ENGINEERING AND DESIGN

**Approved**:
Head of Production engineering Department

*(Signature, date)*

Assoc. Prof. Dr. Kazimieras Juzėnas

*(Name, Surname)*

## MASTER STUDIES FINAL PROJECT TASK ASSIGNMENT

**Study programme: Industrial engineering and management**

The final project of Master studies to gain the master qualification degree is research or applied type project, for completion and defense of which 30 credits are assigned. The final project of the student must demonstrate the deepened and enlarged knowledge acquired in the main studies, also gained skills to formulate and solve an actual problem having limited and (or) contradictory information, independently conduct scientific or applied analysis and properly interpret data. By completing and defending the final project Master studies student must demonstrate the creativity, ability to apply fundamental knowledge, understanding of social and commercial environment, Legal Acts and financial possibilities, show the information search skills, ability to carry out the qualified analysis, use numerical methods, applied software, common information technologies and correct language, ability to formulate proper conclusions.

1. Title of the Project

| |
|---|
| Investigation of influence of supply chain operations on global logistics |

Approved by the Dean on 11.12.2015 Order No. ST17-F-11-15

2. Aim of the project

| |
|---|
| To identify the problem and carryout the reverse logistics process effectively and also in a timely manner during product recall using project management tool |

3. Structure of the project

| |
|---|
| Summary, Introduction, Introduction, 1. Peculiarities of supply chain and logistics, 2. Methodology of risk analysis in reverse logistic system, 3. Analysis of risk and reverse logistics management at Nestle India, 4. Mapping of risks of product recall process in Nestle India, 5. Suggestions using project management tools, Conclusions, References |

4. Requirements and conditions

| |
|---|
| To prepare final project according to KTU regulations and requirements. |

5. This task assignment is an integral part of the final project.
6. Project submission deadline: 18. 12. 2015

Given to the student of industrial engineering and management
Task Assignment received: Divya Selvarajan _____
*(Name, Surname of the Student)* *(Signature, date)*

Supervisor Assoc. Prof. Dr. Rasa Mankutė _____
*(Position, Name, Surname)* *(Signature, date)*

Divya Selvarajan. Investigation of influence of supply chain operations on global logistics. *Master of Industrial Engineering final project* / supervisor Assoc. Prof. Dr. Rasa Mankutė, Kaunas University of Technology, Faculty of Mechanical Engineering and Design, Department of Production Engineering.
Kaunas, 2016. 58 pages.

## SUMMARY

Reverse supply chain has captured a special attention in recent years. Even now the main focus is on forward supply chain; the aim of this project is to identify the risks in the reverse logistics process and also to carry out the process in a timely manner by managing the priorities of the activities. A new management tool named DMAS where the abbreviation stands for Define, Map, Analyze and Suggest is introduced to carry out the reverse supply chain process efficiently. The case study about the recent recall which happened last June 2015 at Nestle India is used as a main base to use this management tool.

DMAS tool can be applied to regardless of any companies and the advantage of using this tool is that it is easy to apply and it gives a profound detail about every process that has to be undertaken to carry out. A crucial reverse logistics process, for example, the time required, resource required, priorities of the tasks can be figured out before beginning the reverse logistics process, so that each step which is taken in the reverse logistics operations will be measured so as to have a consistent flow of the products in the reverse direction without any additional delay.

Key words: supply chain, reverse supply chain, reverse logistics, DMAS, product recall, logistics, retailers, risks.

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Divya Selvarajan. Tiekimo grandinės operacijų poveikio globaliai logistikai tyrimas. *Pramonės inžinerijos magistro* baigiamasis projektas/ vadovas doc. dr. Rasa Mankutė; Kauno technologijos universitetas, Mechanikos inžinerijos ir dizaino fakultetas, Gamybos inžinerijos katedra.

Kaunas, 2016. 58 psl.

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## SANTRAUKA

Pastaraisiais metais reversinė (atvirkštinė) tiekimo grandinė sulaukia vis daugiau dėmesio. Nors dabar pagrindinis dėmesys yra nukreiptas į pirmyn nukreiptą tiekimo grandinę, šio darbo tikslas yra identifikuoti su reversinės logistikos procesu susijusią riziką, kad būtų galima laiku atlikti proceso veiklas atsižvelgiant į jų prioritetus. Reversinės tiekimo grandinės proceso efektyvumo analizės vykdymui pasitelkiamas naujas valdymo įrankis DMAS, kurio sutrumpinimas reiškia: „Nustatyti, Planuoti, Analizuoti ir Pasiūlyti“ (angl. Define, Map, Analyze and Suggest). Šis įrankis panaudotas analizuojant „Nestle“ padalinio Indijoje produkcijos atšaukimą 2015 m. birželio mėn.

DMAS įrankis gali būti pritaikytas bet kurioje įmonėje. Jo pagrindiniai privalumai – paprastas naudojimas ir išsamus kiekvieno proceso, būtino vykdant reversinę logistiką, detalizavimas. Tada reikalinga laiko trukmė, ištekliai, užduočių prioritetai gali būti sudėliojami prieš pradedant vykdyti atvirkštinės logistikos procesą taip, kad kiekvienas žingsnis, kuris yra įtrauktas į atvirkštinės logistikos operacijas, būtų apgalvotas ir būtų užtikrintas pastovus produktų srautas atgaline kryptimi, taip išvengiant papildomų atidėjimų.

Raktiniai žodžiai: Tiekimo grandinė, reversinė (atvirkštinė) tiekimo grandinė, reversinė logistika, DMAS, produkto atšaukimas, logistika, mažmeninė prekyba, rizika.

# CONTENTS

# INTRODUCTION

In today's world economy fierce competition and globalization has made manufacturers to give prime importance to their extended supply chain. The success of supply chain depends upon the organization's ability and efficient strategies carried out in order to reach the right product at the right time, right place and also at right quantity. All the elements starting from the raw material to the finished goods will be traveling across the chain with certain equilibrium if either of them gets disrupted the entire chain gets collapsed. So the companies are always cautious at their successful flow of their supply chain. The day to day products used and consumed by us travel across the global supply chain in order to reach us and every product has their own story. But it's common that most of the companies concentrate pretty much on their forward chain and neglecting the other side of the coin which is the reverse supply chain or which is well known as the reverse logistics.

Even well-known globalized companies cannot tolerate the recall and lacks in proper experience in knowledge in handling how to face the reverse logistics phenomena because they are well practiced with the forward movement of the goods but not the back words. One of the fundamental problem is the lack of transparency for example Some companies aware of their distributors but not the distributor's customer and that particular distributor's customer may be a sub distributor and then the sub-distributors customers they can be either wholesalers or retailers and finally the product reach the consumer.

Product recall can happen to any industry regardless of the size of the organization. Making proactive measures and strategies to carry out the reverse supply chain activity can prevent the companies to undergo a massive loss. In this project a hybrid tool named DMAS where the abbreviation stands for Define Measure Analyze and Suggest, is invented so as to carry the reverse logistics activity efficiently. Time is a prime factor in this reverse logistics activity because sooner the defect products are get backed, better the process reaches its end point without any complication.

**Aim of the project:**

To identify the problem and carryout the reverse logistics process effectively and also in a timely manner during product recall using project management tool.

**Project tasks:**

1. To analyze peculiarities of supply chain and logistics in enterprises and identify the potential risk.
2. To create the process flow of potential risks using the mapping techniques.
3. To analyze and evaluate the risks which is found in the mapping techniques using the risk quantification formula and create a risk matrix chart for the highest risks.
4. To analyze the causes of highest ranked risk using the cause and effect diagram
5. To identify the time required to carry out the reverse logistics process using project management tool.

# 1. PECULIARITIES OF SUPPLY CHAIN AND LOGISTICS

## 1.1.Supply Chain overview

Supply chain is a network created by different companies for producing, handling and distributing a specific product. In generalized manner it is the sequence of process involved in production and distribution of a commodity.

The APICS dictionary defines supply chain as the process from the initial raw materials to the ultimate consumption of the finished product linking across supplier or as the functions within and outside a company that enable the value chain to make products and provide services to the customers. Since the materials as well as the information flow up and down the chain, a supply chain thus includes firm's internal functions, upstream suppliers and downstream distribution channels reaching to the end of customers. This chain of suppliers, producers, distributors, retailers and customers comprises the supply chain. Thus the following are the five most important element of a supply chain. [1]

1) Suppliers of raw materials, components and sub-assemblies
2) Assemblers of final products
3) Distributors or wholesalers,
4) Retailers
5) End customers.


Figure 1.1. Visual Model of Supply chain

Supplier: A supplier is also known as a vendor, is a person or a group of people or companies that provide raw materials/ goods to the other companies for the development process of final product. A Supplier of components can also be the manufacturer. [2]

Producers: Producers are those who assemble the finished goods supplied by the suppliers or the manufacturers. [3]

Distributors: A distributor is an intermediate between the producers of a product and retailers, who receives the final goods from the producer and distribute them to the retailers in the target market place [4].

Retailers: Retailers are the ones who sell the goods or commodities purchased from the distributors to the end customers at fixed markup price. [3]

Customers: An individual or business that purchases the goods or services produced by a particular company directly from the retailers. The ultimate goal of all the business is the customers, since they are the one who pays for the supply and creates the demand. [5]

In a typical supply chain, raw material turned finished products are produced at one or more factories, shipped to warehouses for intermediate storage and then shipped to retailers or customers. Therefore, In order to reduce cost and improve service levels, effective supply chain strategies must consider the interactions at the various levels in the supply chain.

The supply chain, which is also referred to as the logistics network, consists of suppliers, manufacturing centers, warehouses, distribution centers, and retail outlets.

The network is created amongst different companies producing, handling and/or distributing a specific product. Specifically, the supply chain encompasses the steps it takes to get goods or services from the supplier to the customer. Supply chain management is a crucial process for many companies, and many companies strive to have the most optimized supply chain in order to have a significant reduction in the supply chain costs. Quite often, many people confuse the term logistics with supply chain. In general, logistics refers to the distribution process within the company whereas the supply chain includes multiple components / companies such as suppliers, manufacturers, and the retailers.

## 1.2.Logistics Overview

Logistics has been playing a vital role in global development for almost 5000 years now. On very many occasions exceptional logistics solutions have created the foundation for the transformation of logistics as a business conception emerged in the late 1950’s with high complexity and shipping out products in an increasingly globalized supply chain. Logistics is termed as the efficient flow of product from the point of origin to the point of consumption.

The CSCMP, the distinguished worldwide professional association of supply chain management professionals defines logistics as a part of supply chain management that plans, implements and controls the efficient and effective forward and reverse flow and storage of goods /services and related information between the point of origin and consumption [6]. The main fields of logistics include.

Procurement logistics: It is a process that comprises the activities that provide a manufacturer with raw materials, tools and other operational supplies. It allows selecting the suppliers, negotiating contracts for delivery of goods and services. It consists of activities such as market research, requirement planning etc. The procurement logistics is underlying factor for the success of a company, the reduction of material; procurement costs and the reduction of working capital which can enhance the profit of an enterprise significantly. [7]

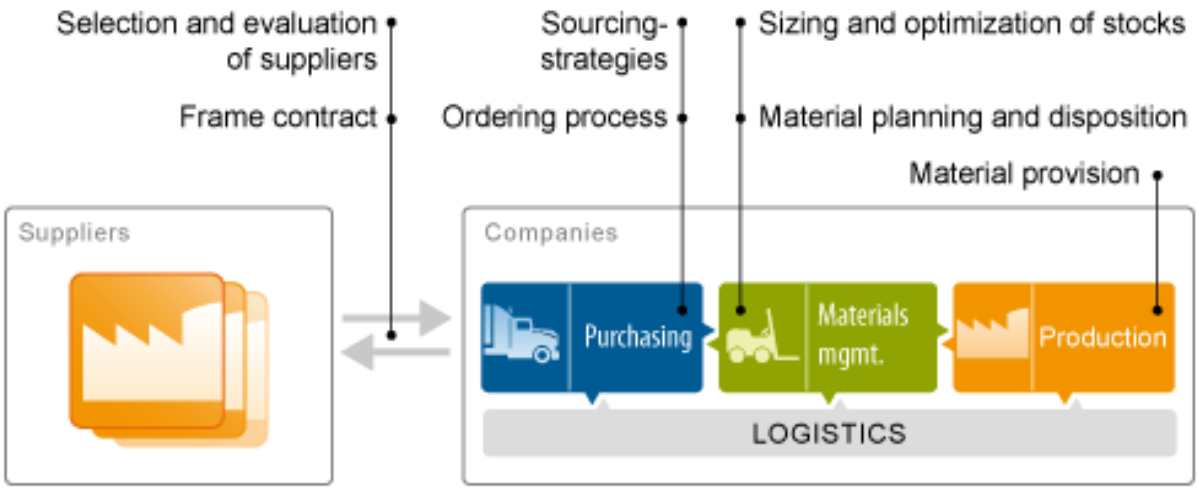


Figure 1.2. Procurement Logistics [7]

Production logistics: The production field of logistics deals primarily with maximizing the efficiency of production. Whether it is planning the factory layout or production line, controlling production elements or ensuring efficiency between processes, production logistics is at its heart. The objective of production logistics is to make sure that each machine and workstation is being fed with the right product in the right quantity and quality at the right point of time. Production logistics are related with organization concepts, layout planning, production quality and controls. [8, 9]

Distribution channels: It is the process of delivering the finished goods/products to the customers, the focal point of distribution logistics is the shipment of goods.

