Erasmus University Rotterdam

MSc in Maritime Economics and Logistics

2012/2013

The Analysis and Comparison of Three Industrial Supply Chains viz Oil, Consumer Electronics and Fast Moving Consumer Goods

by

Sanju Manayani

Acknowledgements

This thesis would not have been possible without the fundamental help and support of the following people especially since it was written in such a short period and time.

Firstly I would like to thank my supervisor Dr. Eelco van Asperen whose steady inputs and guidance has helped me to constantly improve on the quality and content of the thesis.

Secondly I would like to thank the entire MEL staff for their support, understanding and guidance during the last couple of years.

Thirdly I would also like to thank some of my classmates who motivated me to complete the exams and write this thesis.

Fourthly I would like to thank some industry professionals like Mr. Francis Cherian, Mr. Thai Young Kim (Samsung), Mr. Mattheiu de La Chevardiere (Shell), Mr. Paolo Mendes (Coca-Cola) and Miss Ivana Lutterova (Schenker) who helped me through their valuable inputs. All of them agreed to spend their precious time for this thesis at very short notices.

Finally I would like to thank my parents for their unconditional and continuous support during the entire MEL program.

Abstract

The progress of globalization in the last two decades has brought about a lot of changes in the way in which companies position themselves within their individual supply chains. This thesis has been written to basically analyze and compare three different supply chains viz the oil industry, consumer electronics industry and the fast moving consumer goods industry. Supply chain systems are usually very complex. Therefore the models and methods used in the study of the same are also multifaceted. This thesis can help in understanding the supply chains of these three industries in greater depth especially the movement of the raw materials, inventories and finished products of these three categories from the manufacturer to the final consumer.

The basic aim is to provide the readers with a description of the main characteristics of the individual supply chains. It was basically done because it is an area of research which has found to be lacking although the topic is fairly important and not researched so much in depth. Not much academic literature exists covering this topic of analysing and comparing supply chains across industries. Also research was conducted in these three industries on account of their economic importance.

Most of the information and data for the thesis was collected through extensive literature review. Moreover some interviews were conducted with industry professionals. This was done to prove that what was found through the interviews backs up the theory and model which was found and developed through the literature review. We have also used case studies to highlight and address the main issues pertaining to each sector's supply chain. The case studies show the structure and functioning of the supply chains of the chosen individual companies.

What was discovered basically was the structure and functioning of the individual supply chains. Models were formulated and this was based on the extensive literature review studying the characteristics and analysis of the individual supply chains. These models have helped in the better understanding of the way in which the individual supply chains function and have further helped in how they can be compared to each other. The case studies used show clearly examples of company's supply chain functioning. On the other hand interview with supply chain industry experts and 3PL service providers have further helped in confirming the validity of the theory and models with that of the practical functioning of the individual supply chains.

Thus in this thesis we have analyzed and compared the functioning of three different supply chains of the oil, consumer electronics and fast moving consumer goods industries. The thesis will give the reader a good understanding of how the three supply chains function through the analyses and characteristics study of the individual supply chains. This is a relatively new concept and field. It will help future researchers to compare other supply chains based on the findings in this thesis or using this thesis as a guideline. It can also help in improving the functioning of different supply chains by introducing the best practices in different supply chains. It will also help in understanding the short comings in the structure of different supply chains.

Table of Contents

List of Figures

List of Abbreviations

3PL – Third Party Logistics

BRIC – Brazil, Russia, India and China

bn – Billion

B2B – Business To Business

CPFR – Collaborative Planning, Forecasting and Replenishment

CM – Contract Manufacturers

CEO – Chief Executive Officer

CPG – Consumer Packaged Goods

CE – Consumer Electronics

CEA – Consumer Electronics Association

CCTV – Closed Circuit Television

DC – Distribution Centre

EBITDA – Earnings Before Interest, Tax, Depreciation And Amortization

EMS – Electronics Manufacturing Services

EU – European Union

ERP – Enterprise Resource Planning

EDI – Electronic Data Interchange

FMCG – Fast Moving Consumer Goods

FEU – Forty Foot Equivalent Unit

GPS – Global Positioning System

HUF – Hungarian Forint

IT – Information Technology

ISIS – Integrated Supply Management Information System

JV – Joint Venture

JIT – Just In Time

KPI – Key Performance Indicator

LPG – Liquefied Petroleum Gas

MNC – Multinational Companies

NPI – Non Production Items

OPEC – Organization Of Petroleum Exporting Countries

OEM – Original Equipment Manufacturer

OOC – Oman Oil Company

POS – Point Of Sale

PQA – Parts Quality Assurance

ROI – Return On Investment

RFID – Radio Frequency Identification

RF – Radio Frequency

SAP – Systems Applications And Products

SC – Supply Chain

SCM – Supply Chain Management

SKU – Stock Keeping Unit

US – United States

VLCC – Very Large Crude Carriers

VMI – Vendor Managed Inventory

yoy – Year On Year

Chapter 1 - Introduction

1.0 Introduction:

The rate at which globalization has moved within the last 20 years has brought about a lot of basic changes in the way companies position themselves within their individual supply chain (SC). Western countries have become more open with respect to international trade and this has happened on account of increase in economic unification with nearby countries which were before not so friendly.

Since foreign markets are opening up, countries that were before difficult to get into on account of distances, locations and on account of political or economic reasons have had a very strong effect in the way companies across various industries do business with customers and suppliers. During the last several decades, globalisation, outsourcing and information technology (IT) have helped many companies such as HP and Dell to fruitfully control concrete combined supply networks in which each dedicated commerce associate focuses on only a few important tactical actions.

In the twenty first century, new developments in the commerce atmosphere have contributed to the advancement of supply chain networks. First on account of globalisation and the growth in multinational companies (MNC), joint ventures (JV), tactical partnerships and business alliances, many important factors of success were recognized. These factors have further promoted the previous just in time (JIT), lean manufacturing and agile manufacturing practices. Second, changes in technology, most importantly the drastic fall in the cost of information communication, which forms a great proportion of the costs of transaction, have led to changes in coordination amongst members of the SC network.

Wikipedia Website (2009) says that the term supply chain management (SCM) became an official term when a consultant at Booz Allen Hamilton called Keith Oliver first used it during an interview with a leading newspaper in 1982. Organizations are finding out that they must depend on supply chains, or networks, to participate effectively in the world market and networked economy. "A supply chain is made up of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain does not only include the manufacturers and suppliers, but also transporters, warehouses, retailers and customers themselves. Within each organization, such as manufacturer, the supply chain includes all functions involved in receiving and filling a customer order. Finally these functions include, but are not limited to, new product development, marketing, operations, distribution, finance and customer service" (Chopra and Meindl, 2004). Thus SCM includes all the various moves of raw materials, inventory and refined goods from the point of origin (manufacturers) to the point of consumption (consumers).

With globalization, in the 21st century, organizations are focussing on their key strengths and trying to become more flexible. Functions such as ownerships and distribution methods are being outsourced to other companies so that the parent company can focus on the core business and also become more cost effective. Less command and an increase in supply chain collaborators has led to the development of supply chain management theories. Supply Chain Management has been used to

increase trust and partnership among the various players which in the end leads to better inventory control and speedier inventory moves. Beamon (1998) says that in the last few years, people who have been researching as well as practitioners have basically investigated the various processes within manufacturing supply chains at an individual level. However Beamon (1998) points out that in recent times there is more stress placed on performance, design, and analyses of the supply chain as one whole unit. "This attention is largely a result of the increasing costs of manufacturing, the shrinking resources of manufacturing bases, shortened product life cycles, the levelling of the playing field within manufacturing, and the globalization of market economies" (Beamon, 1998).
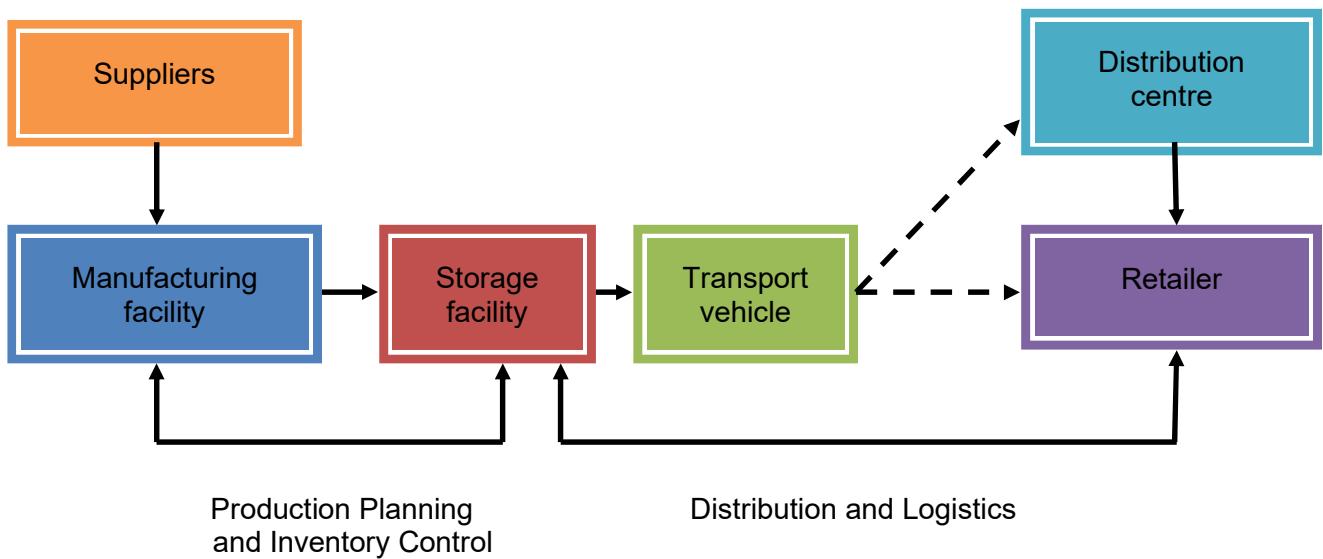
Figure 1: The Supply Chain Process (Source: Beamon, 1998)

Beamon (1998) points out in the above figure that the Production Planning and Inventory Control include all the smaller processes of manufacturing facility and storage facility and their respective interfaces. Production Planning describes the plan and managing of the entire manufacturing process (including raw material preparation and purchasing, manufacturing process design and preparation, and material handling design and organization. The Distribution and Logistics process shows how goods are got back and moved from the warehouse to retailers. These goods may be moved directly to the retailers or may be transported first to the distribution area or centre and then moved again to the retailers. Many companies have recorded exponential growth on account of lean and agile supply chains. The supply chain industries of the oil, consumer electronics and fast moving consumer goods (FMCG) are quite complex. In this thesis we will analyse the individual supply chains and then make a comparison between them.
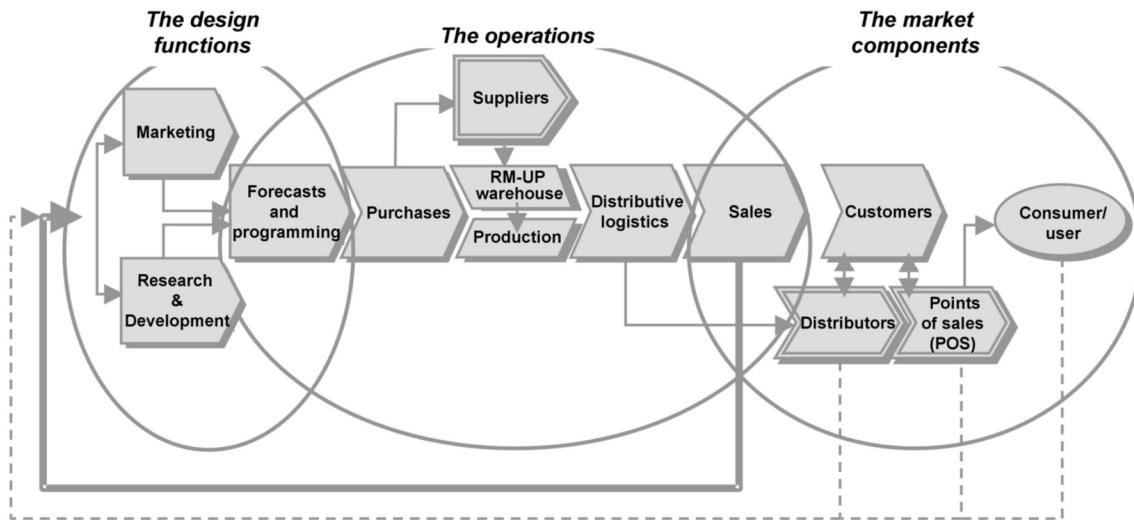
Figure 2: The Supply Chain Components (Source: Battezzati and Magnani 2000)

1.1 Scope and Aim of the Research:

Supply chain as a subject has received a lot of interest in the last ten years or so. There are also a lot of scientific articles that has been written on supply chain in general. We have chosen these three SCs on account of the economic importance of these industries the world over. Although one can find many such articles there is a dearth of information of inter industry supply chain comparison and analysis. With this in mind the reasons for writing this thesis are threefold.

i. Firstly to analyse and address the SC problems facing the three chosen industry of oil, consumer electronics and fast moving consumer goods.

ii. Secondly to compare the SCs of three important industries and to highlight the issues and short comings that each SC of each industry is facing.

iii. Thirdly to extend the study outline that may serve as a basis for future SC research. On account of time constraints this research will be limited to only three industries viz oil, consumer electronics and fast moving consumer goods.

1.2 Methodology:

Data for this paper will be collected through extensive literature review and interviews with industry professionals. In this thesis a qualitative analysis and comparison will be carried out on three industrial supply chains viz oil, consumer electronics and fast moving consumer goods. There will be separate chapters on each industry's SC. Each chapter will include the broad features or general characteristics of each SC, the most important issues regarding each SC including latest trends and supply chain strategies and a case study. Then a model will be formulated in each supply chain to show how the typical supply chain of each respective industry works. Finally, once the analysis of the SCs have been dealt with in great depth a comparison between the three SCs based on wide-ranging literature review will be carried out. There will also be a chapter which will cover an interview with a SC specialist from the three chosen industries and a third party logistics (3PL) provider. To end there will be a chapter with conclusions of the research undertaken and recommendations for further research.

1.3 Literature Review:

"A supply chain is made up of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain does not only include the manufacturers and suppliers, but also transporters, warehouses, retailers and customers themselves. Within each organization, such as manufacturer, the supply chain includes all functions involved in receiving and filling a customer order. Finally these functions include, but are not limited to, new product development, marketing, operations, distribution, finance and customer service" (Chopra and Meindl, 2004). There are various stages in a SC and the following are parts of the SC: customers, retailers, wholesalers, manufacturers and various suppliers.

This thesis is being written to analyse and compare supply chains across three different industries. It is an area of research which has found to be lacking although the topic is fairly important. Wikipedia Website (2009) says that not much academic literature exists covering this topic of analysing and comparing supply chains across industries. This shows that there exists a gap in the literature available on supply chain analysis and comparison.

Gilaninia et al. (2011) say that nowadays with the great developments in the field of competition, firms want that management tactics are implemented which resonate with their supply chain. Studies in the field of comparing patterns of lean and agile SC have shown that supply chain performance in terms of customer value is calculated in terms of four dimensions of quality, price, delivery time and service level. Being lean is defined as means to eliminate all types of wastes. Basis of lean production can be credited to Toyota Production System that focuses on dropping and eliminating waste. Guajardo et al. (2012) say that we are working out a tactical planning in a supply chain that is different. Guajardo et al. (2012) further say that the problem involves decisions with respect to production, stock, internal transportation, sales and final distribution to customers.

Supply chain systems are usually very complex. Therefore the models and methods used in the study of the same are also multifaceted. Barloworld Logistics (2007) say that procuring from and selling to a global market is a really complex activity and a real challenge for many supply chains and most are fighting to keep up with an increase in demand and the utter difficulty involved. Beamon (1998) says that an important part of a supply chain design is in tracing out how an effective supply chain design is established, when having to benchmark against a given a set of performance standards.

1.3.1 Literature Review of the Oil Industry:

Szucs and Hassen (2012) point out that the oil supply chain management has a lot of challenges to meet which are caused by the special character of the oil supply chain industry. "These are its complexity, in-flexible characteristics, long lead times, limited transportation at the various stages in the supply chain, rigid take or pay procurement and limited primary distribution capacity" (Szucs and Hassen, 2012). The powers that control the supply chain in oil and gas are related to the business and also depend on the political and economic environment.

Anderson (2003) says that specialized knowledge and know-how are the basic factors that keep the oil supply chain system together. Anderson (2003) also says that it is further thought that the needs for safety and continuous operation of the engineering activities are never compromised. Spirited powers and rigid forces manipulate the course of SC strategies in the oil sector. Anderson (2003) points out that oil companies are now-a-days joining together to form even bigger companies that have larger purchasing powers which go further down the SC. This trend causes main contractors to move their SC tactic from concentration on price and risk to a focus on administration causing the requirement of e-collaboration and cross functional ability. Koo et al. (2006) claim that supply chains are becoming more multifaceted as companies focus on their main competencies and outsource other activities which are not so important to their core business.

1.3.2 Literature Review of the Consumer Electronics Industry:

The Consumer Electronics sector is amongst the most vibrant today. Goods that did not exist a decade ago have undergone fast change, motivating an endless amount of new items and innovative products. Product life cycles are becoming smaller on account of the consumer's demand for better products and cheaper electronic devices. Dhekne and Chittal (2011) say that in order to take opportunity of the huge surge in consumer demand, consumer electronics (CE) manufacturers need to have more control over their forecasting, procurement, distribution activities and inventory management tactics.

People who use social media and individuals who own digital content are pushing the requirement for devices and defining factors that affect competitiveness and expansion in the consumer electronics area. Mckinnon (2004) reiterate that since in the future the scope for gains in efficiency in the production process will be limited, it will be the supply chain that is likely to become the main source of savings in cost. Iyer (2007) says that the consumer electronics supply chain is not just complex but also the most critical differentiator for branded Original Equipment Manufacturers (OEM). Iyer (2007) also says that consumer electronics are trying to become more competitive by gaining a competitive superiority by collecting the information around supply chain events for both better forecasting and better distribution.

1.3.3 Literature Review of the FMCG Industry:

Most of the CEOs in the FMCG sector believe that globalisation will have a very deep impact on the intricacy of their supply chains. FMCG CEOs have to do global business in order to reduce costs and increase capability by sourcing cheap products. There is very fierce competition in fast moving consumer goods industry. On account of this forecasting requirements are becoming more important in this industry. And this is because firstly FMCG industry has a lot of diversified products. Secondly a consumer has many choices when it comes to FMCGs. Niu (2008) also points out that delivering on time every time, exact demand and top quality are important elements for the company's existence.

Niu (2008) also say that the main issue in the fast moving consumer goods industry is to avoid shortage of goods in the market and keep the minimum level of inventory while

trying to optimize using manufacturing capabilities. Whitehead (2012) examines changes that have been made to FMCG supply chains since the recession of '08/'09 and analyses the effects of the financial conditions on FMCG supply chains and describes how businesses have reacted through taking care of risk, developing flexibility and a move towards local sourcing. "The attributes required for achieving agility within FMCGs supply chain includes: responsiveness; customer service; flexibility; innovation; speed; quality; efficiency; and responsible people thinking" (El-Tawy, 2012).

Mazumder and Chatterjee (2010) support the idea that in the coming decade FMCG companies will have a lot of challenges to face and most important among them will be that of the initiative of applying green supply chain management. Mazumder and Chatterjee (2010) further claim that FMCG companies will be placed in a better position to win over the benevolence of the consumer and it will moreover be a game changer of the industry if they apply the principles associated with green supply chains.

1.4 Research Question:

Oil, consumer electronics and fast moving consumer goods all encompass supply chains which are quite complex. The purpose of this thesis is to determine the supply chain management structures of these three industries, to analyse them and to compare them. This can then help in understanding the SCs of these three industries in greater depth especially the movement of the raw materials, inventories and finished products of these three categories from the manufacturer to the final consumer. Therefore this thesis has its goal as answering the following main research question.
The research question of this thesis would then be as follows:
What are the typical supply chains in the below three chosen industries?
- Oil
- Consumer Electronics and
- Fast Moving Consumer Goods

Sub-questions to be answered in this thesis are:
- How can the supply chains of the chosen three industries be compared with each other?
- Does the practical information achieved from interviews got from 3PLs or industry professionals match the existing theory?

1.5 Structure of the thesis:

The paper is divided into two parts. The first part will answer the main research question whereas the second part will answer the research question's sub questions. The challenge would be to find good literature. Chapters 2 to 4 will deal with the analysis and synthesis of supply chains. Chapter 1 will introduce the topic to the reader. Chapter 2 will deal with the analysis of SCs of Oil, Chapter 3 will take care of the Consumer Electronics SCs and Chapter 4 will cover the SCs of Fast Moving Consumer Goods. In Chapter 5 we will use the example of a 3PL provider and who provides service to these three industries or other professionals who are working in SC industry from among our three chosen industries. Chapter 6 will compare the three SCs and finally there will be a Chapter 7 which will conclude the thesis. The sub questions will be answered by the material in Chapters 5 and 6 which will form the second part.

1.6 Conclusion:

In this chapter, we have thus introduced the topic extensively by giving it a definite direction and structure. Various aspects of the supply chain has been defined and explained. We have also reviewed some literature in the areas of interest, to explore, what has already been written before the undertaking of this thesis. In addition we have drafted the aim and scope of the research and written down the research question with a few sub questions. The thesis will basically revolve around the answering of the research question and the associated sub questions. Moreover we have also defined the methodology that we are going to use to write this thesis. In the next chapter we will deal exclusively with the supply chain of the oil industry.

Chapter 2 – Analysis of the Oil Industry Supply Chain

2.0 Introduction:

Today's world economy is deeply dependent on oil and therefore the oil sector has a very profound effect on the world economy in general and on people's daily lives. In the face of globalization, the effect of world trade and that of transportation has gone up considerably. The numero uno energy source for many industries is oil and therefore with globalization there is also a global increase in the consumption of this black gold. Current statistics show that the USA is the number one consumer of oil closely followed in second place by China. Oil consumption will only increase on account of the improvements in the economies of the BRIC (Brazil, Russia, India and China) countries.

Szucs and Hassen (2012) claim that China, which is the second largest consumer of oil in the world has oil reserves which is reducing all the time. This coerces China to import more and more oil to enable its fast growing economy to maintain its growth momentum. On the other hand Szucs and Hassen (2012) also maintain that the European Union (EU) is in the same boat as China and is also in need of imported oil to keep its economy in motion. Szucs and Hassen (2012) also add that since most of the EU's oil comes from Russia via pipelines there are sometimes availability problems since the pipelines cross so many countries at a time.

Cafaro (2010) says that oil pipelines are the most dependable and cost effective way to transport huge amounts of oil over considerable distances. Cafaro (2010) also goes on to say that it is also environmentally friendly as it does not pollute the air and also it has a better safety standard as it has a good record against spillages. The countries of the Middle East such as Saudi Arabia are one of the largest producers and exporters of this precious commodity. Due to the money-making importance of the oil industry, oil companies are very lucrative and make lots of profits. Alternative energy sources such as solar energy, wind and water are not yet as profitable as the oil sector and therefore not at the same standing as oil companies.

Szucs and Hassen (2012) claim that although oil is available only in limited quantities it will be exploitable for several more decades. Szucs and Hassen (2012) go on to say that this will form the base of the future global economy. OPEC, which is the Organization of Petroleum Exporting Countries, was fashioned by the Middle East countries. "In accordance with its governing statues, the mission of the Organization of the Petroleum Exporting Countries (OPEC) is to coordinate and unify the petroleum policies of its member countries. This is to ensure that the oil markets are stable in order to secure efficient, economic and regular supply of petroleum to consumers, a steady income to producers and a fair return on capital for people investing in the petroleum industry" (OPEC Website, 2012).

Chima (2007) says that the oil sector is a standard example of a reproduction which uses supply chain management techniques. "This is because the oil sector is involved in a global supply chain that includes domestic and international transportation, ordering and inventory visibility and control, materials handling, import/export facilitation and information technology" (Chima, 2007). When a supply chain is dissected, the firm is

connected to its suppliers in the upstream area and distributors in the downstream area as materials. Like in any other industry, companies in the oil sector try to maintain their hegemony over their competitors. Effective Supply Chain Management solutions play a very important role in helping oil companies to maintain a competitive edge. Szucs and Hassen (2012) say that the basic raw materials of the petroleum industry are crude oil and natural gas and that the production of crude oil is situated either deep in the ground or in the remote offshore locations.

After the crude oil is acquired, it undergoes a distillation process which leads to different fractions being formed. Some of the fractions are fuel gas, liquefied petroleum gas (LPG), kerosene and naphtha and these are further transferred to the refineries as feedstock. The next process is the cracking process. Through this process new products are formed for the petrochemical industry such as olefins and aromatics. Other products can be ethylene, propylene, butadiene, benzene, toluene and xylenes. The petrochemical factories can produce more specific products such as plastics, soaps, detergents, healthcare products, synthetic fibres, furniture, rubbers and paints. The oil sector is extremely volatile because of a lot of different erratic factors which are basically constant price fluctuation and political turmoil. All these uncertainties cause the oil sector to develop and adapt a supply chain management that is unique to this sector.

2.1 Characteristics of the Oil Industry Supply Chain:
Gainsborough (2006) say that the ordinary motorists have little idea about how difficult and complex the supply chain is which is used to bring them oil. Almost 85 million barrels of oil are consumed on a daily basis. Gainsborough (2006) claims that if there are more efficient supply chains then almost about 40 cents can be got out of each additional barrel sold which totals out to be about US $ 40 million on a daily basis. The oil industry supply chain is one of the most difficult supply chains in comparison to other sectors. This is on account of the following reasons. Szucs and Hassen (2012) point out that the entire supply chain is separated into two distinguishable segments viz upstream and downstream. This is based on actions before and after the refining phase. There are however thousands of kilometres in distance between the end consumers and the oil exploration area. This is therefore the most important reason why the lead times in this industry are higher than in other sectors. The higher lead times can be directly attributed to the fact that transportation of the oil takes place through ships, road, rail and also pipelines.

There is also an expensive and complex refinery process that crude oil has to undergo. Gainsborough (2006) claims that the supply chain of the oil industry is vertically integrated and this offers it a great advantage by having superior control over the total value chain. The oil companies tend to be vertically integrated due to severe competition, complexity and inflexibility in operations. A chain is only as strong as its weakest link! If we treat the entire supply chain as one unit we can recognise the weak link in the chain and then we can focus out efforts to make this weak link strong. Gainsborough (2006) says that the oil supply chain sector still uses the conventional system where an thing is created, sold, marketed and distributed to customers. The main focus must be to distribute the correct item at the correct time, at the correct price

and with utmost safety. The most important ingredient to victory is persistent quality across the entire supply chain with equipment, systems, processes, behaviours and competences all working together as one unit. Literature review shows the following basic properties of the oil sector supply chain and these are listed as follows:

- Complexity
- Inflexibility
- Vertical Integration and
- Capital Intensive

2.1.1 Complexity:

As already mentioned the oil industry supply chain is very complex. The crude oil has to move a great distance from where it is produced to the refineries. This distance leads to greater lead times and the inclusion of several participants in the supply chain process. Although the production is focussed in only some parts of the world the final product is in great demand the world over. It is the refining process that is the most complicated and expensive part of the supply chain and these final refined products are distributed by pipeline, rail, water or road. The oil sector supply chain can basically be broken up into two closely linked major segments viz upstream and downstream supply chain. There are six main stages in the supply chain which are again divided by the middle refining stage into the upstream and downstream parts of the supply chain. Szucs and Hassen (2012) say that the six main stages are exploration, production, procurement, refining, distribution and marketing.
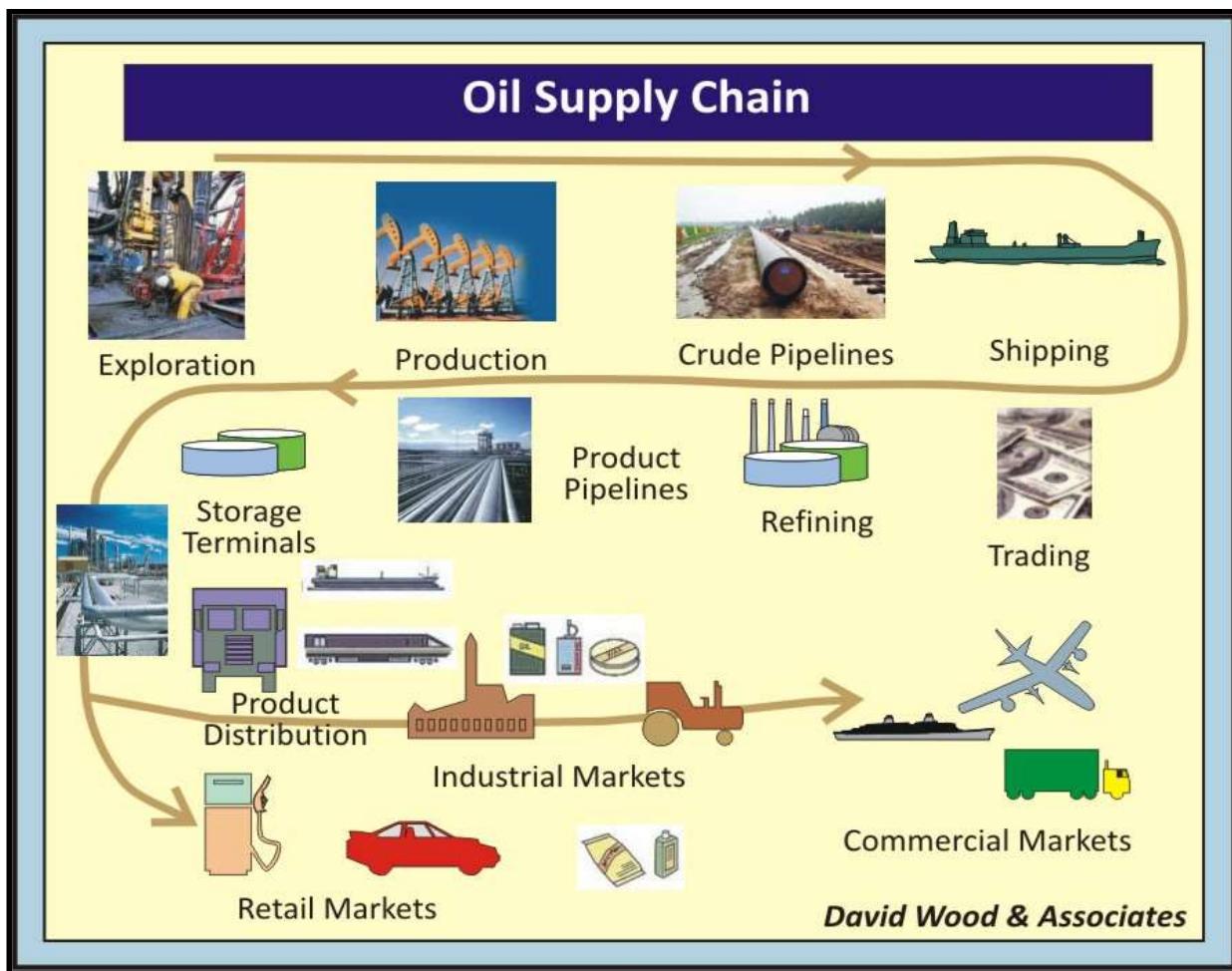
Figure 3: Typical Oil Supply Chain (Source: David Wood Company, 2012)

Upstream begins with the getting hold of crude oil through operations like exploration and production. Afterwards logistics processes start to bring the crude oil from the exploratory areas to the refineries. The exploration process involves geological and seismic activities. The production process on the other hand requires engineering activity in the form of drilling to get the crude oil from the reservoirs. It is then moved via pipelines or huge oil tankers to the terminals for temporary storage from where it is then moved again to the refineries.