Green Logistics: Green logistics is a field that interlinks with other fields but simultaneously works to ensure reduced environmental impact. Companies that are required to adhere to strict environmental regulations often acquire a logistics partner that offers green logistics.

Disposal logistics: Whether it is a small business or large, disposing of waste materials within the confines and requirements of the law can be quite an arduous and resource-intensive task. However, with the right disposal logistics services, disposal costs can be minimized, ensuring compliance and increased profitability.

## 1.3.Reverse Logistics

A critical area of the supply chain is reverse logistics. Traditionally defined as the process of moving product from its point of consumption through channel members to the point of origin to recapture value or ensure proper disposal, this chapter utilizes more holistic definition. Reverse logistics includes activities to avoid returns, to reduce materials in the forward system so that fewer materials flow back, and to ensure the possible reuse and recycling of materials. As the reverse flows normally seek the reinsertion of used materials back into production systems for reprocessing and resale, often these systems are also called “closed loop” supply chains (Guide e van Wassenhove, 2002). The closed loop supply chains therefore are those composed of direct and reverse flows, forming “loops” that make materials (used or not) to return to upstream points of the network for reuse or reprocessing for reuse.[10]

Returns can affect every channel member from consumers, retailers and wholesalers to manufacturers. Returns occur due to different reasons depending upon who initiates them it might be the end consumer, wholesaler or retailer and manufacturer or upon on the nature of the materials involved in packaging or products. Recalls, commercial returns, wrong deliveries, warranties repairs & refurbishment and end-of-life returns are some of the many examples of reverse Logistics that companies face. It has historically been an undervalued part of supply chain management, but is currently gaining much more attention due to its direct impact on profit margins, company’s environmental image and corporate social responsibility.

### 1.3.1. Different categories of returns

Different categories of returns are [11]:

1. Commercial Returns: Returns for which there is an immediate demand at another market location or segment. Possible causes: customer dissatisfaction, catalogue sales, overstocks etc. Commercial returns occur in the sales phase or shortly after.

2. Repairable Returns: Defects and suspect components (modules/parts) from field (exchange) repair activities or products under warranty. Customer is entitled to a replacement product.

3. End-of-use Returns: Returned products/components which are not of longer use to the original owner, but for which new customers can be found. Reasons: end-of-season, end-of-lease, trade-in, product replacements etc.

4. End-of-life Returns: Items of no remaining use, which are processed due to contractual or legislative obligations. These returns are often collected and processed according to legislative obligations.

5. Recalls: Products recalled by the manufacturer due to a condition or defect that could affect its safe operation. Work on a recall is completed at no cost to the product owner.

Returned goods often go through the following activities depending on the return type:

1. Product Acquisition: Retrieval of the product back from the market. The timing, quantity, quality and composition of returned product need to be managed in close cooperation with other supply chain parties.

2. Collection Logistical: Activities (such as transportation, consolidation, transshipment and storage) to obtain the products back from the market and transport them to facilities involved in the other stages.

3. Sorting, Testing & Disposition: The classification (according to quality and composition) of returns and determination stage of the routes that the product will traverse in the reverse chain. Market and strategic conditions are taken into account in the disposition decision.

4. Recovery: The process of recovering value from the returned product by re-use, repair, refurbishment, recycling or other types of recovery.

5. Redistribution & Sales: Basically, no value recovery has materialized until the recovered products, component or materials are brought back into a forward supply chain.

Reverse logistics is becoming a critical part of product life cycle management since most of the attention is paid to the product management on the introductory phase. The ultimate aim of the business is taking good care of the customers, because customer satisfaction holds the key to long term success and providing options such as returning the sold products (defect products) without additional charge is a big part of the equation. Companies have varying degrees of success managing reverse logistics as well varying degrees of missed opportunities when not paying attention to this part of total supply chain.

### 1.3.2. Characteristics of reverse logistics

The reasons for returning products can be distinguished by where the returns commenced.

Listed below are the main return reasons [11]:

- Customer not satisfied

Most manufacturers and retailers allow customers to return products if they do not meet their demands within a predefined period. Money back guarantees are standard practice for most

direct sales channels. Consumers and retailers at times abuse the return policies of manufacturers. Consumers wishing to try a new product will sometimes abuse the 'not satisfied, money-back' guarantee and simply return the product within allocated return period and receive their money back.

- Installation or usage problems

Some customers experience problems with installation or usage of their recently acquired products. They perceive the product to be defective, while the reason for dissatisfaction is actually caused by difficult set-up or installation procedures or ambiguous instructions. this is a common problem in the computer industry where in some categories such as CD-ROM drives, return rates of 25 to 40 per cent are not uncommon. Complicated installation procedures and a lack of clear and simple instructions magnify the issue.

- Warranty claims

Flawed products or parts can be sent back to retailers or the manufacturer for repair. Products might either be dead on arrival, not working according to specifications or partly damaged. This could happen either to the retailer or the end consumer. Alternatively, products might break down during the time of their life cycle. If the product is still within the warranty period extended by the manufacturer, customers might return their product to the manufacturer or if that period has expired, customers could take up other options such as taking the product to a specialist repair center.

- Faulty order processing

Both end consumers and retailers can encounter shipping problems. Products need to be delivered in full and on time or customers can make claims against manufacturers and return (part of) their shipment. Examples of delivery problems are, incomplete shipments or missing parts, wrong quantities, wrong products, duplicate shipments and mistimed delivery, which can cause the customer to miss out on the purposive use of the product.

- Retail overstock

Manufacturers can provide resellers with the comfort of returning unsold stock. This is a usual policy in the book industry, for example. Retailers that need to make their accounting figures look good for the end of quarter or month will sometimes send significant amounts of unsold stock back for credits, only to reorder it again after the end of a financial period.

- End of product life cycle or product replacement

Once a product has reached the end of its lifecycle, many manufacturers want to get it out of the retailer's shelves as soon as possible to stop the sales cannibalization of the new products. This means that the old products have to be disposed of. Manufacturers either have to take the

stock back, based upon the conditions agreed with the retailers, or the latter need to dump the old version rapidly.

- Manufacture recall programs

Serious flaws in a product can lead to a recall, which is found either by the manufacturer or a government agency. Common recalls appear in the automotive, pharmaceutical, and the toy industry. Aside from the safety issues in such situations, getting the tarnished product out of product flow and taking it into the respective storage centers as soon as possible is a critical part of damage limitation strategies. The US Consumer Product Safety Commission in 1999 reported 304 corrective actions involving over 75 million consumer product units of various types that either violated mandatory safety standards or presented a substantial risk of injury to the public.

- Green Factor

New environmental laws are being enacted worldwide and more strict compliance to these laws is mandatory. The laws are usually followed with serious financial implications. Today, the green factor has evolved to a core issue. In the past once a product left the manufacturer's factory doors the duty to dispose the product also gone in the wind. However, legislation in Europe and in the US is changing, sometimes even making manufacturers responsible for the proper disposal of the product at the end of its life cycle, such as in Germany. Previously manufacturers could easily dispose of products in landfill; today there are strict environmental regulations as to how much and what can be dumped. Certain hazardous materials such as chemicals and heavy metals are banned from disposal in landfills, while other products are banned because they can be recycled and therefore should not occupy the valuable landfill space. Landfill costs have also increased steadily. These environmental reasons along with economic considerations cause a growing number of manufacturers to take their products back at the end of their lifetime.

## 1.4.Product Recall Risk Management in Supply chain

What is product recall? The answer is it is the process of retrieving defective goods from consumers and providing those consumers with compensation. Recalls often occur as a result of safety concerns over a manufacturing defect in a product that may harm its end customer or user.

For manufacturers today, brand name has become paramount. Perception among the customers goes hand in hand with a product's success or failure. This is something which is true for the multinational companies with revenues of US$10 billion a year or for a second

generation, family-owned business with sales 1,000 times less. Unfortunately, there are many ways a company's brand image can easily become damaged. Product quality and safety plays a vital role. Internal manufacturing errors, serious design faults or malicious tampering mean that, instead of highlighting the strength of the company's products to customers, the exact opposite can occur. The consequences to a manufacturer's profits and balance sheet can be severe, even fatal. The risk landscape is constantly changing with, for example, the benefits of social media in marketing products having a dangerous flip side when things go wrong. Consumer safety is growing in importance to governments around the world, so that the overall number of product recalls moves only in one direction that is it moves higher and higher.

Organizations such as CPG, food service, automotive, pharmaceutical or life sciences industries have their number one fear which is product recall. Hardly a week goes by without the media covering a recall and, according to the Stericycle Expert RECALL Index, there were few industries are immune to the very public nature of a product recall, not to mention the financial fallout and potential liability issues. A May 2010 report issued by Deloitte on behalf of the Food Marketing Institute (FMI), the Grocery Manufacturers Association (GMA) and GS1 determined the average cost of a product recall to be $10 million. That cost alone is enough to bring a large public corporation to its knees, not to mention the unquantifiable effect on reputation. When performing a recall, time is of the essence. But managing, monitoring and auditing the procurement, production, storage, transportation and handling of inventory during a recall presents a significant challenge to businesses up and down the supply chain. As the complexities expand, so do the laws and regulations enacted by countries around the globe designed to govern food and product handling ensuring consumer safety.

A recent research of senior supply chain executives at 130 brands with revenues in excess of $500M disclosed some alarming findings about the present condition of their companies trace track and recall capabilities. The study discovered a surprising degree of confidence among almost 30 percent of the executives who survived in the reverse logistics process and at the other end of the spectrum almost half of the companies accepted their incapacity to execute a recall within short duration of time.

Product recalls can cause a number of difficulties for companies, especially when they are unprepared. The need for quick withdraws of product throughout supply chains places an additional pressure on warehouse management systems to provide a clear picture of current inventory levels. Data collected in a centralized system can help companies find the recalled product throughout their distribution networks.

As the goods will be shipped back to the manufacturer, It sorts of creates capacity issues for the system. Removing merchandise from store shelves can lead to problems in transportation, as trucks may be unable to handle the additional loads. By constantly examining delivery routes, firms may be able to build contingency plans for handling recalled products. High-profile recalls require quick and efficient management. Contingency plans can help not only with recalls, but may also prevent delays due to disruptions. Companies with a strong reverse logistics plan can make use of their distribution networks to speedily remove the unsafe goods from their stores. [10, 11]

### 1.4.1. Managing the recall risk

A delayed or mishandled product recall can cost a company profoundly, so a pre-determined and crisis management plan is an essential factor. Consumer protection laws in developed countries require companies producing goods for the general public to have established processes for deciding when to notify suspected product defects to the appropriate regulator, when to recall the product and how to do it. A multinational business with many consumer product lines is likely to have experience with recalls compared to medium and small scale business. Cases going back more than 20 years have shown how a delayed or mishandled recall can damage the reputation of a business, sometimes irreparably. The advice of expert consultants is invaluable, both to reduce the risks and deal with any problems that do occur. Many of the steps involved in a recall are over-lapping and differ in urgency according to the severity of the threat or breach of regulations. Because of stringent reporting requirements, companies are frequently obliged to report the product safety issue and decide on a course of action before they have a clear view of the nature and extent of the problem. There are many direct costs associated with a recall, such as shipping, storing, replacing or destroying defective products. Expenses for managing public relations can add up quickly as well. Beyond direct expenses, other less obvious costs can loom even larger. Business interruption and lost profits are often the greatest cost of a product recall. Product liability from products that cause bodily harm to consumers or damage to property can also increase risk exponentially. Product recalls aren’t simple or inexpensive, but costs and potential risks can be managed with proper planning**.** [12-14]

Risk Management: Risk management is an organized/ structured approach of identifying, mitigating and assessing/evaluating risks to reduced losses incurred due to lack of risk management. It includes three steps namely risk identification, risk mitigation and risk evaluation and assessment. [15, 16]

Risk management process involves following three steps

• Risk identification- It is the first step in risk management process which helps identify the possible threats with respect to the system.

• Risk mitigation- It is the second step in risk management process that helps prioritize, evaluate and implement the proposed control method to the system.

• Risk evaluation and assessment- It is the third step in risk management process that analyze and evaluate whether the current control process is applicable to the system.