Gainsborough (2006) says that the aim at most oil companies is to build a downstream supply chain that increases maximum returns to the company. In Downstream activity the first step is the refining process which is based on client demand forecast. Then the procurement and logistics steps happen to move the crude oil to the refineries and to deliver the finished products to the clients. Under procurement the raw materials which is basically the crude oil is sourced and managed to be transported to the refinery at the correct time and in the correct quantity. Refining is a very complicated procedure which involves the conversion of crude oil to its different derivatives. In the distribution stage

the logistics department ensures that the products are made available to the clients at the correct time and with the lowest costs possible. Marketing ensures that the different derivatives are marketed to the correct customers. This activity requires that a very absolute correct knowledge about the current stock levels and refinery activities is maintained so as to take care of the sales activities. "Various geopolitical factors which make up the crude oil production and the additional high volatility of petroleum prices in the international markets add another dimension of components of complexity and variability in the downstream supply chains" (Manzano, 2005).

2.1.2 Inflexibility:

One of the most important characters of the oil sector is its rigidity and the petroleum industry is a prime example of a sector which is inhibited by inflexible supply chains. Manzano (2005) says that the downstream supply chain has partial flexibility as for example the raw materials lead times are very long. As an example a consignment of crude oil will take several weeks to arrive at the refineries. Manzano (2005) also says that the planning process takes several months. Szucs and Hassen (2012) point out that this inflexibility comes from three characters of the oil sector.

Jenkins and Wright (1998) say that firstly the buying of the oil commodity has to be decided atleast nine months in advance of the real sale. Secondly Jenkins and Wright (1998) say that the basic distribution of the oil takes place via pipelines or with the aid of short sea/coastal shipping. Thirdly Jenkins and Wright (1998) point out that as the depots capability for the secondary allocation is fixed, it has to be booked on a take or pay basis which means that one buyer agrees to buy from the seller a minimum amount of product for a certain period of time or to pay the same amount even if the product is not needed. The rising level of rivalry and the high excellence needs also increase the complexity of this supply chain which also has a detrimental effect on the flexibility. The lead times from the point of shipping to the final users also go up on account of long distances which have to be covered and transportation which is rather slow.
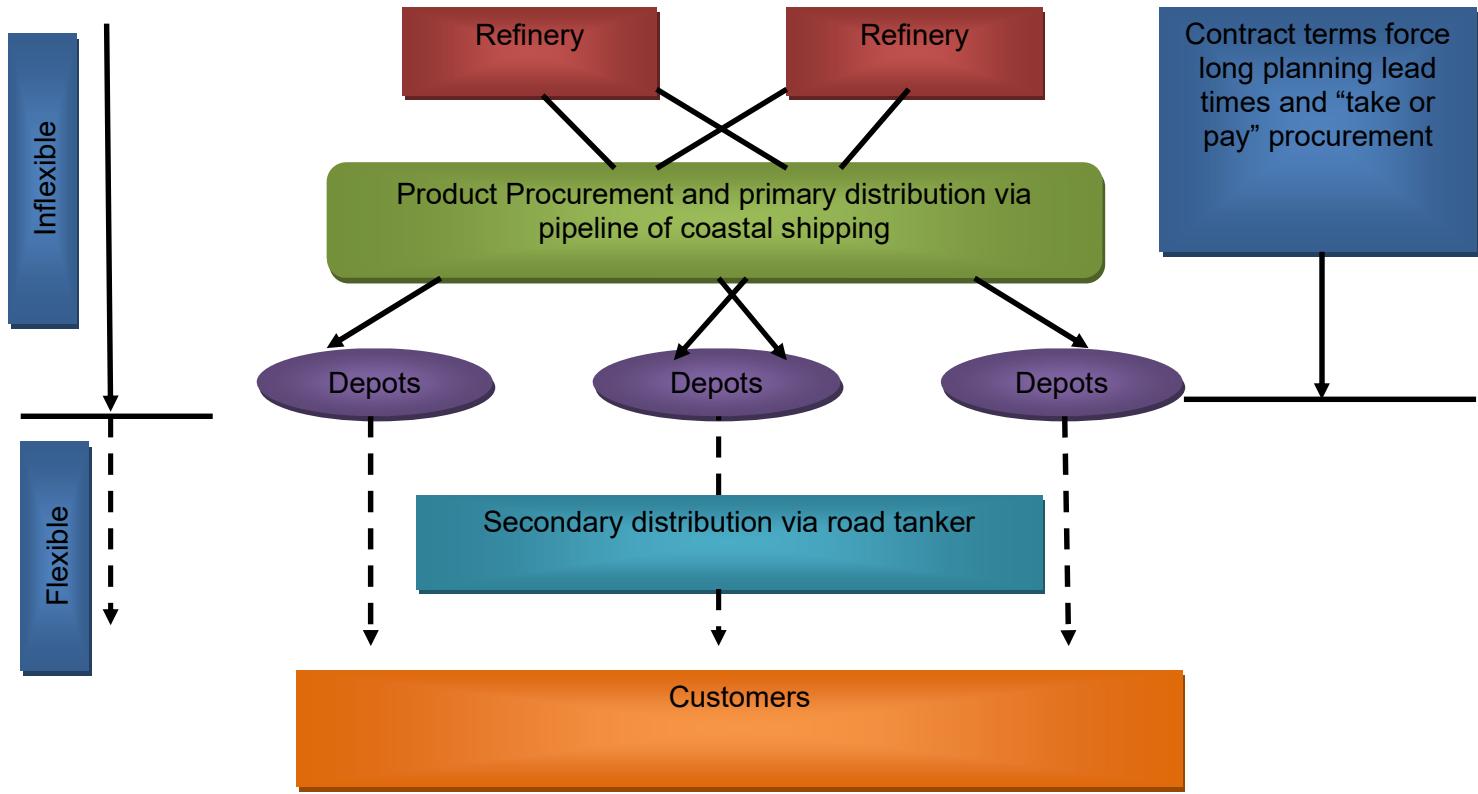
Figure 4: Inflexibilities in the petroleum supply chain (Source: Jenkins and Wright, 1998)

2.1.3 Vertical Integration:

Chima (2007) point out that according to new developments it is important to take care of a company's supply chain in its totality and unified manner. This would include the need for a better and faster customer service, globalization of the oil sector, competition and the use of information technology to exchange information. Thus a more efficient system can be created which leads to a reduction in costs through integration and cohesiveness. Vertical Integration is a very well used system in the oil sector as the output of one company is the input of the other company through the supply chain. Thus the oil supply chain is basically vertically integrated. As already mentioned earlier by Gainsborough (2006), this vertical integration of the oil companies gives them a potential advantage. This is because there is a greater control over the entire supply chain. In addition it is coupled with a push system approach. Keeping costs low as possible is one of the basic goals of this industry. By using transport mode that is dependable and by putting the inventory nearer to the final users improves the client's contentment because of lead time's that are quicker and faster product availability.

2.1.4 Capital Intensive:

Manzano (2005) says that the oil industry is an extremely capital intensive business (a refinery of medium size can cost in the range of three billion dollars) and is moreover also affected by cycles of profitability, by which we mean that quite often lower returns on investment are achieved than when compared to other petroleum businesses which causes periods of unstable investments.

2.2 Analysis of the Oil Industry Supply Chain:

As already mentioned above the oil industry supply chain is complex. Ribas et al. (2011) say that petroleum may be produced from crude oil during exploration in the oil fields belonging to the company itself or be supplied from outside sources. Guajardo et al. (2012) says that the logistics chain is consists of refineries, hubs, depots and sales offices. Guajardo et al. (2012) further say that the refineries and hubs act as production bases. Hubs and depots are used to store products which are saleable. Customer demand is fulfilled through the sales offices. Although an integral part of the main company, the sales offices are looked after separately and the choice on how to transport the products to the customers is decentralized. "According to the demand they observe, the sellers make decisions on type and amount of products to order, and from which storage location to order from" (Guajardo et al., 2012). The decision is dependent upon an internal price which is allocated by the company and the cost of distribution is calculated by the seller.
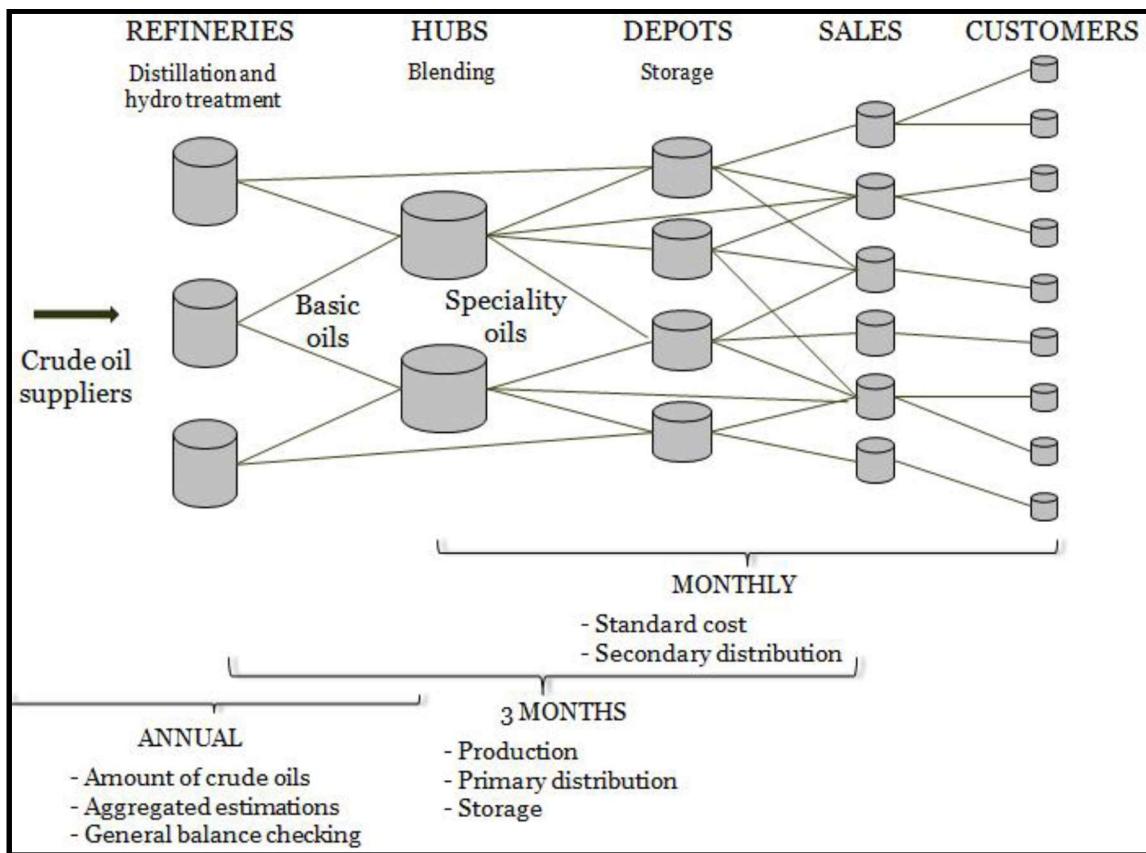
Figure 5: Supply chain for specialty oil products and planning levels (Source: Guajardo et al., 2012)

2.2.1 Exploration:

Chima (2007) says that the oil exploration work includes all the seismic, geophysical and geological operations. A lot of the work and action are recurring in this stage. At this stage the scientists use modern scientific equipment to search for oil below the surface of the ground.

2.2.2 Production:

Many oil wells are drilled every year. At this stage the oil is brought to the surface from the ground through drilling activities. Production consists of all operations including drilling, reservoir, production and facilities engineering. Chima (2007) adds that a drilling contractor is needed and as many as forty five or more various activities are required to drill and finish each well.

2.2.3 Refineries and Products:

The refineries get their supply of crude oil sometimes from external suppliers or from their own drilling activities in their own oil fields. Guajardo et al. (2012) say that there are different types of crude oil depending on the proportion of one constituent or the other. This factor will further decide if the crude oil is suitable in producing one type of

product or the other. At the refinery stage the crude oils undergo certain processes which will produce products which are saleable. The processes in the refineries are different for each product but the basic steps are as follows: distillation, hydro-treatment and blending.

Guajardo et al. (2012) say that distillation is a procedure by which the crude oil is broken down into several variants. The uniqueness of the fractions depends on which type of crude oil is used. In the process of hydro-treatment, the distillates which are got from the distillation process get special properties like density, flashpoint, pour-point and colour. Sulphur which is an impurity gets removed in this procedure. The products at this stage can already be sold in the market but they can also be used for blending to create specialty oils. The final process is blending which does not take place at the refineries instead takes place at the hubs later in the supply chain as shown in the diagram. During blending the basic oils are mixed with special additives to create specialty oils which have a higher market value.

2.2.4 Storage locations:
After the various processes are complete, the products are transported to storage locations in the form of depots. The hubs in which the blending procedure takes place also act as storage points. Guajardo et al. (2012) say that the refineries are also being used as storage for refined products only. From the refineries the products are sent either straight to the depots or via the hubs.

2.2.5 Sales:
Guajardo et al. (2012) say that it is the sellers of the finished products who perform the various sales transactions with the customers. The sellers of the various products play an important role in the supply chain as they decide from which storage location to transport the products to a particular customer to satisfy an order. "Sales looks after the straight delivery to huge consumers like heavy oil for power plants users and for the retail selling section which is done through a network of gas stations" (Manzano, 2005).

2.2.6 Customers:
Guajardo et al. (2012) says that the customers for the various types of oil products include many different types of companies from many sectors of the industry. Manzano (2005) says that the petroleum downstream industry takes care of two types of customers viz the wholesale customers like power plants and the retail customers like gas stations selling petrol to car owners.

2.2.7 Transportation:
Guajardo et al. (2012) talks about two types of transportation viz primary and secondary. Primary transportation includes all the moves from the refineries to the hubs and depots where as the secondary transportation takes care of the moves of the products to the customers. Most of the transport of crude oil from the supply sources to the refineries and from the refineries to the depots and hubs are carried out by ships. The transport of products to the customers is taken care of by tank trucks. Transport within the company's own supply chain is monitored centrally whereas to customers is taken care of by the sellers.

2.3 Oil Industry Case Study:

In this sector we will analyse the supply chain of a leading oil industry company. The chosen company is MOL. We have chosen this company for two reasons. Firstly it is a very profitable company and secondly it is a big employer in Central and Eastern Europe.

2.3.1 Background:

MOL Website (2012) provides information that MOL, The Hungarian Oil and Gas Company Plc. was first established in the year 1991. It is a huge multinational company (MNC) in Central and Eastern Europe with branches in the entire Hungarian Oil and Gas sector. The first big refinery was built in Fiume in 1882 which is present Rijeka in Croatia today. The Hungarian Petroleum Co. Plc was established after a year in Budapest. After the year 1882, Hungary's oil refining sector grew exponentially with 13 operating crude oil processing locations by 1898. MOL Website (2012) says that before the beginning of World War 1 about 12 plants were producing nearly 80% of total national production that is about 560000 tons per year. During the end phase of World War 2 the Hungarian crude oil industry was seriously damaged. After the end of the Second World War, reconstruction of this sector was taken up.

MOL Website (2012) says that after several re-structuring activities, the Hungarian Oil and Gas Company Plc was established in 1991. "The MOL Group includes MOL, Hungary's largest project, the Slovakian oil company Slovnaft, the leading Hungarian petrochemical company TVK, the Austrian retail and wholesale company Roth, the Italian refining and retail company IES and the Croatian retail network Tifon" (MOL Website, 2012). Moreover MOL Website (2012) tells that MOL has a very solid partnership with the Croatian national oil and gas company, INA (25% stake), the Czech electricity group, CEZ and the Oman Oil Company (OOC), having 7% and 8% shares in MOL respectively. In addition MOL has varied operations in more than 40 countries and is a market leader in Hungary and Slovakia. The company gives employment to about 15000 people all over the globe.