Risk management in reverse supply chain:

The global supply chain consists of a number of risks in various stages. In the reverse supply chain these risks / uncertainties are related to many factors such as acquiring products from customers, returned product quality, timing etc. Further risks can be categorized as internal risks and external risk. The internal risks in reverse supply chain include financial risks, strategic risk, transportation risk etc. The external are the ones where the system interacts with external environment such as customer risk, laws and regulation risk etc. [17-19]

### 1.4.2. Notable Recalls

While some recalls are modest, others are global in scale and can have a significant impact on a manufacturer and its brand reputation. While there has been thousands of product recalls over the past decade, some have made headlines worldwide due to the size of the recalls and the impact they have had on manufacturers. [20]

- Pharmaceuticals

SmithKline Beecham International recalled its bestselling Panadol paracetamol (acetaminophen) capsules from sale in all stores in Australia and destroyed large quantities of the product in June 2000 after receiving a contamination. Another Australian paracetamol maker, Herron Co., had received a similar contamination threat the previous March. Two people were hospitalized after taking Herron tablets, which were later found to be laced with strychnine. Panadol was re-launched with new tamper proof packaging in August 2000, but the extortionist soon struck again. On police advice, Smith Kline Beecham moved the painkillers off the counters and restricted sales to customer requests only. Even though the company was praised for the way it handled the crisis, for the company, consumer health care

managing director, Alan Schaefer, said in an interview that the revenue was “down a hundred million (Australian) dollars”.

- Toys Manufacturers

Mattel, the world’s largest toymaker, recalled approximately 21 million Chinese-made toys worldwide over five weeks in 2007, including its iconic Barbie dolls, because of lead paint contamination and tiny but powerful magnet hazards in some toy figures. One reason for the presence of the lead paint, Mattel explained, was that a sub-contractor in China had violated Mattel’s standards and used paint from an unauthorized third-party supplier. The company announced an immediate strengthening of its control systems and procedures. Its third-quarter 2007 results included incremental costs of approximately US$40 million related to the product recalls. “Mattel also pledged to significantly increase the frequency of its paint inspections, testing every batch delivered to every vendor, in order to prevent lead paint from being used in its toys.

- Food Industry

The Sanlu Group China’s dairy industry suffered a major blow in 2008 when it was discovered that the organic compound melamine, which causes liver damage, had been illegally added to milk to improve its tested protein content. It was an enormous scandal in China and impacted foreign companies which had bought milk products from China. The Chinese state news agency reported in July 2010 that food safety officials had seized further dairy materials contaminated with melamine, with the implication that traders were reselling tainted milk that should have been destroyed in 2008.

- Automobile Industry

There is no official figure for the total costs associated with the largest-ever motor vehicle recall, an estimated 14 million vehicles by the world’s largest car manufacturer Toyota Motor. However, the recall certainly cost billions of dollars. Starting in November 2008, Toyota ordered several recalls over a period of 18 months following claims that unintended acceleration had caused a number of fatal car crashes and other accidents. In 2010, the company indicated the costs would be around US$2 billion, but a further recall of 2.2 million vehicles followed in early 2011. The much admired Toyota suffered a real blow to its reputation for reliability and safety, especially in the United States. Not only did it face the expense of an enormous recall, but it also paid US$48.8 million in fines from US regulators for its handling of the recalls. The company’s share price dropped. It lost market share in the

United States as sales fell. The BrandZ survey of the top 100 global brands estimated that the company suffered a 27 per cent loss in its brand value in 2010. Toyota has since made significant repairs to its brand, and it has been able to boast of winning top safety and vehicle dependency awards from important organizations, such as J.D. Power and Associates. Its value in the 2011 global brands survey rose by 11 per cent. The company has not disclosed the cost of the extensive measures taken to restore customer confidence, such as the assignment of a chief safety technology officer and 1,000 engineers to component design and quality.

# 2. METHODOLOGY OF RISK ANALYSIS IN REVERSE LOGISTIC SYSTEM

The road map of the thesis work is represented in a diagrammatic manner. A hybrid management tool has been introduced by combining mapping techniques and project management tools. A schematic diagram of the methodology which will be applied in the later chapters of analysis is shown below.


Figure 2.1. Schematic overview of methodology

## 2.1. Identifying the type of supply chain

Every company has their own supply chain and each supply chain is unique from the other what, similarly what suits for one company may not suit for another. From the literature over view of supply chain the definition of supply chain is the sequence of process involved in production and distribution of a commodity. The xxx company which has been selected for the analysis phase will be identified with the type of supply chain it follows in its process. So once the forward chain has been identified the typical reverse supply chain can be drawn from

it. Example supply chain of Apple is shown below. Apple Inc purchases raw materials from various sources then get them shipped to assembling plant in China. From there, assembler will ship products directly to consumers (via UPS/FedEx) for those who buy from Apple's Online Store. For other distribution channels such as retail stores, direct sales and other distributors, Apple Inc will keep products at Elk Grove, California (where central warehouse and call center are located) and supply products from there. At the end of product's life, customer can send products back to nearest Apple Stores or dedicated recycling facilities. Apple Inc purchases raw materials from various sources then get them shipped to assembling plant in China. From there, assembler will ship products directly to consumers (via UPS/FedEx) for those who buy from Apple's Online Store. For other distribution channels such as retail stores, direct sales and other distributors, Apple Inc will keep products at Elk Grove, California (where central warehouse and call center are located) and supply products from there. At the end of product's life, customer can send products back to nearest Apple Stores or dedicated recycling facilities. [21]

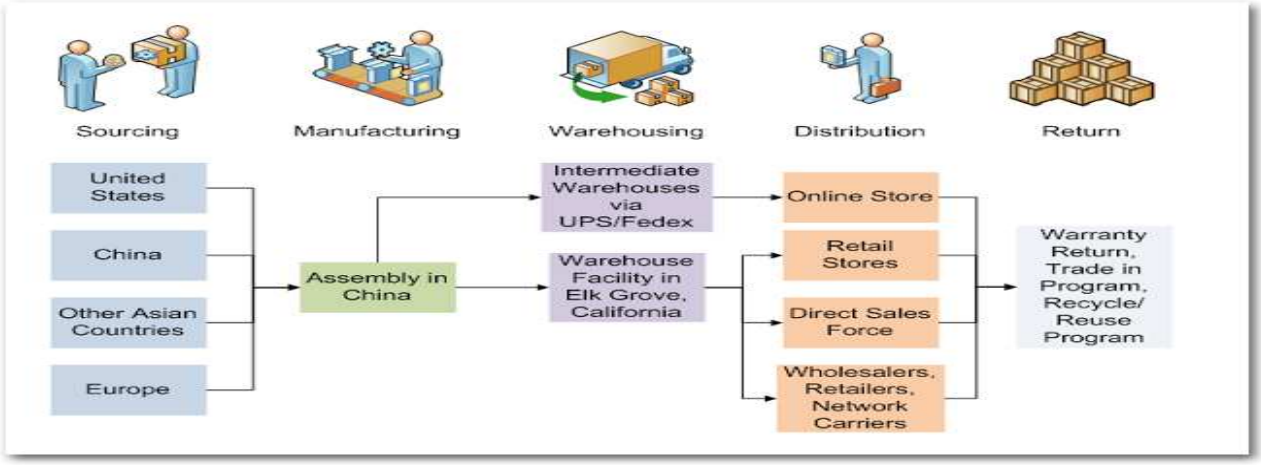


Figure 2.2. Supply chain of Apple. [21]

## 2.2. Framing the reverse supply chain from the forward supply chain

When a product is been identified as flaw by the customer, the point of origin starts from the customer in the process of reverse logistics. If the supply chain is extended and vast then the reverse flow of products becomes complicated depending upon the size of the chain. Traditionally defined as the process of moving product from its point of consumption through channel members to the point of origin to recapture value or ensure proper disposal, this chapter uses a more holistic definition. [22]

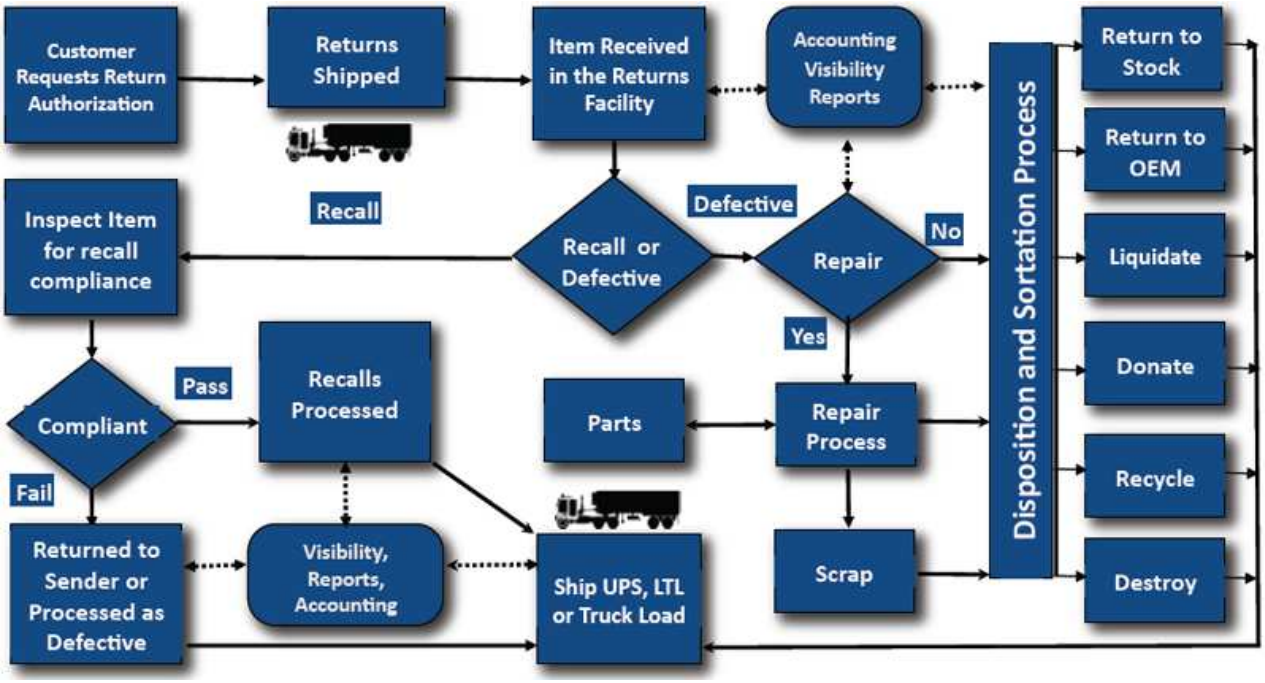


Figure 2.3. Reverse Supply chain.[22]

## 2.3. Identifying the potential risk

Organizations commonly develop and rely on rules as a primary tool for managing risk, equating compliance with overall effective risk management. While complying with rules may be adequate to manage certain types of risks, history has demonstrated that not all types of risk can be effectively dealt with through compliance-focused risk management. In this project new framework for defining and addressing an organization's risks that expands beyond rules-based models. [23]

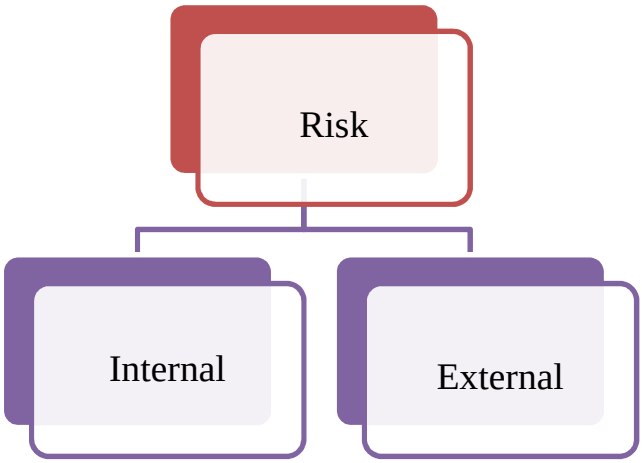


Figure 2.4. Classification of risk

An organization’s risks can be broken down into the following two categories:

- Internal risks, relative to an organization, that can be controlled (e.g. the risk of employee misconduct).
- External risks, relative to an organization, that is largely beyond control (e.g. the risk of impact from a natural disaster, like an earthquake).

  In the next page the various types of risks which come under both internal and external are explained.

Some of the various types of risks in supply chain:

- Supplier risk: Probability of loss occurring from unavailability of the necessary raw material.
- Financial risk: The possibility that shareholders will lose money when they invest in a company that has debt, if the company's cash flow proves inadequate to meet its financial obligations.
- Global risk: A global risk is defined as an occurrence that causes significant negative impact for several countries and industries over a time frame of up to 10 years.
- Transportation risk:
  The risk associated with the impact on project cashfows from infrastructure problems.Als o known as transportation risk.
- Operational disruption risk : Risk that deficiencies in information systems or internal controls will result in unexpected loss
- Facility risk: risks in Plant, machinery, equipment, property, buildings, vehicles, information systems, transportation facilities, and other items of infrastructure or plant and related systems that have a distinct and quantifiable function or service
- Information risk: IT security risk is the potential harm to a process or related information resulting from some purposeful or accidental event that negatively impacts the process or the related information.
- Process risk: also known as operational risk
- Technical risk: Technical Risk is simply the risk associated directly with the knowledge base being employed and its technical aspects including such things as understanding, reproducibility and the like.
- Schedule risk: Schedule risk is the risk that the project takes longer than scheduled. It can lead to cost risks, as longer projects always cost more, and to performance risk, if the

project is completed too late to perform its intended tasks fully. Apart from the cost estimation and resource allocation used in CPM, most of the techniques used in quantitative cost risk analysis are different from those used in schedule risk analysis.