2.3.2 Financial Fundamentals:

MOL Website (2012) says that the year 2011 proved to be a strong year for MOL operations inspite of a weak global economy. "There was an EBITDA (Earnings before Interest, Tax, Depreciation and Amortization) of Hungarian forint (HUF) of 645 billion (bn) which represented a 6% yoy (year on year) improvement" (MOL Website, 2012). Operating profit on the other hand was HUF 337 bn which was the same as the previous year. In 2011 the upstream operations contributed more to the operating profit which was about 70% of the group EBITDA. The downstream area showed a loss on account of a weak external environment and refinery close down in Croatia. The gas midstream was an important contributor to the operating profits. "The implementation of net investment hedging accounting led to a significant improvement of the financial line" (MOL Website, 2012). On account of this the net profit of the group reached HUF 154 bn in the year 2011 while in 2010 it was HUF 104 bn. Currently MOL's market capitalisation is estimated to be around USD 16 bn.

2.3.3 Supply Chain Strategy:

The supply chain management function at MOL encompasses procurement, refinery activities, logistics and marketing. Szucs and Hassen (2012) say that the supply chain is made up of five units viz

- strategic planning unit
- planning and optimization unit
- refinery scheduling unit
- supply and distribution planning unit and
- a performance monitoring unit

The various functions include information sharing and cooperation with the various departments. Szucs and Hassen (2012) also say that the supply chain management also takes action when something wrong occurs along the chain, as an example the marketing department wants to sell so much refined product which cannot be tackled by the logistics department.

Russia is the major supplier of crude oil for MOL which is basically delivered via pipelines. The pipeline crosses the Hungarian town of Fenyeslikte after which the pipeline system belongs to MOL. After the crude oil reaches Hungary it is moved to the refineries in Szazhalombatta. But this system does not exist in each and every country where MOL operates or has subsidiaries. For example INA in Croatia buys its supply of crude oil from tanker ships.

After the crude oil has been procured at the respective refinery it is then refined to produce the required product and quantity demanded. The products so formed are then marketed to the wholesalers or to retailers who can represent the MOL brand or even other competitor's brands. Szucs and Hassen (2012) say that when it comes to diesel usage the main users are heavy automobiles, logistics and agricultural companies. Petrol users are the automobile industry and this is sold by small retailers at the filling stations. Besides producing motor driving materials, refineries also produce many types of oil derivatives. Most of these are produced by the petrochemical division but their markets are usually different and face different challenges.
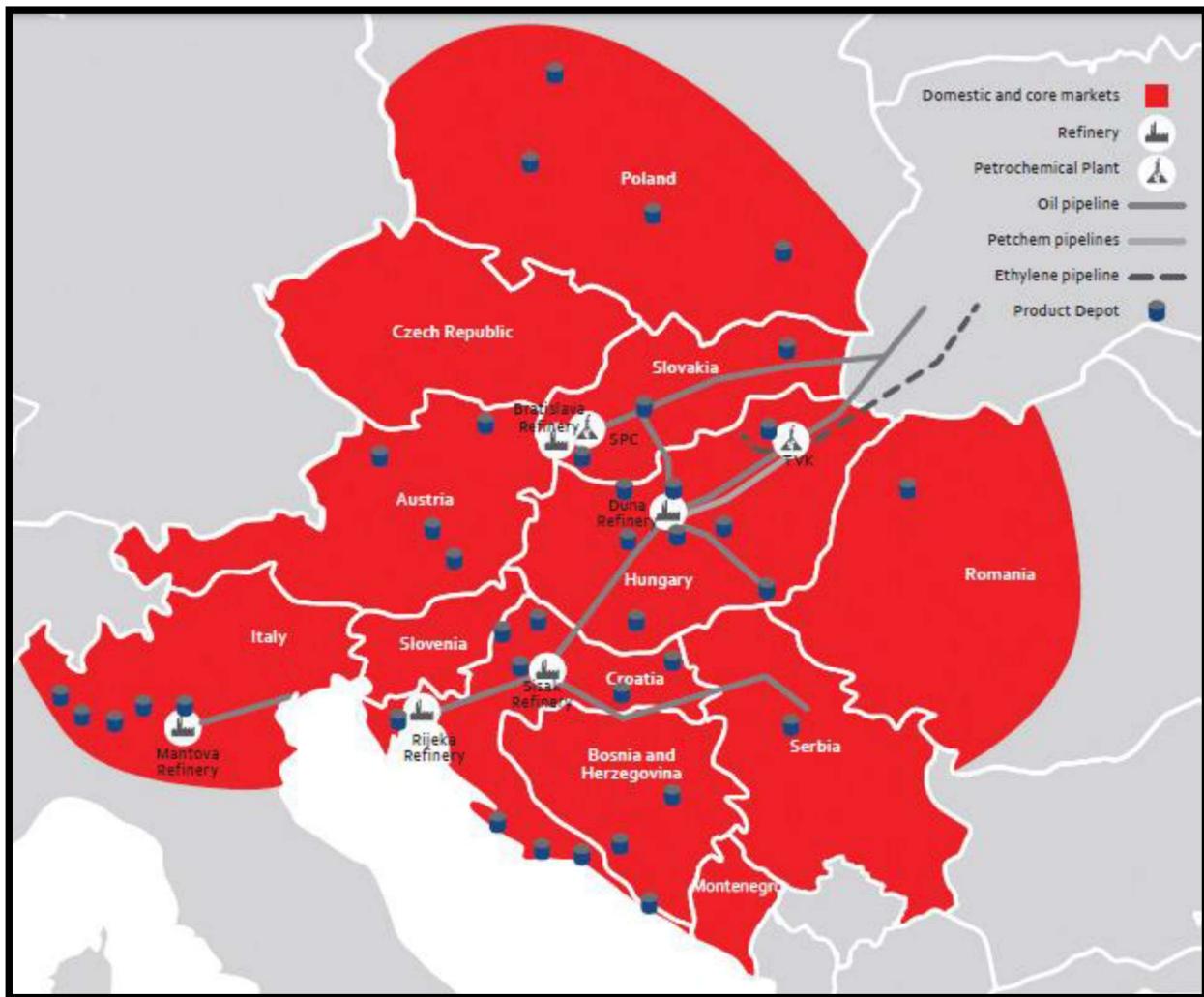
Figure 6: Downstream Map (Source: MOL Group Investor Relation, 2012)

The various functions of downstream supply chain management units are as follows:
- Strategic Planning Unit: The main function of this department says Szucs and Hassen (2012) are for long term planning, product portfolio development and evaluation of the MOL group strategy.
- Planning and Optimization Unit: Ribas et al. (2011) say that the uncertainty and the big economic incentives of the refining business are what drives the forces for improvement in the refinery planning process. Ribas et al. (2011) further adds that in preparing manufacturing targets are put in place and market forecasts, resource availability and stocks are considered. Szucs and Hassen (2012) say that this unit deals mostly with the optimization of the whole downstream supply chain. Jasuja et al. (2009) add that planning includes which feedstock to buy, where to process, what to make and where and how much to buy readymade.

- Refinery Scheduling Unit: Szucs and Hassen (2012) says that the work of this department is short term scheduling based on a rolling plan and triggers the refineries operation at the group level. Jasuja et al. (2009) say the scheduling includes when and in what order feedstock should arrive at the manufacturing facility, when and in what sequence to run the equipment and finally which orders to meet and what dates to promise.
- Supply and Distribution Planning Unit: Szucs and Hassen (2012) point out that this unit plans and schedules the supply chain on daily and also on a weekly basis. It also takes care of the coordination of the refinery, logistics and marketing roles.
- Performance Monitoring Unit: Szucs and Hassen (2012) say that this unit evaluates the performance of the whole downstream supply chain. Part of their activity is also the tracking and analyzing of any change in the plan.

Szucs and Hassen, (2012) point out that sometimes MOL partners on certain projects with their competitors. This type of partnering is called shipment swapping. This is usually done to reduce costs by rationalizing certain functions of the supply chain.

Szucs and Hassen (2012) point out that there are various constraints and solutions for the same at the supply chain function and these are as follows:
- Demand Forecasting: This activity is done by the marketing department. MOL has over the years developed a very detailed demand forecasting system. Demand planning is a very important point of the supply chain since it causes the starting of the whole downstream supply chain.
- Procurement: It is the marketing department which carries out this function. The buying and selling of crude oil and its various derivatives take place under long term contracts. MOL can also work the spot market by taking its products onto the spot market for any customer to buy it.
- Refinery and Inventory Management: The process of refinery is a special process which is found only in the oil sector supply chain. It is also a very complicated procedure as it produces various derivatives. Planning and scheduling operation is very important here. On account of the various types of oil derivatives and storage capacity, storing the oil meets several constraints. For example various derivatives of oils can be stored in the same tank only after a thorough cleaning of the tank first. Manzano (2005) says that refineries are usually located closer to the final customers. This is on account of the fact that there are economies of scale in transporting huge quantities of crude oil rather than final products in smaller quantities. Manzano (2005) also points out that on account of the strategic value of the refining assets governments prefer having a few refinery operations on their respective territories.
- Distribution and Logistics: The supply and distribution of oil and its various derivatives is complicated, takes time and is expensive. Manzano (2005) says that at this stage of the supply chain the transport of finished fuels take place from the exit of the refineries to the consumers and the sale of fuel in bulk or small quantities at the gas stations. Manzano (2005) also says that quantities transported are smaller than when just crude oil is transported and they are typically in the range of 10 to 50000 tons. Transport capacity is usually fixed and shipping everywhere is also not an option. Pipeline building is an expensive task

and moreover has only fixed capacity. The logistics department therefore has to take into consideration all these constraints. It is the logistics department which has to provide the correct information to the planning and optimization unit about their capacities and various possibilities. The planning and optimization department will send a solution back to the logistics department based on which the logistics department will carry out its functions.

- Marketing: MOL has two target markets and they are the wholesale and retail markets. Wholesale basically covers the business to business market whereas the retail covers the business to customer sector. The most important markets of MOL are situated within a radius of 500 kilometers of each refinery. Hence the goal of the marketing department is to serve market demand at the lowest cost to achieve maximum profits.

2.4 Typical Supply Chain Model of the Oil Industry:

"The supply chains are traditionally characterized by a forward flow of materials and a backward flow of information" (Beamon, 1998). The literature review so far shows the characteristics and structure of a typical oil industry company. In this section we will try to build a model which will represent the typical oil industry supply chain. It might be possible that in some companies the structure might be slightly different especially with respect to the functions of some of the departments coordinating the supply chain. Anderson (2003) points out that oil companies are now-a-days joining together to form even bigger companies that have larger purchasing powers which go further down the SC. As already mentioned before, the oil supply chain is a complex one. It includes domestic as well as international transportation, materials handling, storage facilities like depots and hubs, refineries and pipelines.

There are three phases in the oil supply chain process and these are upstream, midstream and downstream.

- Upstream: Initially the oil is discovered by geologists either on land deep underground or in the offshore areas. Equipment is then supplied to build the drilling platform. This is all included in the exploration, forecasting and production of crude oil. Engineering activities then get the crude oil out of the ground through drilling activities to the surface. There are suppliers who supply the oil rig with various articles for the drilling activity as well as the daily requirements of the oil rig workers.
- Midstream: The crude oil so extracted is transferred from areas of production to the refineries via pipelines or ships like Very Large Crude Carriers (VLCC). At the refineries the crude oil undergoes various processes to get various distillates.
- Downstream: The various derivatives are further transported from the refineries via pipelines or ships like Aframax and Suezmax to the hubs for blending the basic oils to produce specialty oils and then further transported to depots for storage. The wholesalers market the products to the retailers and from the depots they are transported to the customers via tank trucks. This is the typical structure of the oil industry supply chain.

2.5 Conclusion:

In this chapter we have discussed about the importance of the supply chain of the oil industry in great detail. "The oil sector's progress will be based on the formation of well organized business processes, the better use of information systems and a huge investment in human capital to perform the activities which make up a supply chain that is successful" (Manzano, 2005). We have talked about the characteristics of the oil industry which are its complexity, inflexibility, vertical integration and capital intensive nature. After this we have further analyzed the supply chain of the oil industry and introduced the case study of MOL Oil Company. Finally we have concluded the chapter with a presentation of a model of the typical supply chain of the oil industry. In the next chapter we will deal exclusively with the supply chain of consumer electronics.

Chapter 3 – Analysis of the Consumer Electronics Supply Chain

3.0 Introduction:

The Consumer Electronics (CE) sector is one of the most vibrant industries in today's world. Dhenke and Chittal (2011) say that products that were not in the pipeline until a decade ago have undergone speedy transformations, leading to an endless chain of innovative new products. Wilkerson (2010) points out that the consumer electronics industry is very powerful with respect to innovating new goods. Wilkerson (2010) also points out that the consumer electronics industry is leaps and bounds ahead of other sectors in using new technology for its supply chain needs. The iPod which was launched in October 2001 has really revolutionised the way in which consumer electronics items are made, designed and put to use. Banker (2012) says that since Apple, the manufacturers of the iPod, have become such a large entity, it holds advantages in procurement due to which its smaller rivals cannot keep up. As an example Samsung lost United States (US) dollars 10 billion in value when Apple placed a huge order for flash memories with Elpida. Since Apple has become so big it has to pay a premium for many of its customized components and inspite of this Banker (2012) says that the company's cost structure resembles that of companies which source only common components.

Today there is an unending offer of mobile smart phones, TVs with 3 D effects, tablets, cameras which project images and Global Positioning System (GPS) instruments to fit the need of each and every individual. Kampani (2013) say that GPS technology aides the supply chain professionals to locate the exact position of vehicles, people and even inventory in the supply chain. "With the help of such data, delivery schedules can be modified and materials moved in tandem with the requirement" (Kampani, 2013). "All these gadgets are facing increasing demand because they tend to change the way in which people interact, consume entertainment, manage their finances and organize their daily lives" (Dhenke and Chittal, 2011). At the same time people who use social media and owners of digital content are pushing the demand for electronic devices and they lay down the rules of the game that impact the competitiveness and the exponential growth in the consumer electronics sector.

"Improving the performance of the supply chain can very much affect the economical position of the company within markets that are competitive and supply the activity with a competitive advantage over its rivals" (Chavosh, 2011). "Today's electronic industry is characterized by an accelerating pace of innovation and greatly reduced product lead times" (Phillips Electronic Company Website, 2012). Phillips Electronic Company Website (2012) also points out that a very high percentage of parts and products are now outsourced rather than manufactured in within the company.

Kato (2011) says that in the past decade there has been a lot of mayhem in the consumer electronics sector. Changes in technologies, severe competition, the 2008-2009 global financial crisis and the bankruptcy of big companies are just a handful of the issues that have reshaped the sector. The Consumer Electronics industry has also issues like sustainability, regulatory and acceptance of contract manufacturing to deal with. All these three have moved from the discussion tables to reality within ten years.

Product lifecycles are becoming smaller on account of the customer's demand for better products and cheaper items. All this is leading to the obsolescence in technology. Dhenke and Chittal (2011) have said that new products are coming speedily into the markets, raising the rapidity of marketing events and activities promoting new products. The Consumer Electronics Association (CEA) analysts have forecasted a ten percent growth of consumer electronics devices globally and they have predicted it to reach 964 billion. The Consumer Electronics Association analysts also say that sales globally might also reach one trillion United States dollars. Dhenke and Chittal (2011) say that for the consumer electronics sector these are interesting times with a lot of possibilities for exponential growth only if they can take care of the increasing intricacies in manufacturing of products.

"To use the chances presented by the consumer demand explosion, consumer electronics manufacturers need to make better use of their forecasting, sourcing, distribution and inventory management strategies" (Dhenke and Chittal, 2011). But to be successful in a consumer electronics sector that is full of hard competition, the manufacturers must change their attitude toward supply chain management. They must use techniques that bring more refinement and sophistication to supply chain management. Totally new ideas have to be used to better understand the needs of consumers and reply to them. All this has to be done while being flexible in production, distribution and logistics.

Dhenke and Chittal (2011) point out that the conventional ways of demand planning and supply chain planning are just not sufficient enough to meet the challenges in the near future. To take care of the great pressure from competition, margins that are getting smaller and customers that are difficult to keep satisfied, consumer electronics manufacturers have to prepare a vision plan to increase the scope and role of supply chain management. Dhenke and Chittal (2011) say that there are new challenges for future supply chains of consumer electronics sector and these are as follows:
- Supply Chain Collaboration: There is an increasing trend among the consumer electronics sector to outsource activities that are not essential to its core business. At the same time collaboration with retailers has become very important. Increase in data sharing with the retailers in real time is becoming very important in order to make logic and form of the demands.
- Supply Chain Risk Management: On account of globalization in the sourcing and manufacturing of products costs have gone down considerably but on the other hand there is an increase in exposure to various risks. "Supply Chain models have been growing with sophistication in the capture of data, monitoring and analyses all throughout the manufacturing chain to reduce risk and its effects" (Dhenke and Chittal, 2011).
- Supply Chain Planning: In the consumer electronics industry the time that is available to react to changing demand conditions and other changes is becoming very small. The manufacturers need to become more nimble and supple. They need to become bigger and enlarge themselves in a circumstance that does not allow exact forecasting through efficient partnership with the retailers.

- Reverse Logistics and Sustainability: Currently on account of short product cycles there is a lot of e-waste accumulating. E-Waste Management has also been attracting a lot of regulations. Original Equipment Manufacturers (OEM) are increasingly given the responsibility of taking care of returns. Consumers of products are also demanding lowered carbon footprints of the products that they buy. Thus the two issues of economic value of returns as well as sustainability will create more severe ways of grading vendors and suppliers.
- Social Media: The increasing use of social media has also generated demand for consumer electronics. Consumer Electronic manufacturers are using social media as a marketing tool and a channel for feedbacks. Social Media will definitely play an increasingly important role in supply chain management.
- Digital Supply Chain: Digital content owners are pushing the demand for consumer electronics devices. The reply from consumer electronics manufacturers to innovations in the delivery of digital content will decide competitiveness and expansion.

Kato (2011) says that in order to stay alive and be victorious in these future environments, manufacturers need to focus on superiority in supply chain and more mutual collaboration with important retailing partners. Adexa Company Website (2012) also adds that thus on account of increasing pressure from shareholders to create value for the share and in order to make its market position stronger consumer electronics companies have used supply chain management to give swiftness, suppleness and top customer package to maintain their competitive position.

3.1 Characteristics of the Consumer Electronics Industry Supply Chain:

Adexa Company Website (2012) says that the electronics industry is losing its vertically integrated nature and different multi stage supply chain configurations have come up which promotes greater efficiencies, suppleness and receptiveness. Below are some of the most important characteristics of the consumer electronics industry supply chain.

3.1.1 Mass Customization:

Adexa Company Website (2012) says that customers are looking out for consumer electronics companies to manufacture customized products speedily and at cheaper prices. On account of this there is a great amount of pressure on consumer electronics companies to be very proactive to build supply chains that are low in costs and has a fast response time. Battezzati and Magnani (2000) say that a lot of firms are now implementing postponement strategies which means that they will finish manufacturing a product only after the receiving an order.

3.1.2 Short Product Life Cycles:

Adexa Company Website (2012) says that in order for manufacturers of electronic commodities to increase profits, retain market share and to demand a top price they have to constantly introduce new goods with new features. The above reason leads to very short product life cycles. This again causes complications in the predictions for consumer demand. Also a lot of forecasting algorithms need at least one year's sales data in order to function. On account of these reasons manufacturers must establish a very close relationship with retailers and resellers. "There can be adequate control over

market demand only by maintaining close contacts with the customers and by using collaborative development techniques" (Schlacter and Yehiav, 2008).

3.1.3 Taking Care Of Inventories Which Are Subject to Rapid Depreciation:

Adexa Company Website (2012) says that increasingly manufacturers of product components are bringing to the market new and improved array of functions at lower prices. In order to maintain a competitive advantage the manufacturers of whole products feel compelled to use these new parts into the manufacture of their products. On the other hand the manufacturers of whole products have to also make use of the old existing inventories to maintain the profit margins. Although the semiconductor industry is cyclical in nature and there are many problems like matching capacity with demand and increasing the return on investment (ROI), it can also give a lot of benefits. Estimates point out that if there is a reduction in the inventory stock by ten days there can be an expected rise of 1% in profits.

3.1.4 Supply and Demand Mismatch:

Adexa Company Website (2012) says that the consumer electronics industry is a material controlled business. By this we mean that as new products are being regularly brought to the market, older products are on the other hand being redesigned to use components with increased functionality. All of this takes place in areas where consumer demand is very hard to forecast. To be successful in such an environment, manufacturers need to work very closely with the suppliers to fulfil demand. This is again same in the sense how manufacturers need to work with retailers to predict demand. With respect to all of above, manufacturers who use collaborative development techniques are the companies which have the best chance to be successful.

3.1.5 Pressure from Retailers and Resellers:

Adexa Company Website (2012) says that manufacturers are under great stress to supply products at the right situation and right instance. Although this might not always be possible it is very important to set the right expectation. This means that there must be a lot of collaboration and correct communication. Schlacter and Yehiav (2008) point out that retailers need that manufacturers keep to precise delivery dates so that marketing events do not fail. On the other hand the retailers need firm dates in the fulfilment process in order to avoid surprises.

3.2 Analysis Of The Consumer Electronics Industry Supply Chain:

3.2.1 Extremely Multifaceted Supply Chain for Components:

"The increasing amount of suppliers that are available, various supply bottlenecks and a supply base that is constantly evolving are pushing the necessity to be competitively adaptable" (Wilkerson, 2010). This is especially true at the front end when new products are introduced or at the back end of a product's lifecycle.

3.2.2 Broad Set Of Demand Channels:

Wilkerson (2010) says that the two basic ways of allotment in the electronics industry and these are brick and mortar and direct fulfilment. However mixed approaches which

fit together off these two channels are being checked and extended frequently. Some of the ways in which order channels are continuously being extended are online advertising, coupons and gift cards being given out to customers through retail and storefronts.

3.2.3 Availability Of Lots Of Information:

"The information received from various suppliers, retailers, industry relations and sales channel partners leads to a great amount of information availability which can be used for demand forecasting and supply needs as well as managing performance. The well established collaborative planning, forecasting and replenishment (CPFR) is being supplemented with a rich point of sale (POS) data as well as consumer behaviour data which provide a broad range of possibilities for improving the supply chain information flow" (Wilkerson, 2010).

3.2.4 Continuous Reinvention Of Lean and Competitive Marketplace:

Wilkerson (2010) says that in today's extremely competent business settings there is a lot of rivalry and cut throat competition. This leads to a situation where the technologies which are being used are forward thinking and cheap. Wilkerson (2010) also adds here that it is information technology that forces the supply chain to become long term market leaders and information technology will allow very little edge for mistakes in meeting functionality and performance requirements.

3.2.5 Promising Outlook for Continued Growth:

Wilkerson (2010) points out that recent studies show that 2010 and the coming years looks positive for the consumer electronics industry as a whole. It was concluded that about two thirds of the consumers are going to spend more than they spent in 2009. Companies can stay competitive and build on their past successes through the successful management of their supply and demand through the use of IT.

3.2.6 Union Of Product Lifecycle Management, Supplier Relationship Management and Global Trade Management:

Wilkerson (2010) says that all the above three areas are all set to be jointly managed rather than in the past when they were conventionally handled independently. Wilkerson (2010) also says here that we are all set to see more progression in solutions if the software innovations continue to keep tempo with the inventive market.

3.2.7 A Just In Time Supply Chain:

"The implementation of JIT principles in the consumer electronics industry makes the production operations more efficient, cost effective and customer responsive" (Larson, 2005). Consumer electronics companies using JIT have a better competitive position over the others that do not adopt JIT. This is because they have the right amount of inventory to meet the demands of the production processes (raw materials) and that of the final consumers (finished goods), no more no less!

3.3 Consumer Electronics Industry Case Study:

3.3.1 Background:
Sony Supply Chain Solutions Inc. was established on 13 February, 1962. Sony Supply Chain Solutions Malaysia Website (2012) says that what began as logistics solution supplier has been very speedily changed into a vibrant bond to Sony and non Sony customers overseas as well as locally. The company has a capital of 1.55 billion yen and sales profit of 45.4 billion yen. The numbers of employees are 463 as of 01 April, 2012. Moreover it also has 42 domestic offices and 12 international offices. The Sony Supply Chain Solutions Inc. Website (2012) says that the main role and intention of the company is to keep up a system for parts procurement and products distribution that connects local and overseas operations. It helps in making it possible to provide a fast supply chain in the Sony Group of companies. The Sony Supply Chain Solutions Inc. Website (2012) says that the company has four main basic operations which are as follows:
(i) Local Distribution
(ii) Overseas Logistics
(iii) Parts Sourcing and
(iv) Client Service Operations
The Sony Supply Chain Solutions Malaysia Website (2012) adds that the company is always aware of new happenings and new requirements that take place in the market in order to fulfill the customer's requirements to the fullest. "The company takes care of inventories, reissuing of invoices, creating order processes, incoming and outgoing of local as well as international goods and consolidation of cargoes" (The Sony Supply Chain Solutions Malaysia Website, 2012). It also extends the supply chain which covers every point in between the Sony warehouses and customer's factories. Besides the company takes care of orders, inventories, production moves in and out and coordinates multiple stops to take care of production schedules to make use of Just in Time (JIT) management.

3.3.2 Local Distribution:
The Sony Supply Chain Solutions Inc. Website (2012) says that the company provides distribution operations for plants and sales offices of the Sony group of companies but only in Japan (locally). Factory operations take care of parts which are sent by domestic or international suppliers. This starts at dispatch and finishes at arrival in the factories. Under sales they take care of the movement of devices from the factories to warehouses or to customers. In case of imports this company takes care of all the overseas import which has to be distributed to customers and warehouses. Thus the company provides distribution to 27 different offices in Japan. Since they are the exclusive contractor for all Sony distribution activities they can provide the best service on account of the distribution knowledge that they have accumulated. In the future this company will outsource all distribution activities to third parties. Also in the near future the company also wishes to unite the various departments in order to provide solutions which are consistent.

3.3.3 Overseas Logistics:

In this function the Sony Supply Chain Solutions Inc. Website (2012) says that the company acts as a source of overseas logistics operations to Sony which includes distribution of products of Sony, Sony devices, parts and the private goods of Sony employees moving abroad. The company acts as headquarters of all the hubs which is why they can conduct logistics operations at a global level. There are hubs in the United States (U.S.), Europe, China and South East Asia which are all controlled by this company. Since the ratio of products being manufactured overseas has been increasing the position of the International Logistics Operation has also increased. The Sony Supply Chain Solutions Inc. Website (2012) says that per year 100000 FEU (Forty Foot Equivalent Unit) containers and 100000 tons of air cargo is moved around the world over. On account of the global international logistics operations being close to the various Sony offices and factories the world over, the company has exact knowledge and information about the needs of the group as a whole. In the future the company has the goal of trying to improve the logistics processes in developing countries.
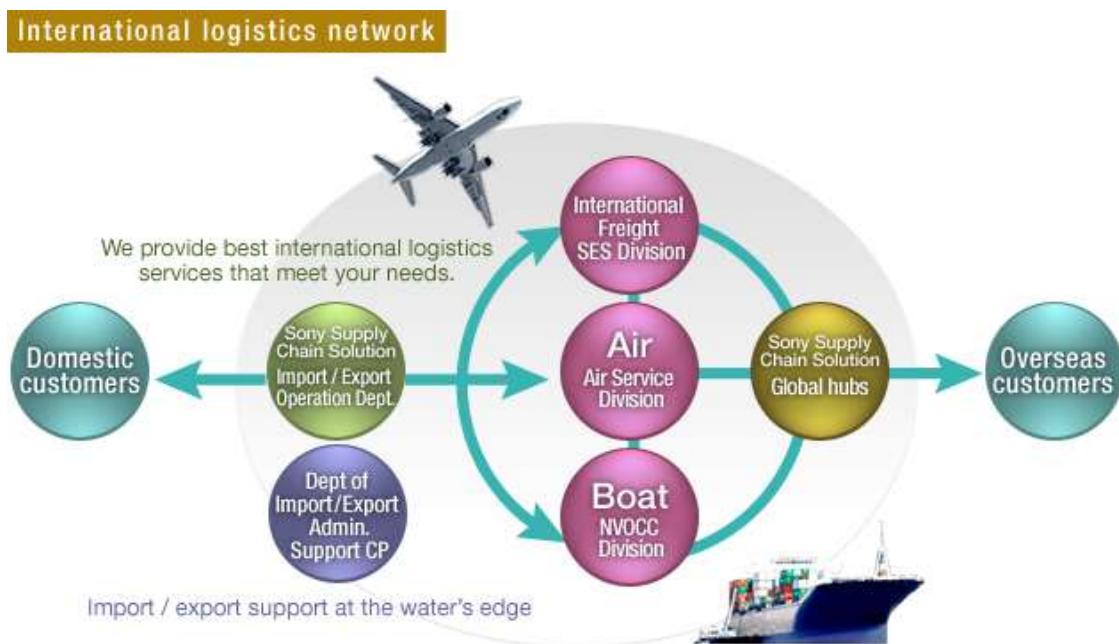
Figure 7: Sony's International Logistics Network (Source: Sony Supply Chain Solutions Inc. Website, 2012)

3.3.4 Parts Sourcing:

The Sony Supply Chain Solutions Inc. Website (2012) says that the parts sourcing division is in charge of supplying parts for Sony products and components every time a demand arises from one of the factories and the Sony business groups all over the world. There are procurement hubs in countries such as Japan, China, Malaysia, Taiwan, South Korea and the United States whereas the headquarters is located in Japan. The parts which are purchased from over 1500 suppliers are supplied to over

100 plants the world over. The main mission of this department is to buy the needed parts in a time and cost efficient manner. The Sony Supply Chain Solutions Inc. Website (2012) adds that the sourcing services are not just limited to Sony factories but also provide services to OEM (Original Equipment Manufacturer) and EMS (Electronics Manufacturing Services) factories. Thus the key advantage of this department is the one stop shop solution in parts procurement that it offers towards each plant's production line. For the future the next plan is to set up a central order processing centre to supply the required parts globally for a more faster and efficient operation.
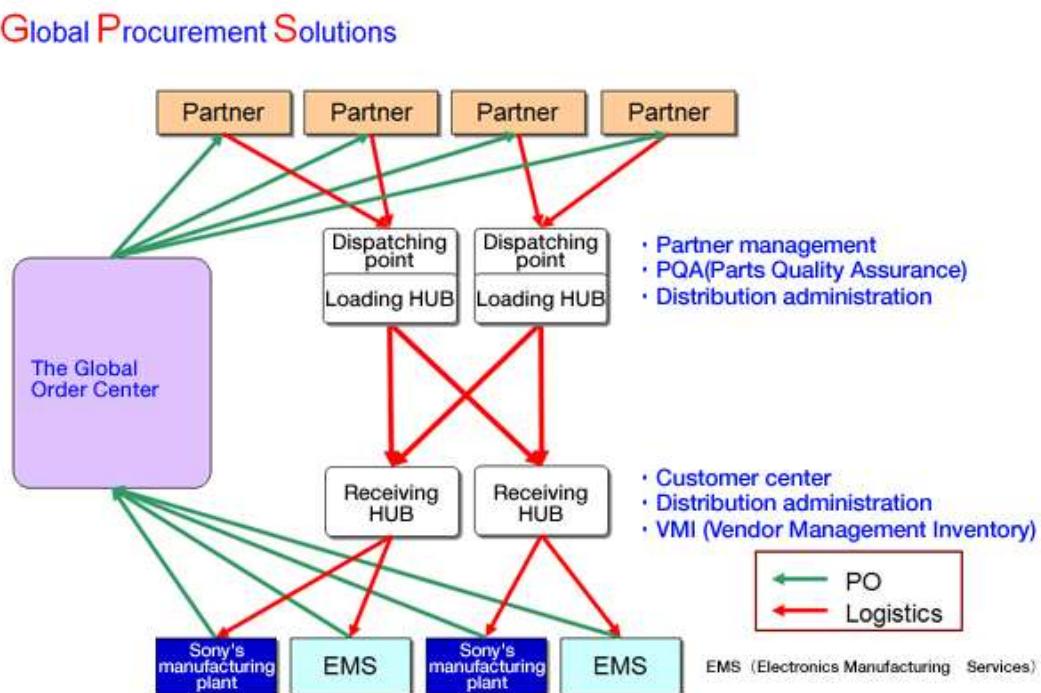
Figure 8: Sony's Global Procurement Solutions (Source: Sony Supply Chain Solutions Inc. Website, 2012)

3.3.5 Client Service Operation:

The Sony Supply Chain Solutions Inc. Website (2012) says that the client service operation department basically takes care of the allotment of revamp parts for Sony products. Using the global network of Sony, the department can handle repair parts in a timely and in an accurate manner with low costs. This results in the Sony products being repaired as fast as possible and in a timely manner with the lowest possible costs. Since Sony has manufacturing and sales centers the world over it is therefore necessary to also have repair centers that span the globe. With this intention in mind repair centers have been set up in Japan, China, Belgium, Singapore and Mexico. With these strategic locations Sony is able to meet customer demands in a timely manner. Initially the repair parts were sent individually which had high costs but now there is consolidation achieved through integration with those of complete products and mass produced parts.