- Human risk: Risk that the group may incur losses due to drain or loss of personnel, deterioration of morale, inadequate development of human resources, inappropriate working schedule, inappropriate working and safety environment, inequality or inequity in human resource management or discriminatory conduct.
- Quality risk: Quality risks are defined as the risk associated to the quality product across the product lifecycle.
- Compliance risk: Compliance risk is exposure to legal penalties, financial forfeiture and material loss an organization faces when it fails to act in accordance with industry laws and regulations, internal policies or prescribed best practices.
- Strategic risk: Strategic risks can be defined as the uncertainties and untapped opportunities embedded in your strategic intent and how well they are executed. As such, they are key matters for the board and impinge on the whole business, rather than just an isolated unit.
- Environmental Risk: The risks with which this report is concerned are all in some way 'environmental'. They arise in, or are transmitted through, the air, water, soil or biological food chains, to man. Their causes and characteristics are, however, very diverse. Some are created by man through the introduction of a new technology, product or chemical, while others, such as natural hazards, result from natural processes which happen to interact with human activities and settlement.
- Reputational Risk: A threat or danger to the good name or standing of a business or entity. This risk can occur through a number of ways: directly as the result of the actions of the company itself; indirectly due to the actions of an employee or employees; or tangentially through other peripheral parties, such as joint venture partners or suppliers.
- Recall Risk: A product recall is a request to return a product after the discovery of safety issues or product defects that might endanger the consumer or put the maker/seller at risk of legal action.

## 2.4. Mapping the risks and sub risks

Risk can impact an organization in many different ways, however, the largest impact a risk can have is the potential chain reaction of other risks that may follow. This occurs in supply

networks for the reason that there are multiple links and processes connecting different locations in the network. As a result, multiple risks are connected and linked together as well.

Before assessing risks, a process box for each risk in the organization should be drawn. Secondly linking each risk to other risks it may affect. Lastly, organizing risks in hierarchy order to visualize impact of each risk.

Step1: creating a process box for each risk


Figure 2.5. Process box of risks

Step 2: Linking each risk with its associated sub risks

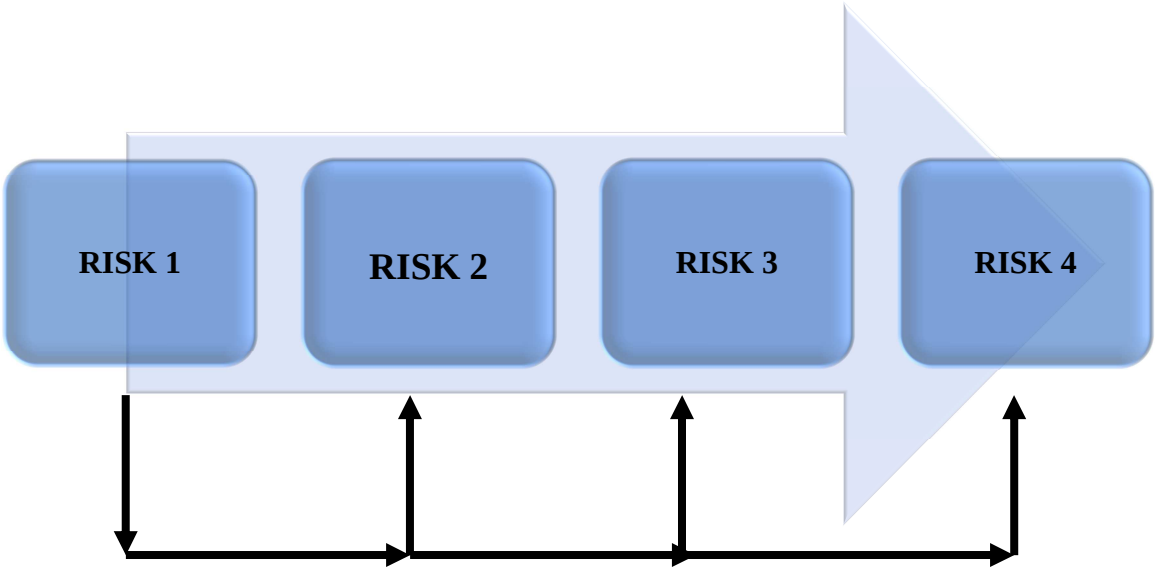


Figure 2.6.Linking of associated sub risks.

Step 3: Organizing the risks in hierarchical order

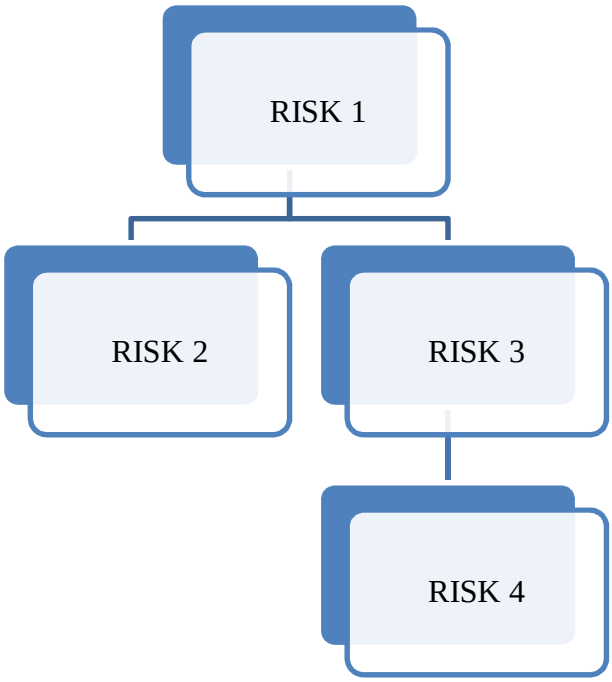


Figure 2.7.Hierarchy of risks.

Mapping of risks and creating a risk impact diagram of all the risks in the organization allows management to visualize the potential chain reaction of risks. In addition, the risk impact diagram illustrates how an individual risk or event is capable of affecting several other risks. However, it can also display several risks and events influencing only one individual risk. Risks can also be grouped together if they are all in the same location or have similar affects. The process of creating this diagram will also help assess and quantify risk impact further on in this chapter.

## 2.5. Quantifying and Assessing of risks

Once risks have been identified and located, they must then be assessed as to their potential severity of loss and to the probability of occurrence, these quantities can be either simple to measure, difficult to know for sure in the case of the probability of an unlikely event occurring. Therefore, in the assessment process it is necessary to make the best educated guesses possible in order to properly prioritize the implementation of the risk management plan. The fundamental difficulty in risk assessment is determining the rate of occurrence since statistical information is not available on all kinds of past incidents best educated opinions are the primary source of information. A scoring system is proposed in this model to measure impact and probability of risk. Using levels of High, Medium, and Low, each risk will be given an impact score and a probability score based on the following tables. [24]

Impact – A risk, by its very nature, always has a negative impact. However, the size of the impact varies in terms of cost and impact on health, human life, or some other critical factor.

Table 2.1. Impact of Risk Scoring Table Impact of Risk

| IMPACT OF RISK | |
|---|---|
| LEVEL | SCORE |
| HIGH | 3 |
| MEDIUM | 2 |
| LOW | 1 |

Probability – A risk is an event that "may" occur. The probability of it occurring can range anywhere from just above 0 percent to just below 100.

Table 2.2. Impact of Risk Scoring Table Impact of Risk

| PROBABILITY OF RISK | |
|---|---|
| LEVEL | SCORE |
| HIGH | 3 |
| MEDIUM | 2 |
| LOW | 1 |

The following formula is used for risk quantification of individual risk,

$$R_r = I_r \times P_r \quad (2.1)$$

Where, $R_r$= Total risk of risk r

$I_r$= Impact score of risk r

$P_r$= Probability score of risk r

Using the scoring tables and the risk quantification formula, we can conclude the following for an individual risk:

Table 2.3. Total Risk Score

| Total Risk Score | |
|---|---|
| Range of $R_r$ | 1-9 |
| Maximum $R_r$ | 9 |
| Minimum $R_r$ | 1 |

## 2.6. Cause and Effect diagram

After evaluating the risks, the risk with high score will be evaluated and the cause and effect diagram will be drawn for it. Cause-effect diagrams are a simple and pragmatic way of doing root cause analysis. A cause and effect diagram, also known as an Ishikawa or “fishbone” diagram is a graphic tool used to explore and display the possible causes of a certain effect. Use the classic fishbone diagram when causes group naturally under the categories of Materials, Methods, Equipment, Environment, and People. Use a process-type cause and effect diagram to show causes of problems at each step in the process. A cause and effect diagram has a variety of benefits it helps teams understand that there are many causes that contribute to an effect. It graphically displays the relationship of the causes to the effect and to each other. It helps to identify areas for improvement. [25] A sample picture of a cause and effect diagram is described below.

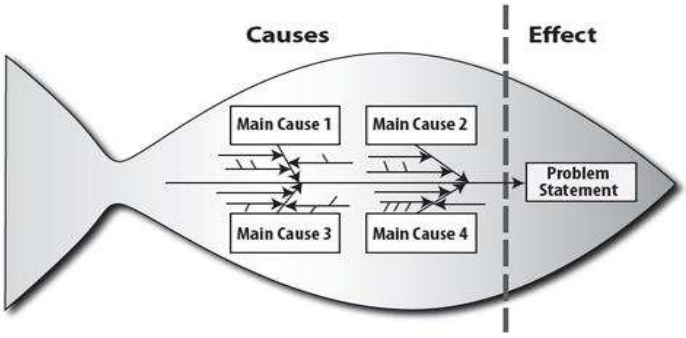


Figure 2.8. Fishbone Diagram or Cause and Effect diagram.[25]

# 3. ANALYSIS OF RISK AND REVERSE LOGISTICS MANAGEMENTAT NESTLE INDIA

## 3.1. Company's background

Nestlé India is a subsidiary of Nestlé S.A. of Switzerland with eight factories and a large number of co-packers, Nestlé India is a vibrant company that provides consumers in India with products of global standards and is committed to long-term sustainable growth and shareholder's satisfaction. It is acknowledged amongst India's 'most respected and reputed companies' and amongst the 'top wealth creators of India. [26]

Nestlé India has many brands mostly in the food and beverages segment many of its brands are household names in India (for example curry, masala). The several brands of Nestlé India can be divided into four categories:

1. Milk Products & Nutrition
    - Nestlé everyday
    - Nestlé milk
    - Nestlé nesvita
    - Nestlé fresh 'n' natural
    - Nestlé cerevita
    - Nestlé milkmaid
    - Nestlé nido
2. Coffee And Beverages
    - Nescafé
    - Nestlé milo
    - Nestea
3. Prepared Dishes & Cooking Aids
    - Maggi noodles
    - Maggi dehydrated soups
    - Maggi seasonings
4. Chocolates & Confectionery
    - Nestlé Kit Kat
    - Nestlé munch
    - Nestlé milky bar
    - Nestlé bar-one

- Nestlé milk chocolate
- Polo
- Nestlé éclairs

## 3.2. What kind of risk occurred in Nestle India?

Answer**:** Product Recall Risk.

Companies today must understand that the ability to manage the product throughout their life cycle is very important right from the phase of transforming raw materials to finished goods. Product recall risk occurs due to the reason that the product may cause some harm to the customers due to the defect it carries with in itself these defect arises mainly because of the mistakes in the manufacturing process. The reason why nestle India one of the world's leading food manufacturers was requested by food safety authority of India ( FSSAI) to recall the famous instant noodles maggi from India due to the detection of lead levels above the allowable limits and also findings of Monosodium glutamate. Nestle India announced that it would momentarily stop selling maggi noodles until the situation was resolved. [27]

Some of the reasons why recalling of product produced by food manufacturers happens:

- Discovery of hazardous chemicals which may cause severe impacts on the health of the customers.
- Discovery of potential allergen in a product
- Mislabeling or misbranding of the food product.

### 3.2.1. Process of recall

After the official announcement of withdrawal of the instant noodles from the market on June 5$^{th}$ 2015, Nestle India estimated that there were 27,420 tonnes of maggi noodles in the factories / distribution centers / distributors / market on 5th June 2015. The 27,420 tonnes of maggi, that's half the weight of the Titanic, or equal to a modern medium-size cargo ship at full capacity is believed be contain 400 million packets of noodles. The reason why the above mentioned numbers were just estimation because stocks which was with customers and retailers and in customers home was not under control, making it difficult to be certain of how much had been consumed and how much was stored. [28-30]

### 3.2.2. Nestle India's Supply chain.

With the details given by the Nestle India at theory official websites it has been stated that the Nestle has 8 factories across India, out of eight, five manufacturing sites produce the instant maggi noodles. So according to the calculation five out of eight and when converted in terms of percentage it is about 62.5 % out of 100 % of total production and 38 distribution centers which are under direct control of Nestle India. From these distribution centers the products are sold to 1400 distributors once the product has been sold they are no longer under Nestlé's direct control. These distributors sell to other distributors or retailers. Direct selling of nestle products are also made to big retailer chains of India like Bharti-Walmart, Reliance, Big bazaar. With the estimation around 3.5 million outlets in India by nestle it is said that half of the outlets covered by the supply chain through 1400 distributors the rest are covered by other routes to the markets. The below tabular columns represents the production percentage of Nestle products across the eight manufacturing sites in India.