Figure 9: Sony's Global Network of Repair Part Supply Chain (Source: Sony Supply Chain Solutions Inc. Website, 2012)

3.4 Typical Supply Chain Model of the Consumer Electronics Industry:

In the consumer electronics industry there is extensive overlap of supply chains. This is because many manufacturers of finished electronic devices source the various parts from the same subcontractors and suppliers. Also the supply chain for electronic components is highly complex which is on account of the huge number of suppliers. "The consumer electronics supply chain needs a very powerful cooperation between design, manufacturing, distribution and transportation" (Juneja and Rajamani, 2003). The literature review so far shows the characteristics and structure of a typical consumer electronics industry company. In this section we will try to build a model which will represent the typical consumer electronics industry supply chain. It might be possible that in some companies the structure might be slightly different especially with respect to the functions of some of the departments coordinating the supply chain.

Most of the branded consumer electronics companies take care that their products are manufactured only from conflict free metals. Initially the required metals are mined. The raw materials so mined are then further used by the component manufacturers to manufacture certain parts like semi conductors, resistors and capacitors. In the next stage the component manufacturers sell the parts to the enclosure manufacturers. The enclosure manufacturers provide design services, enclosure fabrication and system integration. "Large assemblers are pushing inventory upstream by putting pressure on key component manufacturers/suppliers to locate, own and manage inventory in warehouses close to the assembly plants" (Adexa Company Website, 2012). Zeng and Sycara (1999) add here that decisions with respect to the choosing of suppliers have to be based on the cautious assessment of the impact of raw material costs and delivery time responsiveness on the supply chain in its totality.

In the next step the Original Equipment Manufacturer (OEM) approaches a Contract Manufacturer (CM) with a design. Zeng and Sycara (1999) say that OEMs are the most important participants in consumer electronics sector. The Contract Manufacturer will quote a price based on the various processes involved, cost of labour, tools and the cost of materials used. The OEMs will collect such quotes from various contract manufacturers. After the bidding process is over and after the selection of the final candidate, the contract manufacturer will start functioning as the OEM's factory. All warehousing and logistics services are outsourced to 3PL providers. Zeng and Sycara (1999) add here that managers will have various options of transport modes to choose from. Zeng and Sycara (1999) say that the right alternative of transport technique depends upon how important the order is, the costs involved and where the transport activity is located in the supply chain network. After this OEM's like Sony will sell the various devices and equipment to retailers or will also sell via their own outlets. This is very briefly the typical supply chain of the consumer electronics industry.

3.5 Conclusion:

Adexa Company Website (2012) says that a lot of the area in financial presentation between consumer electronic companies can be attributed to the impact of supply chain best practices. In this chapter we have discussed about the importance of the supply chain of the consumer electronics industry in great detail. We have discussed about the characteristics of the consumer electronics industry. After analysing the consumer electronics industry supply chain we have also introduced the case study of Sony Supply Chain Solutions Inc. Finally we have concluded the chapter with a presentation of a model of the typical supply chain of the consumer electronics industry. In the next chapter we will deal exclusively with the supply chain of the fast moving consumer goods.

Chapter 4 – Analysis of the FMCG Industry Supply Chain

4.0 Introduction:
Fast Moving Consumer Goods (FMCG) which are also known as Consumer Packaged Goods (CPG) are any of those goods which are sold quickly and moreover also do not cost a lot. These are also those goods and products which are usually sold within a year's time. They usually have very short shelf lives as there is a high demand for these products or because the products get spoilt very fast. Common examples of FMCG products include items like toiletries, soaps, cosmetics, oral hygiene care products, shaving products, detergents, glass items, electric bulbs, pencil cell batteries, paper products and plastic goods. Wikipedia Website (2012) points out that although the profits made by FMCG companies are small they however sell in large quantities. The three most global FMCG companies in the world are ITC Limited, Procter and Gamble and Unilever.

Wikipedia Website (2012) points out the main characteristics of FMCGs which are as follows:
From the consumer's side:
- Purchasing frequently
- Almost no real effort in choosing the product
- Fairly cheap priced

From the marketer's side:
- Large volumes
- Low participation margins
- Delivery networks that are well covered
- High turnover in stock

The growing world population especially in the Far East, the Indian Subcontinent and Africa presents a great untapped opportunity for FMCG companies. The FMCG companies have a lot of opportunities for exponential growth in the developing economies where the population is growing; there are increasing disposable incomes, better educational levels and urbanization.

During the last few decades companies in the FMCG sector have been affected by many adverse market forces. According to DHL Supply Chain (2012) from the year 2006 onwards customer spending manners of nations such as North America, Western Europe and Japan became more uneven. These were warnings and indications of the oncoming harsh economic crisis. The major effects of this economic crisis were a fall in the value of housing, non availability of credit, increase in the unemployment rate and a fall in the level of personal savings. This resulted in consumers spending less money on FMCG products in these countries. The above reasons will therefore continue to limit the development possibilities in these countries. On the other hand investigations show that the vast majority of the middle class of the BRIC (Brazil, Russia, India and China) countries, Mexico and South Africa are increasing the quantity of currency that they expend on FMCG products.

In today's world the competition in the markets is vicious and this is especially true of the FMCG sector. Niu and Dartnall (2008) say that forecasting in this segment is

becoming very important. In this sector most of the products are very diversified and this would mean in addition that inventory of unprocessed goods and finished products involves a lot of costs. Also in this sector the customers have a lot of different choices. Niu and Dartnall (2008) point out that the level of customer contentment becomes a very important Key Performance Indicator (KPI) for a company. Niu and Dartnall (2008) further add that on time and regular delivery, accurate demand and top quality are the main parameters for this KPI. Other important issues in the FMCG sector are avoiding shortage of goods or keeping the minimum amount of stocks and to optimize processes by using the correct production capabilities.

"Both manufacturers and retailers all through the FMCG supply chain are finding it quite hard to deliver a margin on their goods, and the firms that have responded well are those that have been giving supply chain issues a priority" (Whitehead, 2012). The most pressing and important issue in this sector is to give operational suppleness by dipping lead times. On account of this there is an increasing trend to move the supply chains towards a local for local production model. Although many companies may set up manufacturing hubs in the Far East in order to be close to the fast developing Indian and Chinese consumer markets most of these gains are lost on account of surging fuel prices. As an example many of the goods which are manufactured in China are as expensive as manufacturing in Romania.

In the 1990s the new tactic for taking care of changes in the business settings was to become agile which basically means developing the ability to adapt to various situations. "The following are the important attributes for achieving supply chain agility within FMCG business industry: responsiveness, customer service, flexibility, innovation, speed, quality, efficiency and responsible people thinking" (El-Tawy and Gallear, 2012). "Agility can be defined as the ability to respond rapidly to unpredictable changes in demand or supply" (Christopher and Peck, 2004). The two most important components of agility are visibility and velocity. FMCG sector is very complex. This is because manufacturers produce goods which are almost immediately sold. So it is a very fast moving sector and therefore the sequence between demand and supply is more or less uninterrupted. With respect to this El-Tawy and Gallear (2012) point out that in the future competition will not be between individual firms but between rival supply chains.

"In low margin and high volume businesses like FMCG very close attention is required to the planning and operational procedures of the entire value chain activities because these minute details can change the fortune of any organization" (Nagarjuna and Siddiah, 2012). In today's times there are new ways of measuring business performance. True that businesses must bring profits and investment value to its shareholders. But all this must be done with sustainability and the environment issues in the mind. Consumers, investors and the government expect businesses to be more conscious of their environments and implement green supply chain strategies. Mazumder and Chatterjee (2010) finally add that for the FMCG sector where supply chain is the most important aspect to achieving spirited gain, greening the supply chains strikes equilibrium between community goals and commercial goals.

4.1 Characteristics of the Fast Moving Consumer Goods Industry Supply Chain:
Barker (2006) says that big volumes and fast turnovers are the most important characteristics of the FMCG supply chain. It is also not very easy keeping track of the inventory or stock. For our thesis the FMCG sector will be limited to beauty, grooming, household care, health and well being.

4.1.1 Contract Manufacturing:
Scribd Website (2012) says that it is very widespread for third party suppliers to put together products. A lot of companies prefer to manufacture their products by contract manufacturers in order to keep the prices low and allow a larger mass of the population to afford their products.

4.1.2 Less Capital Intensive:
Scribd Website (2012) says that the sector is not so capital intensive. This is because most of the various goods require very little funds in permanent resources. "The industry is also characterized by high turnover to investment ratio, turnover is typically five to eight times the investment made in a Greenfield plant at full capacity" (Scribd Website, 2012). A second reason for this industry being not so capital intensive is because majority of sales from producers takes place on a cash basis.

4.1.3 Heavy Launch Costs:
Scribd Website (2012) points out that FMCG companies incur huge costs when they launch new products. There is a large amount of money that is required for activities like expansion of new goods, market research and test marketing. "In order to build brand awareness and develop a network of franchisees for a new brand, expenses are incurred on activities like launch advertisements, free samples and product promotions" (Scribd Website, 2012). Launch costs can be in the region of 50 to 100% of the revenues secured in the first year of the brand and over time they keep on reducing as the brand becomes well known in the market, becomes familiar with the customer and when turnover increases.

4.1.4 Marketing Drive:
Marketing is a very important activity in building the brand image of a product. It helps in making the product more popular with the consumers and also positions it in the market to compete successfully against the existing brands. Even well established brands require constant marketing and care to keep increasing the demand from consumers.

4.1.5 Marketing Research:
Market research is usually done before the launching of a new product to check how keenly it will be welcomed by the consumers. Scribd Website (2012) points out that people's buying choices are based on ideas about brands which keep on altering with lifestyles. As the competition goes up, there is a great pressure on companies to do a lot of market research before launching a new product.

4.1.6 Presence Of A Large Unorganized Market:

Scribd Website (2012) point out that in the third world countries the FMCG sector is characterized by a huge unorganized market. "The entry barriers to the FMCG sector are quite low on account of low capital investment, tax incentives from the government and low brand awareness has led to the mushrooming of the unorganized sector" (Scribd Website, 2012).

4.1.7 Distribution Network:

On account of the fragmented nature of the FMCG companies in developing countries and on account of bad infrastructure, FMCG companies have to develop their own distribution networks to set base in both urban and rural markets. A well established distribution network will give them an upper hand against their competitors.

4.2 Analysis of the Fast Moving Consumer Goods Industry Supply Chain:

"Supply chain is made up of various processes made up of varied interlinked tasks and hence analysing the processes opens up the 'black box' of the supply chain" (Beck et al., 2003). The FMCG sector is very much reliant on the competence of its supply chains. In the FMCG industry on account of limited shelf life and perishables lasting only a matter of days, Barker (2006) says that stock movements are well timed and precisely tracked. In trying to lower the costs of the supply chains vendors are increasingly taking the help of Information Technology to fine tune their supply chains to the demands of the retailers. Reducing costs and improving service levels to the maximum are two differing but real objectives of today's FMCG sector. "Five leading short term objectives of any supply chain are as follows:

- Alignment of supply chain with the business strategy
- Distribution network optimization
- Optimizing outbound transportation
- Lowering procurement costs
- Reducing inventory" (Barloworld Logistics, 2010).

Güleş et al. (2012) point out that one of the most important matter in the FMCG sector is the availability of products in the market. On account of non availability of the good, the consumer will choose another product or brand. All these can cause huge loss of sales. Güleş et al. (2012) say that the availability of products in the market can only be supplied by producing and shipping the right goods at the right quantity at the right time.

4.2.1 Applying the Right Strategy:

"One of the ways that the FMCG companies and their 3PL providers can make use is to prevent products entering the warehouse where possible and this is where cross - docking is becoming very useful to the FMCG supply chain" (Barker, 2006). By accepting goods and sending them on their way to their destinations on the same day warehouses can considerable reduce their costs. Here software plays a very important role in increasing the visibility of the supply chains. This helps in giving better opportunities to cross-docking. By keeping a check and control over the products which are in the warehouse and those which are on their way to the retailers, Radio Frequency (RF) can help vendors to have an absolutely correct picture of their inventory at any given time. Barker (2006) says that this can help in preventing

damage, especially that of delicate stock. "Batch-tracking from the end of the production line to its final destination is further secured by the use of RF data validation" (Barker, 2006). RF data validation gives a real time picture of where the stock or goods are at any given time.

4.2.2 Being Responsive and Flexible:
As products start depleting off the shelves and racks of the stores, retailers are expecting lightning fast replenishment from the FMCG vendor. Barker (2006) points out that by keeping track of goods that sell fast on an everyday basis or products that sell fast during particular parts of the seasons and by getting the right inventory in the correct position within the godowns, the picking process becomes quicker and the warehouse processes are optimised. Barker (2006) also says that by using old data and forecasting for zenith times, vendors are much more likely to be able to fulfil orders and avoid stock-outs at busy periods.

There is now a new trend in the FMCG supply chain on account of the fast growth of internet retails for FMCG products like food and cosmetics. Although online purchase are motivated by lower prices the bottom-line here is that fulfilling such consumer orders requires a supply chain that is smooth with ever available inventory levels. Whether the customers are online clients or that of the retail stores, being responsive and flexible remains the crowning glory of a successful FMCG supply chain. In order to ship the right good to the correct place at the right time there needs to be collaboration and visibility all throughout the supply chain. "The one way of achieving this goal is to make use of integrated supply chain management systems that not only regard the distribution centre (DC) or warehouse as a link but as an essential hub in improving customer service and delivery" (Barker, 2006).

4.2.3 Distribution and Storage:
Today's supply chain structures were developed at the beginning to supply the warehouses of retailers with products according to strategies well laid out and orders placed in much advance. Li (2011) point out that distribution and storage still form a big part of the product's selling price. Li (2011) says that a lot of FMCG companies are endlessly advancing and improving and innovating the processes and delivery systems through cross-docking. Here goods which arrive at the warehouse through inbound trucks are directly loaded on outbound trucks without storage as inventory in the warehouse. This method can be used to reduce inventory, handling costs and cut on delivery times.

4.3 Fast Moving Consumer Goods Industry Case Study:

4.3.1 Background:
Logisticsit Website (2009) says that to meet buyer request – more than 150 million times for each day, a person somewhere around the world is choosing a Unilever product. Therefore the company must make sure that a steady supply of its merchandise is available to retail outlets around the world. Dhawan et al. (2010) in their report on Unilever's Supply Chain say that Unilever is a company which is situated in Rotterdam in the Netherlands. Unilever was first established in the year 1890. Unilever

Website (2012) says that William Hesketh Lever, invented the Sunlight Soap. This was an absolutely new product which helped in cleanliness and hygiene in Victorian England. "The idea was to make cleanliness a common thing, to reduce the household burden for women, to promote health and to contribute to personal attractiveness" (Unilever Website, 2012). Unilever Website (2012) further adds that all this was done with the idea in mind to make life more pleasant and satisfying for the people who use Unilever's items.