Table 3.1. Nestle India Products Production percentage

| Nestle India Manufacturing sites | Percentage of Nestle Maggi production | Percentage of other Nestle products production. |
|---|---|---|
| Site 1-5 | 100 % | 0 % |
| Site 6-8 | 0 % | 100 % |

From the details described in the previous page it is clearly stated that said that out of eight manufacturing plants 5 produces the maggi instant noodles. So in terms of percentage 62.5 % maggi products are produced in the 5 manufacturing plants.

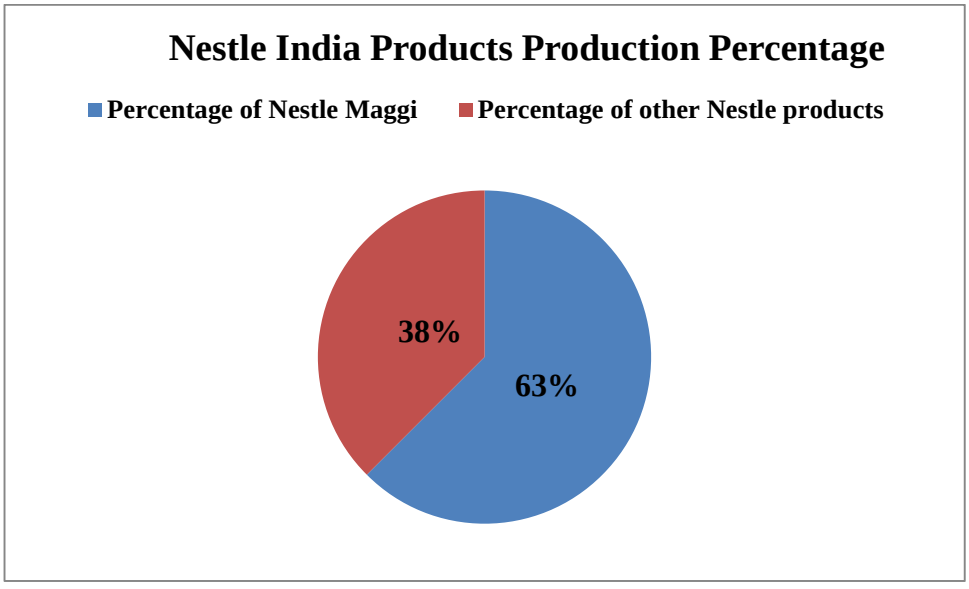


Figure 3.1. Nestle India production percentage

## 3.3. Supply chain of Nestle India

As mentioned in the beginning of literature part every company has their own supply chain depending upon their size and expansion around the country or across the globe. With the information collected from Nestle India, the supply chain diagram of nestle India consists of 8 manufacturing plants , 38 distribution centers , 1400 distributors and the chain extends further till it reach the end customer which is the consumer of their products who purchase from super markets or other small provisional or retail outlets. The supply chain diagram of Nestle India is represented graphically in the next page.

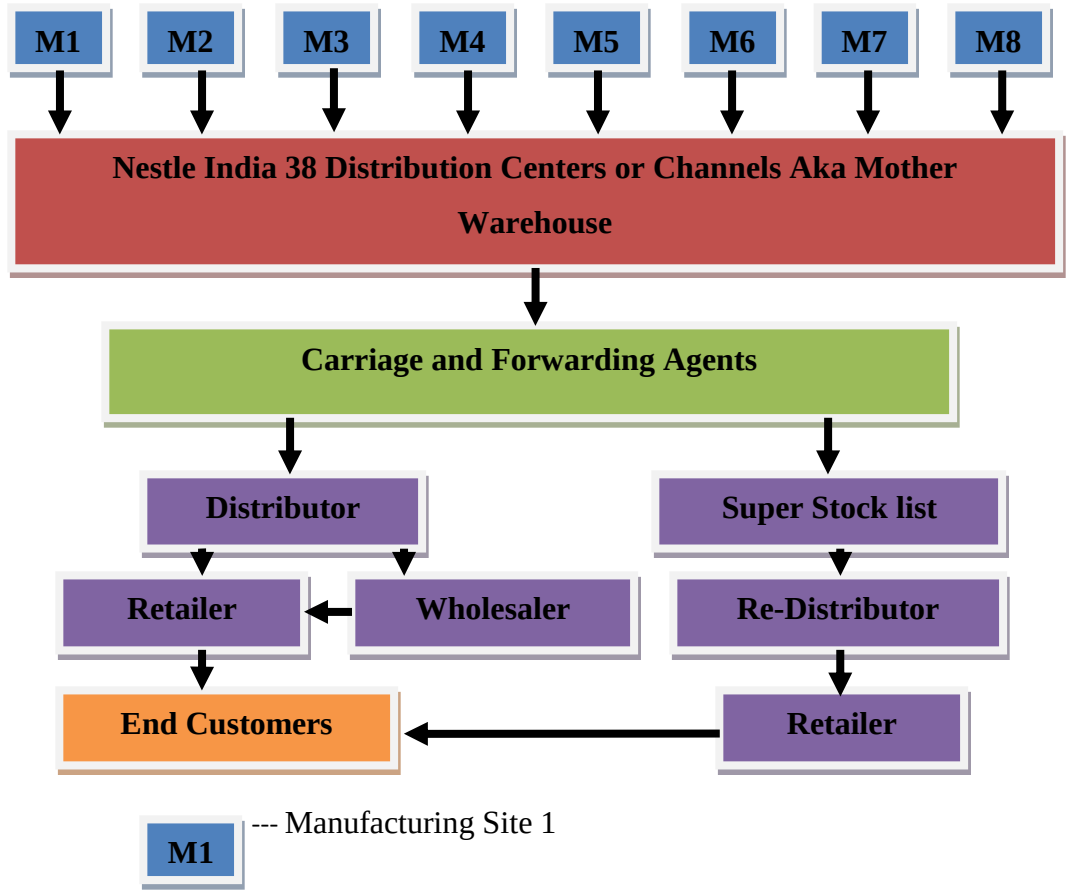


Figure 3.2. Supply chain of Nestle

## 3.4. Framing the reverse supply chain

In the previous chapter the supply chain of Nestle India is represented ideologically through the collected information about the organization. Since it is a massive recall of 27000 tonnes the formation of reverse supply chain through the glimpse of forward supply chain is necessary. It is not obligatory that all the reverse chain should start from the end customer,

depending upon the nature and price of the product, the point of origin in the reverse supply chain differs from product to product. Nestle India requested all the retail outlets and its distributors to return the goods to its mother warehouse and from the warehouse the recalled products are taken to the destruction point.

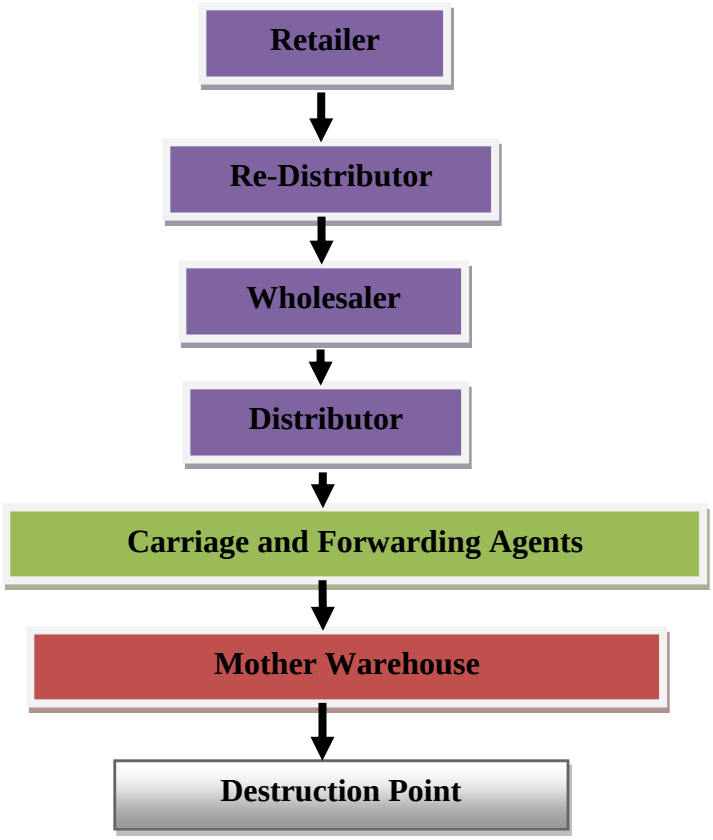


Figure 3.3. Ideological reverse supply chain of nestle India

# 4. MAPPING OF RISKS OF PRODUCT RECALL PROCESS IN NESTLE INDIA

The main reason for a product recall is due to the poor quality standards which are associated with product quality risk. Since supply chain is an interlinked process, trigger of one risk will obviously influence the other elements of risk corresponding to it. So the situation of Nestle India is the product recall risk which is the result of product failure due the confirmation of lead content above the permissible level by FSSAI(The Food Safety and Standards Authority of India) during the quality test and inspection.

In this section mapping of risks and the interlinked risks associated with the major risks will be discussed. The first step is to create a process box of each risk. The second step is to link each risk with its associated risk that is if risk A occurs what are all the risks pops out due to the trigger of Risk A and it will be linked using the arrow mark. The third step is to draw a hierarchy diagram of the entire risks.

Step 1: Creating a process box diagram of risks.

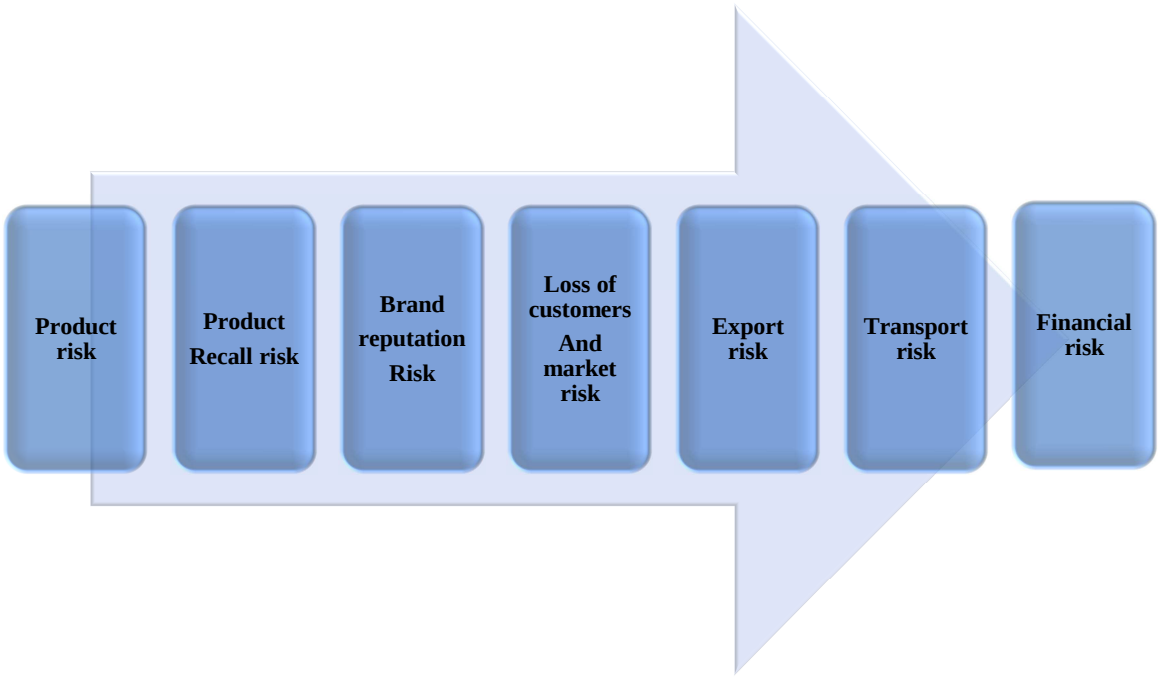


Figure 4.1. Process box of risks

Step 2**:** Linking the risk with its associated risk

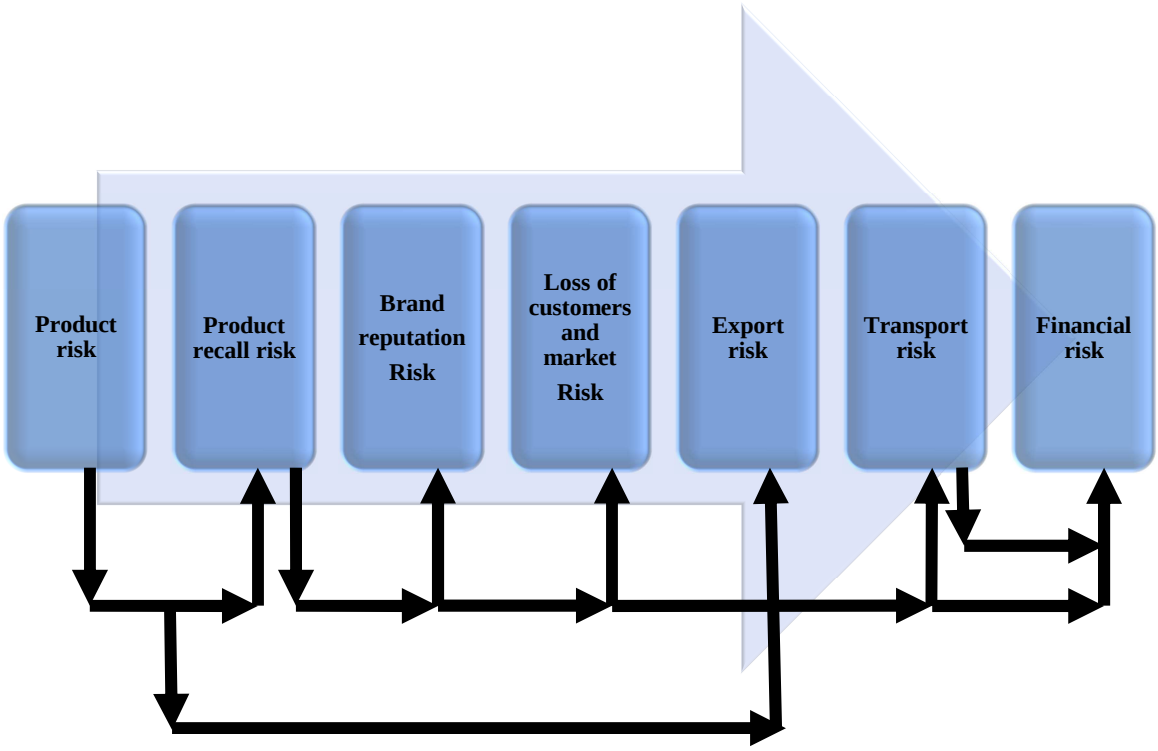


Figure 4.2. Linking the risk with its associated risk

- Explanation of the diagram

The first risk in the process diagram is the product risk so when this risk occurs the other risks ultimately pops out, product risk occurs due to the quality failure or product defect so when such risks occurs the it will automatically lead to the recall of the product which was sold in the market, when the recall risk appears it will lead to brand reputation risk and the loss of customer satisfaction. Export risk appears when it has quality defect and affecting the potential exportation process to other foreign markets. And above all the next risk is quite complicated which is the transportation risk to get back the product for the reverse logistics process, carrying out transportation process is not successful without a sound financial support.

Step 3: Drawing the hierarchy diagram of the process


Figure 4.3. Hierarchy diagram

Creating a risk hierarchy diagram of all the possible risks that can occur due the trigger of one main risk in the organization allows management to know the reaction of each risk in the supply chain. Obviously each risks cause different impact but the ultimate result would end in loss. In addition, it also illustrates how an individual risk or event is capable of affecting several other risks. However, it can also display several risks and events which were influenced by one individual risk.

## 4.1. Quantity Analysis of Risk

Once risks have been identified and located, then calculating the potential risk and probability of occurrence must be done. They can be either simple or difficult to know for sure in the case of the probability of an unlikely event occurring. Therefore, making the best educated guesses should be made using the available statistical information on all kinds of past incidents and the primary source of information. So it is necessary to evaluate the level of magnitude of risks which has been analyzed.

A scoring system is proposed in this model to measure impact and probability of risk. Using levels of High, Medium, and Low, each risk will be provided with an impact score and a probability score based on the following table

Impact – A risk, by its very nature, always has a negative impact. However, the size of the impact varies in terms of cost and impact on health, human life, or some other critical factor.

Table 4.1. Impact of Risk Scoring

| IMPACT OF RISK | |
|---|---|
| LEVEL | SCORE |
| HIGH | 3 |
| MEDIUM | 2 |
| LOW | 1 |

Probability – A risk is an event that "may" occur. The probability of it occurring can range anywhere from just above 0 percent to just below 100.

Table 4.2. Probability of Risk Scoring

| PROBABILITY OF RISK | |
|---|---|
| LEVEL | SCORE |
| HIGH | 3 |
| MEDIUM | 2 |
| LOW | 1 |

The following formula is used for risk quantification of individual risk,

$$R_r = I_r \times P_r \tag{4.1.}$$

where, $R_r$ = Total risk of risk r

$I_r$ = Impact score of risk r

$P_r$ = Probability score of risk r

Using the scoring tables and the risk quantification formula, we can conclude the following likelihood score for an individual risk.

Table 4.3. Likelihood score risk

| Total Risk Score | |
|---|---|
| Range of $R_r$ | 1-9 |
| Maximum$R_r$ | 9 |
| Minimum $R_r$ | 1 |

Now Type of risks enlisted in the process box diagram will be calculated with the above mentioned formula. After awarding of the total scores for likelihood and impact of risk categories will proceed to multiplying the two variables. Once the calculation are done based on the formula it will help to prioritize risks. Once this part is done effectively, the organization can focus the majority of their time and effort on the most important risks.

The different types of risks that have been analyzed previously are applied using the stated formula above and they have been ranked from the scale of 1-9 in the following table.

Table 4.4. Likelihood score risk

| $R_r = I_r \times P_r$ | | | |
|---|---|---|---|
| Types of risks | Impact $I_r$ | Probability $P_r$ | Total $R_r$ |
| Product quality | HIGH | LOW | 3 |
| Product recall | HIGH | MEDIUM | 6 |
| Brand reputation | HIGH | LOW | 3 |
| Loss of customers& Market | MEDIUM | MEDIUM | 4 |
| Export Risk | MEDIUM | LOW | 2 |
| Transportation Risk | HIGH | HIGH | 9 |
| Financial Risk | HIGH | MEDIUM | 6 |

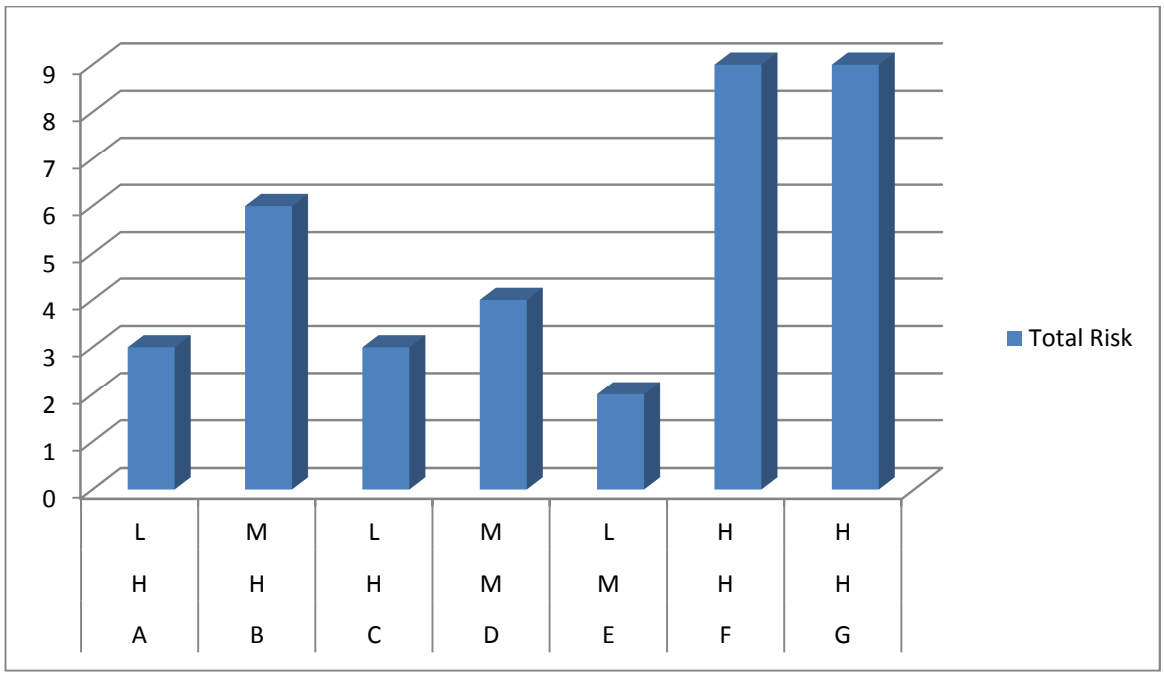


Figure 4.4. Risk impact and probability chart

Where, A- Product quality, B-Product recall, C-Brand reputation, D-Loss of customers& Market, E-Export Risk, F-Transportation Risk, G-Financial Risk, L-LOW, M-MEDIUM and H-HIGH.

In the previous page in the risk matrix chart, the transportation risk and the finance risk was ranked highest among all other risks, the reason for providing high value for the transportation risk is because, Nestle India required 2500 trucks and above in order to recollect the 27000 tonnes of maggi noodles across the country which is a very complex system and it will lead to additional cost for the reverse logistics operations. This systemic risk across the supply chain and transport network needs a high level of collaboration among the organization. Additionally telephonic surveys were made at 20 big retail chains outlets across India to name a few, Reliance, Walmart India, Big bazzar, Nilgiris. Out of 20, 16 store managers accepted that the recall process was laborious but the products were sent back to their own distribution center via the trucks which comes weekly twice to drop the goods to the supermarket and Nestle India obliged to recollect from individual retail chain's distribution centers, but financially nestle had paid back for the returned goods and also the supermarkets personally experienced loss of sales for the particular maggi brands due to their ban on sales and production.

## 4.2. Cause and effect diagram

Once the total score of the risk has been identified, it is indeed necessary to investigate about its impact. The effect which will be discussed about is the transportation risk. Why the transportation risk is high, what are the reasons behind a transportation risk will be illustrated visually using a cause and effect diagram. As discussed earlier in the literature review cause and effect diagram is a graphic tool used to explore and display the possible causes of a certain effect. The effect is represented on the right hand side and the causes are represented on the left hand side direction in the following diagram. Seven main causes of transport risk are labeled in the alphabetical order from A to G and they are **(A)** insufficient trucks, **(B)** insufficient man power or poor skilled drivers, **(C)** high fuel cost, **(D**) capacity shortage, **(E)** excessive cost of warehousing. **(F)** Delays or misroutes, **(G)** incorrect loading (wrong product, right truck or right product wrong truck).

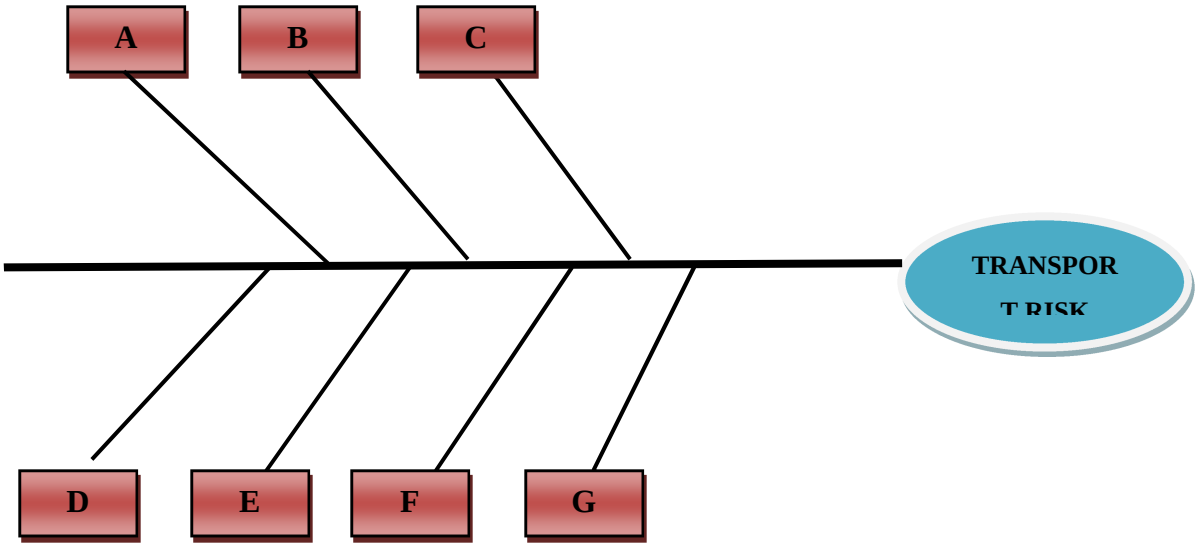


Figure 4.5. Cause and Effect diagram for Transport risk

- Insufficient trucks

If a manufacturing company has to retrieve their product back from the market, it has to analyze the products in terms of weight, quantity, nature of the product for example if the product is fragile, combustible non-combustible etc. Later the company has to figure out whether it has the suitable and sufficient truck to carry out the recall process if not it becomes a tangled situation. The company has to manage with available resources which add extra layer of complexity to the company such as additional time, labor, and fuel cost in order to carry out the recall process. This is one of the important causes leading to transport risk.