Their business areas cover basically the consumer brands. The basic products which they manufacture are food products, beverages, cleaning agents and personal care products. They provide employment to over 163000 people all over the world. Moreover they are located in 100 countries and sell their products in over 170 countries. The company has over 400 brands in their portfolio which concentrate on health and wellness products. These products generate totally sales in excess of Euros one billion every year.

Dhawan et al. (2010) point out in their statement that the top 25 brands in their selection report for almost 75% of their sales. They have number one position in many of the food categories like savoury, various spreads, dressings, tea and ice cream. They also hold the numero uno position in skin care and deodorants. Moreover they also have a very strong presence in home and personal care sections. Unilever also has 264 production sites globally. All these manufacturing bases adhere to their strict policies with respect to safety, efficiency, quality and environmental impacts. Dhawan et al. (2010) also point out that Unilever buys almost 12% of the world's black tea production, 6% of its tomatoes and 3% of its palm oil.

In 2009 the company's Chief Executive Officer (CEO) wrote that the company's new vision was to double the size of the company and at the same time to bring down the total impact of the company on the environment. Unilever Website (2012) says that no company touches so many people's lives in so many different ways. Business Insights Website (2007) says that the commercial plan of Unilever is to basically reach the greatest profitability, growth and return on resources. The company's global strategy is to have a local supply chain for local demand to reduce difficulties.

4.3.2 Reduction In Non Production Items (NPI):

Unilever has put into place a global supply chain model which tries to reduce Non Production Items (NPI). Right now this has been implemented in the markets of North America and Europe. It will slowly be extended to other areas. NPI teams have been set up to implement strategic sourcing strategies and other plans to reach the desired savings levels. Usually most of the NPI's have been bought locally but there have been negotiations conducted at the national and supra national levels. "Unilever's Supply Chain Model has a basic function of making the Unilever Group understand the scope of the supply chain and its sub processes" (Business Insights Website, 2007). It helps the various groups within Unilever in finding out the hidden synergies.

4.3.3 Distribution and Selling:

"Most of Unilever's range of products is sold through its sales department, independent brokers, agents and distributors, wholesale, co-operative and independent grocery accounts, food service distributors and institutions. Products are distributed via distribution hubs, satellite warehouses, company operated and public storage facilities, depots and other facilities" (Business Insights Website, 2007).

4.3.4 e-Procurement:

Business Insights Website (2007) adds here that aggregation of demand and access to new suppliers through real time partnership has enabled Unilever to improve efficiencies to the extended supply chain. "E-Procurement gives Unilever the chance for enjoying the benefits gained from strategic sourcing through information, compliance and business process simplification" (Business Insights Website, 2007). Totally e-Procurement helps promote Unilever's overall strategy. "Workflow automation and simplification to global sourcing processes has resulted in increased productivity and reduction of transaction costs" (Business Insights Website, 2007). "Data made available can then be used to harmonize items purchased, rationalise needs with suppliers and monitor and reduce usage, thus further increasing Unilever's buying opportunities" (Business Insights Website, 2007). There is enough proof for Unilever that e-Procurement can have a positive effect not just on simple transactions but also on the whole supply chain operation.

4.3.5 Exports:

Unilever sells its products in most of the countries in the world. It also manufacturers in many of the countries. In countries in which it does not have a manufacturing base it exports its whole range of products. As an example, in the European Union (EU) it manufacturers its products only in a few member countries for sale in the whole EU. Business Insights Website (2007) says that the criteria for choosing a production centre depend on prerequisite for advances for novelty, excellence, service, cheap prices and suppleness.

4.3.6 Global Supply Chain Management Solutions Providers:

Business Insights Website (2007) says that in order to make more efficient its day to day operations Unilever has roped in many partners in the field of technology and logistics on a global basis. Some of them are SAP, Adexa Inc., Ariba, Manugistics Group Inc., SSA Global, DSC Logistics and Exel. "Unilever's technology vision includes web technologies that enable it to come closer to the client and business analytics to make management information easier to access" (Business Insights Website, 2007). "Unilever's recent Information Technology (IT) achievements include business intelligence software from Hyperion and SAP (Systems Applications and Products) ERP (Enterprise Resource Planning) wall to wall as a standard the world over" (Business Insights Website, 2007).

"Unilever has also saved a lot of money by using Ariba's sourcing technology which reduced the office supply purchasing budget by millions of dollars and consolidation of data centers from eighteen to five" (Business Insights Website, 2007). "On the Business to Business (B2B) front, in addition to its RFID (Radio Frequency Identification) efforts,

Unilever is participating in an industry-wide effort to standardize data elements throughout the supply chain through UCCNet" (Business Insights Website, 2007). Presently Unilever uses 100 separate SAP ERP systems. Business Insights Website (2007) says that Unilever's ISIS (Integrated Supply Management Information System) helps its local, regional and overseas supply chain managers to make correct sourcing decisions and to initiate discussions with suppliers which will be of advantage to both groups.

"To have an unambiguous idea of the business performance throughout its 34 companies and in 19 countries Unilever Latin America has started an enterprise scale data warehouse and business intelligence project called Sinfonia" (Business Insights Website, 2007). Sinfonia will deliver answers that will extend to include one of the biggest databases for warehouses globally. "By using the KALIDO enterprise data warehousing solution, the organization is successfully delivering a large-scale enterprise data warehouse, on time and within budget, while simultaneously rolling out a region-wide SAP system" (Business Insights Website, 2007). "The KALIDO solution will help in enhanced understanding of regional supply chain processes, brands, customers and suppliers and moreover will also enable Unilever to take action quickly to new possibilities even when there is a constant change in internal and external business environment" (Business Insights Website, 2007). To conclude KALIDO will help to improve strategic planning and will be the key driver to enhance the decision making process by offering tailor made information at great speeds to key decision makers.
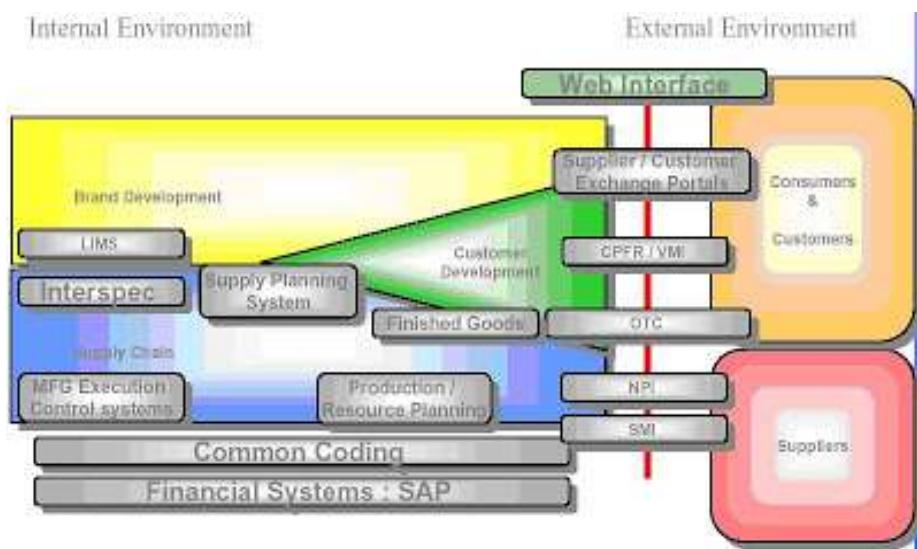
Figure 10: Unilever's Supply Chain System Vision (Source: Business Insights Website (2007)

Unilever says that its logistics operations provide it with the biggest chances to rationalize its supply chain and to help the company to reach its haughty growth goals. The company has currently shut down many of its warehouses from thirty to five. These five warehouses have the ability to ship orders within twenty four hours. The consolidation in the number of warehouses has taken place on account of the fact that retailers are practising a zero inventory policy. These policies require that Unilever make the best use of flow-through and cross-docking services in the warehouses.

"To increase asset utilization, lower inventories and improve service, Unilever adopted collaborative planning, forecasting and replenishment (CPFR) relationships with some retail customers" (Business Insights Website, 2007). Christopher and Peck (2004) point out here that in the FMCG area there is now a lot of close cooperation and partnership between manufacturer and retailer in the form of CPFR programs. The aim of collaborative working is the great reduction in uncertainty through information exchange. On account of all these Unilever has been able to reach a target of 10% inventory reduction, 10% increase in forecasting and 5% increase in sales due to better availability of the products on the shelves.

4.3.7 RFID:
Business Insights Website (2007) says that the Supply Chain team of Unilever wants to use tracking devices so as to understand how better tracking of products will affect production in factories, distribution centres, warehouses and retail shops. "Unilever thinks that their production plants will have to decrease the length of product runs and make other adjustments in order to respond faster to changes in demand" (Business Insights Website, 2007). With this initiative in mind it put RFID tags on 30000 packs of deodorants and had them monitored as they were moved from the production plants to retail stores. "RFID can be defined as an automatic identification and data capture technology that uses radio waves to provide real-time communication with objects at a distance, without contact or direct line of sight" (Sarac et al., 2008).

In the last few years RFID has been increasingly being used to keep track of inventory, asset tracking and to locate the position of an object. Bottani and Rizzi (2008) point out that RFID technology helps in tackling problems such as stock differences, replacement policies and bullwhip effect. "Through real-time data sharing, companies have broad and plain visibility over logistic flows and can use this information to optimize logistics processes and supply chain management" (Bottani et al., 2010).

"Bullwhip effect can be defined as the general tendency for small changes in end customer demand to be amplified within a production-distribution system" (McCullen and Towil, 2002). "The consequences of bullwhip are swings in inventory, additional inventory to buffer against the uncertainties of variable demand, necessary fluctuations in the level of production and shipments, and patchy product availability" (McCullen and Towil, 2002). RFID can also help Unilever to increase its revenues and reduce the cost of stocking.

4.3.8 Maintaining a Seamless Supply Chain:

Logisticsit Website (2009) says that one of Unilever's most important goals is to ensure that people are provided with food in which they can ensure quality of the utmost level throughout the sourcing, manufacturing and distribution of its products. Logisticsit Website (2009) says further that to take care of day to day actions, the two North American divisions depends very much on ERP systems which are in turn are supported by a number of huge databases. Logisticsit Website (2009) also adds that the ERP system supports a range of central business processes such as sales, distribution, sourcing and finance. ERP systems help in the better flow of information. By improving the quality and deployment of the database, Unilever North America were able to bring down substantially the operating costs and increase output with which they could take care of the supply chain continuity and best practices in the manufacturing processes.

4.4 Typical Supply Chain Model of the Fast Moving Consumer Goods Industry:

A good FMCG supply chain differentiates itself from an ordinary supply chain by timely product deliveries and low costs. Chiles and Dau (2005) say that FMCG supply chains vary in how multifaceted their structures are. Depending on the structure they can include various manufacturers, suppliers, distribution centers and retail locations. Before a FMCG product reaches a consumer it has to go through various echelons and numerous links. The first link in the chain is the Vendor. The Vendor provides the raw materials which go into the manufacture of the products. After the sampling and testing the material will move towards the next stage which is production. Modgil et al. (2012) say that if the resources provided fulfill the stipulated conditions then they are used in the production process. They also provide the packaging materials. Then comes the role of the Contract Manufacturer. Not all the products are manufactured by the final manufacturer. The production, filling and packaging of some of the products is outsourced to Contract Manufacturers. The Manufacturers also are involved in the production, conversion, filling and packaging of the products.

The products manufactured in this way are then sent to various warehouses located in strategic locations. The transportation and logistics services are usually outsourced to various 3PL providers. In between each echelon various transport providers are used to transport the products. The products are then sent via sea, road, rail and air to the distributor's warehouses. Here the goods are again stocked. They are also consolidated with other products. The distributor then distributes the products to the wholesalers. The wholesalers then sell the products again to the retailers like supermarkets, hypermarkets and various corner shops. A special trait of the FMCG sector is that retailers have store outlets through which the customer can buy a particular product. This is different from some of the business to business supply chains where goods are directly sent from the supplier to the consumer. The final customer then buys the required products from the various retail stores and consumes them.
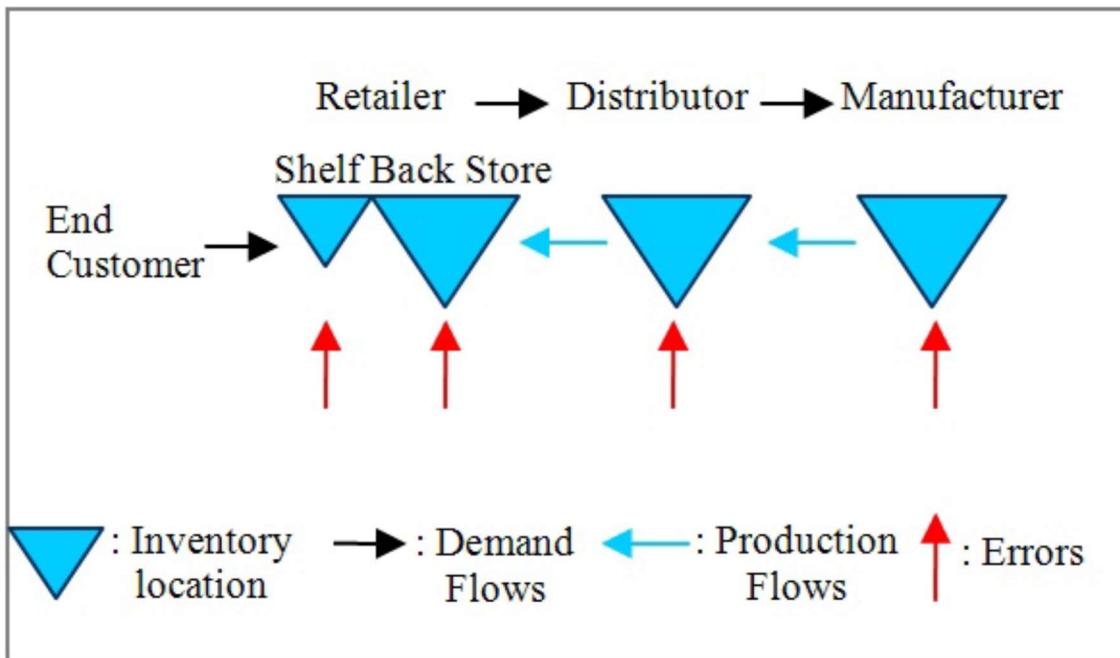
Figure 11: FMCG Supply Chain Model (Source: Sarac et al 2008)

Chiles and Dau (2005) point out that along with the physical goods flow; there is also an information flow between supply chain partners. The information that is exchanged could be point of sale data, forecast over a certain time period and status of the inventory. Cross-docking and distribution center bypass are two methods to increase the velocity of products in the supply chain. These reduce the lead times throughout the supply chain. In the above diagram Sarac et al 2008 report that final consumers purchase some amounts of quantities of FMCG goods from the shelves of the retailers. The retailer places replenishment orders with the distributor who in turn gets the products from the manufacturers. The distributor delivers such orders and the retailer stocks the goods in the backspace of his warehouses. The retailer can take care of consumer demand as long as the products are assessable on the shelves. The shelves have limited space. The sold out products are placed again on the shelves following a reorder level policy or a consumer out of stock situation.

4.5 Conclusion:
The FMCG industry has its own very special challenges for the supply chain. Retail companies expect the right products at the correct place and at competitive prices. If FMCG companies are not able to fulfil orders they have to pay a very hefty price for it. Various contracts are got and gone depending on the excellence and precision of the service. In this chapter we have discussed about the importance of the supply chain of the fast moving consumer goods industry in great detail. We have discussed about the characteristics of the fast moving consumer goods industry. After analysing the fast moving consumer goods industry supply chain we have also introduced the case study of Unilever. Finally we have concluded the chapter with a presentation of a model of the typical supply chain of the fast moving consumer goods industry.