- Insufficient Man Power or Poor skilled truck operators

Though the company has sufficient infrastructure it carry out the recall process, the important power to operate them is the manpower. If a driver is not there to operate the truck the process will be paused for certain time until someone comes to occupy the space but in all the possible cases it will lead to delay of the entire process. Other situation is if the truck is operated by a person with an inadequate skill it might lead to accidents or breakdowns.

- High Fuel Cost

Skyrocketing fuel prices have affected the supply chain and the fuel price occupies the lion's share of the operation cost. Many companies are under mounting pressure because of the hike in fuel cost which increases the freight transportation cost and an imbalance to meet the supply and demand. During the recall or reverse logistics activities especially when the transportation activity is done by in-house, the company is forced to take the losses.

- Capacity Shortage

Capacity crunch is another problem in the logistics activity. If the truck capacity is 30 tonnes and the product that required to be fetched from the market id f 60 tonnes and there is no other spare truck available the truck has to proceed the journey an additional time in order to carry the other 30 tones which leads to extra time, additional fuel cost and labor cost.

- Excessive Cost of Warehousing

Storing back the recalled products results in keeping more inventories on hand than what is necessary additionally it increases the handling cost and working capital.

- Delays or Misroutes

This often extends the transit time of either taking the product from the warehouse to the market and vice versa. Delays occur due to external events such as traffic, weather etc. Misroutes happen when the drivers are not skilled enough. They might not be very good with the orientation or mapping skills which lead to misroutes of trucks; this happens especially with newly hired drivers.

- Right Product, Wrong Truck or Wrong Product, Right Truck.

The accidental swapping of products or truck happens when there is lack of communication, mistakes in schedules eventually causing transport risk.

# 5. SUGGESTIONS USING PROJECT MANAGEMENT TOOLS

Once a product recall occurs it is very important to frame the reverse logistics system which is also known as the reverse supply chain in which the flow of the product will be in the reverse direction which starts from the customer while returning the product from point of destination (where the product is sold or bought.) to the point of origin (where the product is made). What is very important in reverse supply chain is how long it will take to get back the defect product from the customers or from the market to the point of origin either to recycle or to destroy depending upon the condition of the product. So it is indeed necessary to evaluate the time it takes to complete the project. Before any activity starts related to the work of a project, all project requires advanced, accurate time estimation, without an accurate estimation, no project can be finished within the budget and the target completion date. Developing the estimation is a complex task. If the project is large and has many stakeholders, things can be more complex. Therefore, many strategies have been developed to come up with different techniques for estimation phase of the project in order to make them more precise. [31]

PERT (Program Evaluation and Review Technique) is one of the successful and proven methods among the many other techniques, such as, CPM, Function Point Counting, Top-Down Estimating, WAVE, etc. The Program Evaluation and Review Technique (PERT) is a widely used tool for planning and coordinating large-scale projects. "PERT is basically a management planning and control tool. It is used as a road map for a particular program or project in which all of the major components (events) have been completely identified simultaneously with their corresponding inter dependence. The objective behind PERT style planning is to identify critical activities on which others depend, this technique is often referred to as PERT/CPM, the CPM standing for "critical path method" [32, 33].

A project usually consists of multiple activities, which occurs both concurrently and sequentially. To determine the flow of these activities, it is necessary to create a precedence diagram. After creating the precedence diagram, the activities that can cause the project to come in late can be identified. This is the Critical Path definition**.** A delay in any of the critical path activities will delay the entire project, nonetheless of whether the other project activities are completed on or before time.

The act of identifying the Critical Path is known as the Critical Path Method or the Critical Path Analysis. To determine the Critical Path and conduct Critical Path Analysis, the following activities has to be done [34, 35]:

- Define the duration of each activity.
- Identify all the paths.
- Calculate the duration of each path.
- Identify the longest path.

In this project the product recall risk in the reverse supply chain is evaluated and measured in terms of critical path analysis tool, in order to identify the duration to get the product from the shelf to the destruction point. According to the information given by Luca Fichera executive vice-president of supply chain, Nestle India, "Out of the 27,420 tonnes, about 1,422 tonnes were at Nestle India's five factories, which have now stopped producing Maggi noodles; about 8,975 tonnes were in its 38 distribution centers; about 7,000 tonnes were with distributors; and about 10,020 tonnes with retailers that Nestle could track. That makes for about four million cartons, consisting of 96 units of 70g packs that need to be recalled from 1,400 distributors that connect over 3.5 million retails outlets across the country. Of these, just about 1.5 million retail outlets are under the direct control of Nestle India. The task is complex and enormous. Between 9 and 13 June 2015, Nestle India had managed to destroy just 169 tonnes of Maggi noodles at three cement plants, where the noodles are crushed and then mixed with fuel and burnt in incinerators. Once in full swing, all five or six cement plants together will be able to destroy about 700 tonnes of noodles every day. The cement factory officially known as the as Gujarat Ambuja Cements,is believed to have been paid 2758746 € by Nestle India for burning the recalled packets of Maggi noodles at its cement plant in Chandrapur in Maharashtra, India. [36, 37]

From the above details it is clear that 10,020 tonnes of maggi are with retailers and 7000 tonnes of maggi are with the distributors and out of 3.5 million outlets across the country Nestle India had direct contact with only 1.5 million outlets. To destroy 700 tonnes of noodles across the five or six cement plants will take one complete day and to destroy the 27000 tonnes of maggi will take 40 days approximately.

But that's the final phase, what will be the preceding steps such as getting the product from the outlets, taking the products to the drop point and getting it to the destruction point. The critical path analysis has been derived based on the provided information which is collected from newspapers, official websites and other media resources. Though the details of time and

cost have not been given for retrieving the product from the shelves, an educated guess was done in order to provide the estimated time duration for the sequential activities.

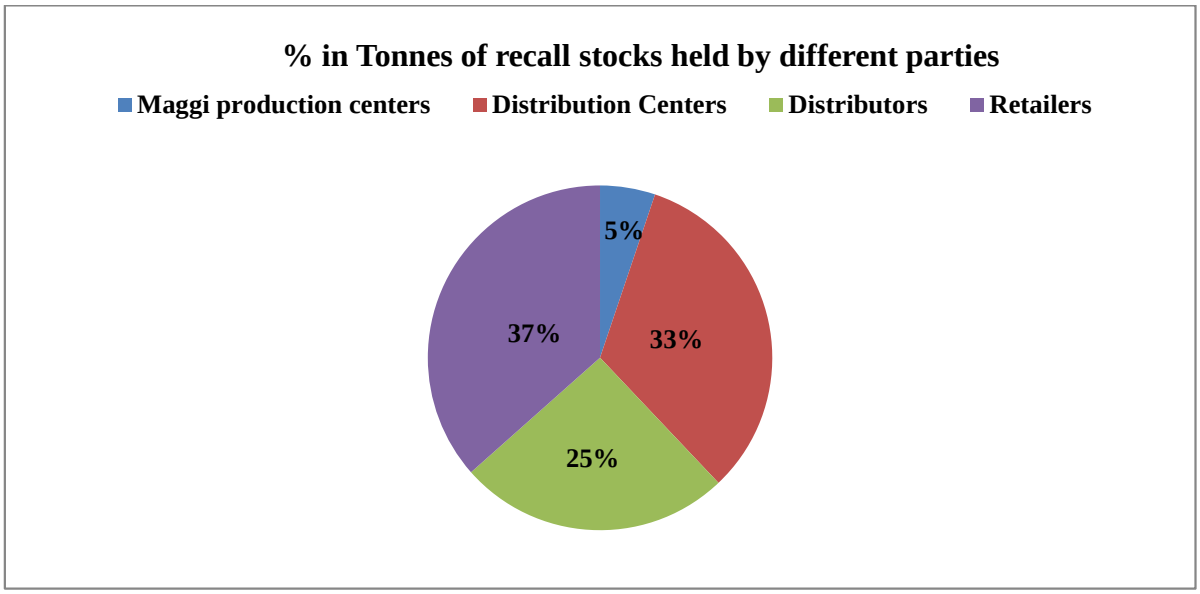


Figure 5.1. Percentage of recall stocks held by the different parties

The objective is to get the 25 % of recall stock from the distributors and the 37 % percent from the direct retailers across the country. According to the information given by the Nestle officials this is one of the largest recalls in the history of Nestlé, and in the rest of the food industry.

## 5.1. Identifying the critical path

Problem Statement: To draw the network precedence diagram and calculate the estimated time the project will take in order to complete the task, which is to get the recall product from the outlet, distribution centers and to the final destruction point, later calculating the critical path from the diagram.

Step 1: Start

Step 2: To enlist the activities in sequential order and allocate the time period in a tabular column.

Step 3: To label the activities and denote the predecessors which is for example if A is predecessor of B then B cannot be started without the completion of A.

Step 4: Draw the network precedence diagram

Step 5: Calculate the early start time and early finish time

Step 6: Calculate the latest start time and Latest Finish time

Step 7: Calculate the slack or float

Step 8: Identify the critical path using the float calculation and highlight it

Step 9: End

The tabular column represented in the next page and the activities are listed sequentially, labeled according to the alphabetical order and the duration of the activities is also provided based on an educated assumption.

Table 5.1. Activities enlisted with label and duration

| ACTIVITIES | LABEL | PREDECESSORS | ESTIMATION TIME |
|---|---|---|---|
| Collect the details of outlets, Distribution centers | A | ------ | 1 |
| Inform the outlets about the product recall via telephone, email and sms. | B | A | 1 |
| Send the transports to the respective centers to retrieve the product | C | B | 1 |
| Hire 3PL to outsource the retrieving activity | D | B | 0.5 |
| Get the product from the outlet and DC and warehouse and take it t the nearest drop off point | E | C | 1 |
| Get the product from the outlet ,DC warehouse and take it to the nearest drop off point | F | D | 0.5 |
| Take the recalled products to the destruction site. | G | E,F | 0.5 |
| Destroy the product in the incinerators. | H | G | 1 |

Using the table mentioned in the previous page the network precedence diagram should be drawn in order to calculate the critical path activity.

## 5.2. Network precedence diagram and the calculation

1. In the beginning the Early Start, Early finish, Latest Start and Latest finish are assigned as zero in the in the diagram which indicates the initial stage of the process.

- ES- Early Start, EF- Early Finish, LS- Latest Finish and LF- Latest Finish, D- Duration of the activity and ET- Estimated Time.

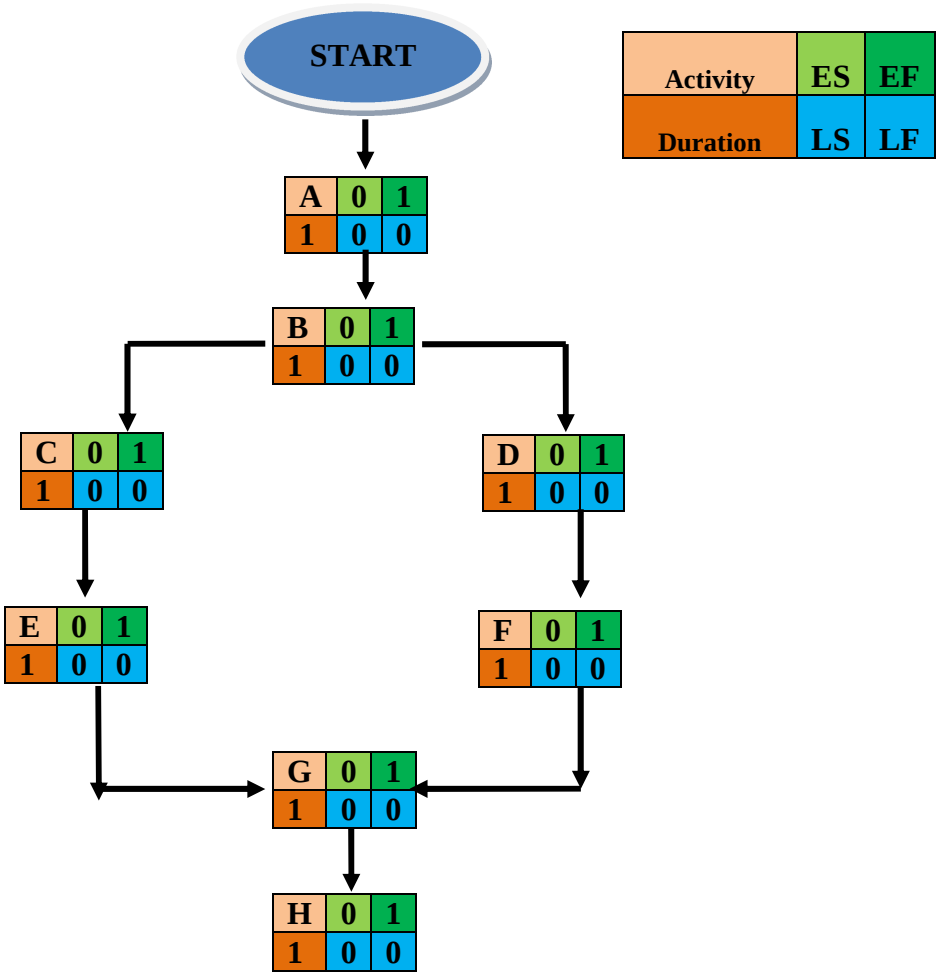


Figure 5.2. Network Precedence Diagram

The meaning of A → B is: Activity B cannot begin until activity A has been completed

2. In the second phase using the formula mentioned below the early start and early finish of the activities are assigned.

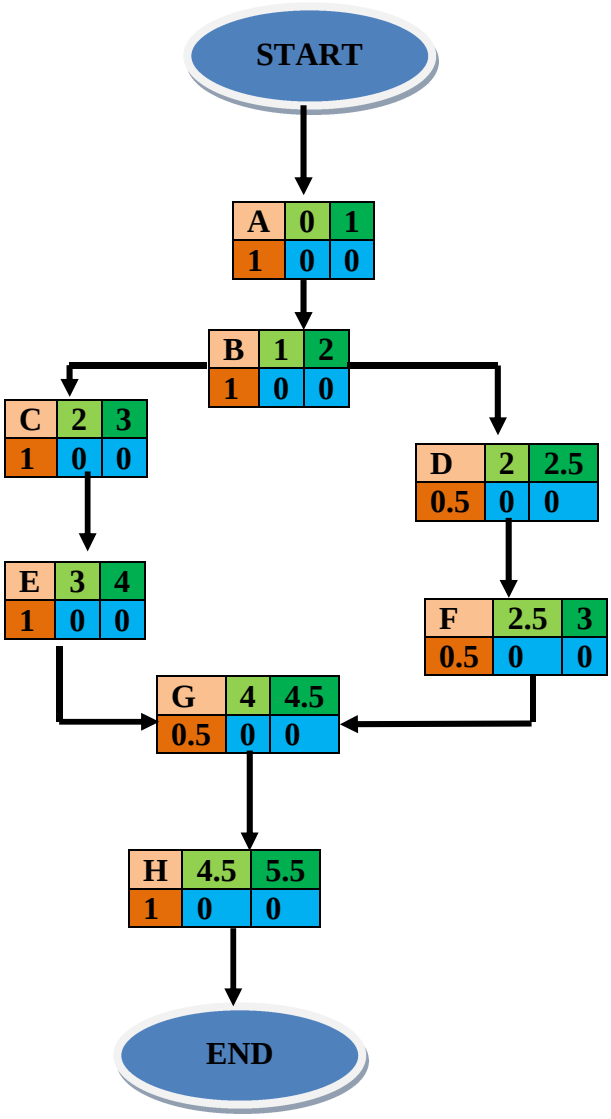


Figure 5.3. Network Precedence Diagram

Earliest Start Time (ES) = the earliest time that an activity can begin

Earliest Finish Time (EF) = the earliest time that an activity can be completed

$$EF = ET + D \qquad (5.1)$$

3. In the third phase using the formula mentioned below the latest start and latest finish of the activities are assigned.

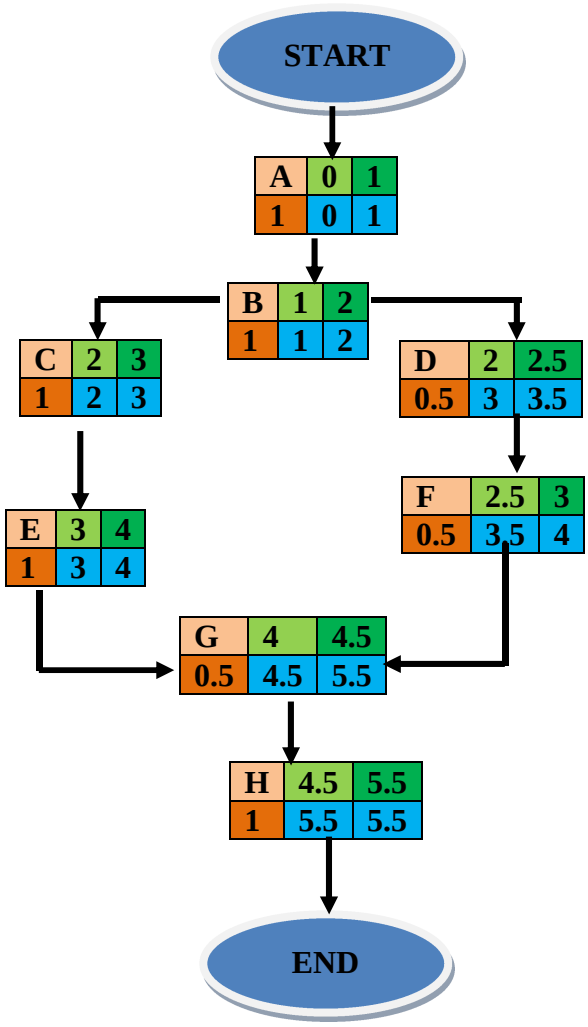


Figure 5.4. Network Precedence Diagram

Latest Start Time (LS) = the latest time that an activity can begin without lengthening the minimum project duration

Latest Finish Time (LF) =the latest time that an activity can be completed without lengthening the minimum project duration.

$$LF = LS + D \qquad (5.2)$$

4. In the fourth phase using the calculated early start, early finish, latest start and latest finish the total duration of the project is determined.

Duration of the project = the difference between the maximum value of the “latest finish time" of projects and the minimum value of the "earliest start time" of projects

Project duration = max (LF) - min (ES) (5.3)

= max (5.5) - min (0)

= 5.5 days.

5. In the fifth phase the activity which causes the delay of the total duration are identified using the slack formula. These activities which cause the delay are known as the critical paths or critical activities.

Slack is the amount of time that a project can be delayed without increasing the duration of the project. Slack-S.

$$S = LS - ES \quad (5.4)$$

Table 5.2. Identifying the slack

| ACTIVITY | SLACK |
|---|---|
| A | 0 |
| B | 0 |
| C | 0 |
| D | 1 |
| E | 0 |
| F | 1 |
| G | 0.5 |
| H | 0 |

So from the above float calculation the activity with 0 slack displays the critical path and it’s clear that activity A, B, C, E and H are proven as critical path and which also has the longest duration path of the project and hence much concentration has to be given to the above path so that it will not result in the delay of the entire project. The above critical activities is done only for one main metro city of India which is Mumbai, the rest metro and major cities might also have executed in similar way for the destruction of the recall product. The reason why in house logistics activity causes the delay for the entire project, According to the information given by the swissinfo.ch, The 27,420 tonnes of maggi noodles that need to be recalled would require the minimum 2,500 trucks. “maggi noodles are sold all over the country so many thousand truck journeys will need to be made to complete the task, it is rational to

think that it is impossible for one company to have 2500 trucks collectively in order to carry out the recall process, and that's why certain activities are outsourced.

The reason for the in-house logistics delay might be because of the following reasons:

- Shortage of transport or trucks,
- Shortage of drivers or man power to operate them,
- Not enough capacity tucks,
- To get operated only with few trucks and this will lead to discrete operations.

These are only a few outlined in-house logistics problem, the fact is most of the companies are not well expertise with the reverse management process which also leads to lack of knowledge in this specialization. Nestle India case study is just considered as an example to connect the methodologies and tools used in this project, Reverse logistics might happen to any company regardless of size but the ultimate question is how the company will overcome and what has to be done when such situation strikes. One good example can be provided from the pharmaceuticals industry that is they outsource their logistics operations to niche logistics companies who can handle their products much better than any other normal logistics companies. Because these medical products needs extensive care and needs to get stored in a safer environment and sometimes specially designed storing centers, pharmaceutical products have specific storage and handling needs. It is not something which can be expected from an ordinary logistics companies unless they have special department to carry out the special requirements from their customer.

Reverse logistics process also requires special attentions and it is very obvious that though the companies might anticipate about the recall minimally and sometimes they won't be having enough experience to handle the reverse logistics process if it happened for the very first time and for sure it will lead to other unexpected situations like financial loss if the process was not carried out in an optimal way. So in order to avoid such events it is necessary to evaluate the highest critical activity and decide whether to carry out the activity either by in-house or by outsourcing them. One of the other best options is to hire a niche specialist who undertakes reverse logistics activity and try to take off the additional cost off from the balance sheet so that the companies can focus on their core activities.

Nestle India, has different product portfolio in which maggi noodles has high influence and high product share in the market.

While conducting a telephonic survey at Nestle India at the Mumbai office, one of the marketing officials said that India's 80-90 % of total noodles share in Indian market was held by Nestle, so this ban on the noodles due to the contamination of led has resulted in a massive loss , It is also important to note that the 'prepared dishes and cooking aids (PDCA)' segment (that mostly comprise Maggi) that contributes close to 30 per cent of the revenue for Nestle India has been the only volume driver for the company. Nestle India reported 20.1 per cent decline in net overall sales during the quarter. Stating the reason, the company said, "It is largely due to the impact of the Maggi noodles issue. Net domestic sales decreased by 20.6 per cent. [38, 39]

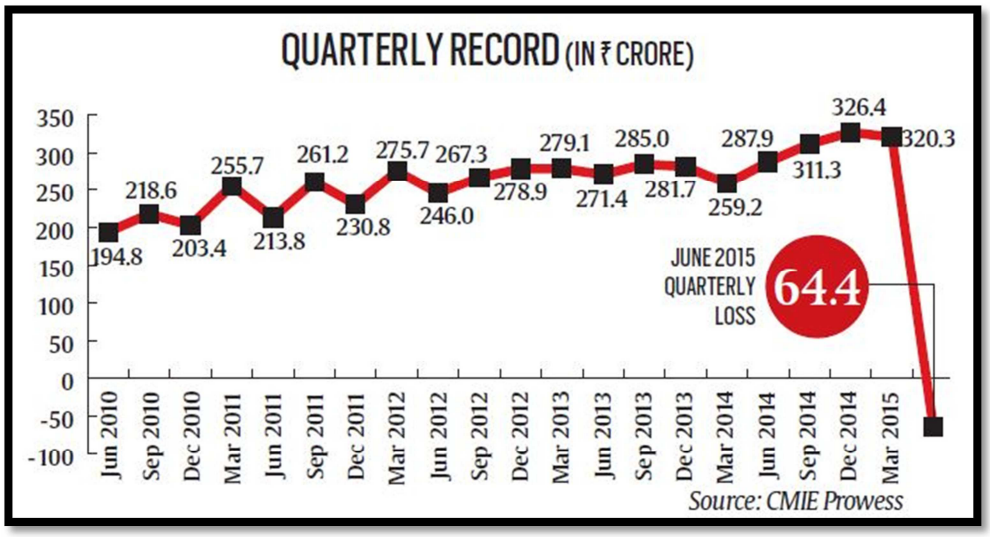


Figure 5.5. Nestle India's quarterly record during 2015. [40]

Nestle India on Wednesday reported a net loss of 64 million euro core for the second quarter ended June 30, 2015, this is the first quarterly loss in at least 17 years of nestle India. It is also clear from the above sales records that this recall of one particular product has influenced the other products of nestle, ultimately resulting in the decline of sales. When the manufacturing companies which are especially conglomerate must focus the product which contributes highest share or major driver of the company's revenue. For example, PepsiCo has different portfolios but the major contributor is the drink Pepsi, so eventually major concentration should be inclined towards this particular product when compared to others. Since the largest and internationally renowned companies may survive from this potential product failure but imagining the condition of a small scale industries such incident can blow of them from the market for ever and also when there is insufficient funds to meet the requirements or carry out the recall process will bankrupt the entire company.

# CONCLUSIONS

Reverse logistics problem is now seeking a paid attention by every manufacturing companies, to bring back the defect product effectively is the key factor in the reverse supply chain system to carry out a proactive recall process a good planning system is required, The DMAS tool which is applied here in this project can be applied to all type of industry regardless of the size, it's a quick approach to analyze the problem deeply and also helps to identify the critical activities through which weighted concentration can be provided to those particular critical activities in order to avoid the massive impact and also it gives the way for the company to decide whether the critical activities can be done on their own or can outsource the activities to some niche specialist who are expertise in carrying out the recall process. Such outsourcing might help to lessen the severity of the loss than the anticipated. The DMAS tool in this project is a simple, efficient and most importantly a quick tool to get implemented in order to carry out the project reverse logistics activities. The concept of this tool is what can be done now and something which can be done later for example analyzing why the product was a failure or fault, detecting and testing the quality of the product. Reverse logistics is all about focusing the present situation rather than thinking about the past mistakes of the product or the rectifying the mistakes in the future.

1. After analysis of Nestle India's supply chain the potential risk was identified which was product recall risk.
2. Using the mapping techniques and process flow diagrams the other risks associated with product recall risks were identified: transport, financial and brand reputation risks.
3. The risks which are found in the mapping techniques are analyzed and evaluated using the risk quantification formula. The risks which ranked top among all was the transportation risk and the financial risks which had a total risk score of 9 and which was the maximum score.
4. Using the cause and effect diagram the main causes of highest ranked transportation risks were identified: insufficient trucks, insufficient man power, high fuel cost.
5. The time required to carry out the reverse logistics process is identified using developed project management tool DMAS and the total days to recover the recall products from one city was summed upto 5.5 days. The critical activity which causes the delay is identified to be in house logistics system.
6. Developed DMAS tool will be an efficient management tool when implemented on reverse logistics process especially in identifying the critical tasks.

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