Chapter 5 – Interviews with Industry Professionals

5.0 Introduction:
In this chapter interviews will be conducted with industry experts and 3PL professionals. The main aim of conducting the interviews with supply chain industry experts and 3PL service providers are to further help in confirming the validity of the theory and models with that of the practical functioning of the individual supply chains. The people below were chosen because they are considered to be experts in their particular field of functioning. Four people were chosen, one each from the three supply chains under consideration and one from the freight forwarding sector.

The interviews were conducted with the help of emails. Questionnaires were sent via emails to the interviewee and replies were also got via emails. In some cases a personal interview was conducted via Skype to further explain the replies that were sent via emails. The questions were framed in such a manner to find out the functioning and characteristics of the supply chain in question. The main function of the interview was to see if there was a relationship between the theory got from the literature review and the practical side of the supply chains.

5.1 Oil Industry Supply Chain Interview with Mr. Matthieu de La Chevardiere (Trader Graduate) of Shell, London, United Kingdom:

Question 1:
How does effective supply chain management help oil companies to maintain a competitive edge?
An effective supply chain will allow an oil company to reduce market risk to the minimum. Efficient Supply Chain Company will be the most profitable. Since refineries have come up in India and China the refineries in North West Europe are not needed anymore and therefore a lot of refineries in North West Europe have closed down.

Question 2:
Why is the supply chain of the oil industry complex?
Like any other commodity the extraction of oil requires a very large amount of logistics and moreover it is very capital intensive. Extraction and finding of oil has thus become very complex. There are many people involved in the projects which are huge like for example Bechtel will provide the pipes and other equipment for extraction. The projects are very capital intensive.

Question 3:
Why is the lead time higher in the oil sector than in other industries?
Most of the production of crude oil is quite far away from any downstream refinery and once processed by a refinery; the refined product can still travel the world to find a suitable outlet for the sale of the products.

Question 4:
Why is the supply chain of the oil industry inflexible?
The supply chain of the oil industry is inflexible again on account of the huge logistics. The lead time cannot be reduced here as it takes about 3 months for the oil to reach its final customer after the extraction. The processes that the oil industry requires to get the finished products take time.

Question 5:
Why the supply chain of the oil industry is vertically integrated?
The supply chains are not always vertically integrated but for big companies like BP and Shell it is mostly vertically integrated. There is a tendency for big companies like BP and Shell to focus on the upstream business. This is because it is the most cost effective and the most profitable structure to have production, trading crude, refinery, trading product and final sale to consumer under the same roof.

Question 6:
What is the typical structure of the oil industry supply chain or how does the supply chain of the oil industry function?
It all starts with the upstream processes of exploration and production. At this stage the oil is extracted from the earth. Then the crude oil is traded and shipped to the refineries via ships such as VLCCs. The crude quality is different. Refineries are also different as the value that they are able to extract is different. At the discharge terminals the crude oil is transported via pipelines to the refineries. Here begins the downstream activities. The depots and hubs act as storage and buffer points. They are then traded again and sold to local consumers or sent to other places.

5.2 Consumer Electronics Industry Supply Chain Interview with Mr. Thai Young Kim (Process Innovation Manager) of Samsung, Breda, The Netherlands:

Question 1:
Why are consumer electronics companies using postponement strategies? That is they will finish manufacturing a product only after the receiving an order.
Consumer Electronics companies are using postponement strategies because the price of consumer electronics has a tendency to decrease in the short term. Stocking would mean loss after price changes or price falls.

Question 2:
How does the short product lifecycle of consumer electronics affect the supply chain?
The shorter the product lifecycle, the less are the stock days required in the Supply Chain Management.

Question 3:
Why do consumer electronics companies using Just in Time (JIT) have a better competitive position over the others that do not adopt JIT?
JIT can make more profits for a manufacturer as there will be more efficiency in the Supply Chain Management costs like warehousing and distribution costs.

Question 4:
Why are the supply chains of consumer electronics highly complex?
There are comparably various Stock Keeping Units (SKU) in one product group, so it is a complex operation to manage to match demand into manufacture in advance.

Question 5:
What is the typical structure of the consumer electronics supply chain? How does the supply chain of the consumer electronics sector function?
The typical structure of the consumer electronics supply chain has a demand forecasting IT system which connect sale into manufacturing so that it facilitates the whole Supply Chain Management in the most efficient way.

5.3 Fast Moving Consumer Goods Industry Supply Chain Interview with Mr. Paolo Mendes (Planning Director) of Coca-Cola, Sao Paulo, Brazil:

Question 1:
What are the important attributes for achieving supply chain agility within the Fast Moving Consumer Goods (FMCG) business industry?
Agility is an important concept and a key differentiator in the fast moving consumer product goods segment. The concept of agility as a business wide capability that embraces organizational structures, information systems, logistics processes and being flexibility are the key characteristics. Also four characteristics of an agile supply chain can be identified as market sensitive, network based, process integration and virtual supply chains, being this last characteristic defined as the information sharing network between buyers and suppliers.

Question 2:
Why do FMCG companies outsource their manufacturing activities to contract manufacturers?
Coca-Cola does not outsource their manufacturing activities to contract manufacturers.

Question 3:
In trying to lower the costs of the supply chains, vendors are increasingly taking the help of Information Technology (IT) to fine tune their supply chains to the demands of the retailers. How does IT play a role in improving the supply chain visibility?
Supply chain visibility is a key enabler for the companies to become demand driven, understand better their consumers and customers needs and better develop new products and services. To get visibility, it is imperative to have support from IT systems which will provide demand information across the supply chain for manufacturers, suppliers and vendors to use in the decision process. There are several different types of IT systems already available that are in use to share demand information between retailers and manufacturers, being the example of Retail Link from Wal-Mart, a good one.

Question 4:
How useful is Cross-Docking when it comes to reducing inventories, handling costs and cut on delivery times in the FMCG supply chains?
Cross-docking is a proven and practical logistics practice to create an agile and flexible way to serve the customers at the same time that reduces warehouse operational costs.

Question 5:
Does using tracking devices like Radio Frequency Identification (RFID) help in order to comprehend how better tracking of products will affect manufacturing plants, distribution centres and stores?
Coca-Cola still does not use RFID in their manufacturing processes.

Question 6:
What is the typical structure of the FMCG supply chain? How does the supply chain of the FMCG sector function?
It usually considers key retailer customers, manufacturing plants and warehouse sites and vendors who are responsible for raw material and product material supply.

5.4 Consumer Electronics Industry 3PL Interview with Miss Ivana Lutterova (Dedicated Operational Manager) of Schenker, Gan, Slovakia:

Question 1:
What are the types of services that Schenker provides to the consumer electronics industry?
Schenker provides services like warehousing, logistics, transport, supporting IT solutions, consulting and backward services.

Question 2:
Since how many years has Schenker been providing these services?
Schenker has been providing these services since 1993.

Question 3:
Does Schenker consider the consumer electronics sector a growth market and if yes why?
Schenker does consider the consumer electronics sector a growth market because of increasing demand of the market and offered good solutions from side of developers.

Question 4:
How would you rank the services your company provides to the consumer electronics industry, in terms of contribution to profit?
On a suitable level, Schenker offers flexibility for expanding in the European market and Schenker is also a determined partner providing sufficient level of services beside competition.

Question 5:
Which service within the consumer goods supply chain, in your opinion, shows the greatest growth potential for a company like Schenker?
Services such as warehousing, logistics and transport (all types, road, rail, air and sea) are all strong aspects of Schenker.

Question 6:
Could you elaborate how Schenker takes care of warehousing and distribution function for the consumer electronics goods sector?
Schenker uses specialist unloading processes with trained and continuously retrained personal, using of scanners for inbound and outbound operations, flexible opening hours of warehouse, using of modern handling technologies, equal administration, strict documentation supervision, statutory archiving of the documents, continuous Closed Circuit Television (CCTV) camera system in all parts of the warehouse and sufficient archiving of records.

Question 7:
What are the softwares that Schenker uses and what are their functions?
No reply for this question.

5.5 Conclusion:
In this chapter we have conducted four interviews. Three interviews have been conducted with industry professionals from the oil, consumer electronics and fast moving consumer goods sector. One interview has been conducted with a 3PL service provider. The interviews give us practical insights into how supply chains functions. Moreover it also tries to validate the information that has been found so far from the literature review.

Chapter 6 – Comparison of the Oil, Consumer Electronics and Fast Moving Consumer Goods Industry Supply Chains

6.0 Introduction:
The supply chains in the future will be heavily dependent on technology. The previous chapters have been aimed at giving the reader an overview and structure of the oil, consumer electronics and fast moving consumer goods supply chains. In this chapter we will do a comparison between the three supply chains viz oil, consumer electronics and fast moving consumer goods supply chains. In the last few chapters we have discussed the individual supply chains of these three sectors in great detail. To compare the supply chains we have chosen below certain criteria and points to compare. We have got these from the previous chapter's literature review when we wrote about the characteristics and analysis of the individual supply chains.

6.1 Push and Pull Supply Chains:
Sangam (2010) points out that all supply chain processes fall into two categories depending on how they are executed while being compared to consumer demand. These two categories are push and pull supply chains. There is also a hybrid model which is called Push and Pull supply chain which encompasses both types. In pull supply chain types goods are produced based on specific consumer orders. Pull supply chains are sometimes known as built to order or configured to order. The goal of this supply chain model is to reduce the stocking of inventory and optimize the supply. Pull supply chain models have come about on account of increasing demand uncertainty and shorter product lifecycles. A pull system always starts by actual customer demand. A push system always runs the risk of over production. In a pull system the downstream part of the supply chain only manufacturers if needed.

In the past companies would manufacture goods which they thought customers required and was indispensable to their need and would push such type of goods into the market. If the goods could not be sold at the original price then they would reduce the prices to a point where they would sell. This reduced the profit margins and brought profits to a lower level. However today the producers of Consumer Electronics goods especially those of laptops (Example: Dell) depend on customers pulling goods through the supply chain. All this requires a superior understanding of the customer's performance and preference selections. Battezzati and Magnani (2000) say that a lot of firms are now implementing postponement strategies which means that they will finish manufacturing a product only after the receiving an order.

"Some of the characteristics of the pull supply chain model are as follows:
- Volatile demand situation
- High rate of Customization;
- Minimal Inventory Carrying;
- Not a off the shelf product;
- Highly dynamic and effective distribution network" (Sangam, 2010).

Based on above we can categorize the Consumer Electronics industry supply chains as an example of the hybrid model of pull and push supply chain. This is because certain consumer electronics like television sets exhibit the push supply chain model whereas

certain consumer electronics like computers (Example Dell) exhibit the pull supply chain model.

In push supply chain type goods are produced based on speculative and anticipated consumer orders. Push supply chain are sometimes known as built to inventory or built to stock. Goods are produced in anticipation of consumer requirements. "Some of the characteristics of the push supply chain model are as follows:
- High inventory costs
- Challenging working capital requirements due to low inventory turns
- Huge warehousing and distribution costs
- Inability to meet dynamic market conditions and
- Seasonal demand and off the shelf product" (Sangam, 2010).

Based on above characteristics we can categorize the oil industry and the fast moving consumer goods supply chain as an example of the push supply chain model.

6.2 Vertical Integration:

The Oil Industry supply chain is basically vertically integrated. This is unique to this sector and it gives the oil industry a potential advantage. This is because there is greater control over the entire supply chain. The output of one company here is the input of the other company through the supply chain. On the other hand the supply chains of consumer electronics and fast moving consumer goods show excellence in operations through value chain de-verticalisation. There is an increasing trend among the consumer electronics and fast moving consumer goods sector to outsource activities that are not essential to their core business. This basically means outsourcing your supply chain activities to third parties. Thus de-verticalisation permits consumer electronics and fast moving consumer goods companies to concentrate their energies entirely on customer and consumer management. Different multi stage supply chain configurations have come up which promotes greater efficiencies, flexibility and responsiveness.

6.3 Lead Times:

The Oil Industry Supply Chain is very complex. The crude oil has to move thousands of kilometres in distance from where it is produced to the refineries. This distance leads to greater lead times and the inclusion of several participants in the supply chain process. This is therefore the most important reason why the lead times in this industry are higher than in other sectors. The higher lead times can be directly attributed to the fact that transportation of the oil takes place through ships, road, rail and also pipelines. Thus the oil sector is therefore inhibited by inflexible supply chains and a consignment of crude oil will take several weeks to arrive at the refineries. The lead times on the other hand of the consumer electronics sector is a little more shorter with the lead time of the fast moving consumer goods being the shortest. This is because today's consumer electronics and fast moving consumer goods sector is characterized by an accelerating pace of innovation and therefore greatly reduced product lead times. In order for manufacturers of electronic commodities and fast moving consumer goods to increase profits, retain market share and to command a premium price they have to constantly introduce new products with new features. The above reason leads to very short product life cycles.

6.4 Capital Intensive:

The oil industry supply chain is highly capital intensive (a mid sized refinery may cost upto US 3 billion dollars) and is moreover subject to cycles of profitability, getting often lower returns on investment than other petroleum businesses which causes periods of unbalanced investments. On the other hand the consumer electronics and fast moving consumer goods supply chains are not so capital intensive.

6.5 E-Waste Management:

Currently on account of short product cycles there is a lot of e-waste accumulating. E-Waste Management has also been attracting a lot of regulations. Original Equipment Manufacturers (OEM) are increasingly given the responsibility of taking care of returns. Consumers of fast moving consumer goods are also demanding lowered carbon footprints of the products that they buy. Thus the economic value of returns as well as sustainability will create more strict ways of grading vendors and suppliers. This is however not so strict in the oil industry supply chains.

6.6 Lean Manufacturing:

The implementation of JIT principles in the consumer electronics industry and fast moving consumer goods sector makes the production operations more efficient, cost effective and customer responsive. QAD Inc. (2004) points out that Lean Manufacturing sends Kanban signals within a manufacturing factory or to vendors through EDI (Electronic Data Interchange) to downstream operations. "Kanban signals help in making accurate inventory replenishment information visible right away, reducing information lead-time and eliminating waste in the flow of material from suppliers to customers" (QAD Inc., 2004). This system does not exist in the oil sector supply chain.

6.7 Radio Frequency Identification:

In the consumer electronics and fast moving consumer goods sector keeping track of stock is not an easy task on account of high volumes and rapid turnovers. In the FMCG industry on account of limited shelf life and perishables lasting only a matter of days, stock movements must be timely and accurately tracked. In the last few years RFID has been increasingly being used to keep track of inventory, asset tracking and to locate the position of an object. This system cannot be used in the oil industry supply chains.

6.8 Cross-Docking:

Here goods which arrive at the warehouse through inbound trucks are directly loaded on outbound trucks without storage as inventory in the warehouse. This method can be used to reduce inventory, handling costs and cut on delivery times. The consolidation in the number of warehouses has taken place on account of the fact that retailers are practising a zero inventory policy. This system has been used extensively in the supply chains of consumer electronics and fast moving consumer goods. This system however cannot be used in the supply chains of the oil sector.

6.9 Conclusion:

In this chapter we have compared the three supply chains of the oil, consumer electronics and fast moving consumer goods with each other. It seems that the supply chain of the consumer electronics is somewhat similar to that of the fast moving

consumer goods supply chain. The short product lifecycles of the consumer electronics and small shelf life of the fast moving consumer goods has increased the complexity of the supply chain as more variants and consumers have to be handled by the same company. In the next chapter we will conclude the thesis with recommendations for further research.

Chapter 7 – Conclusions

7.0 Introduction:

The rate at which globalization has moved within the last 20 years has brought about a lot of basic changes in the way companies position themselves within their individual supply chain. In the twenty first century, new developments in the commerce atmosphere have contributed to the advancement of supply chain networks. First on account of globalisation and the growth in multinational companies, joint ventures, tactical partnerships and business alliances, many important factors of success were recognized. These factors have further promoted the previous Just in Time, Lean Manufacturing and Agile Manufacturing practices. Second, changes in technology, most importantly the drastic fall in the cost of information communication, which forms a great proportion of the costs of transaction, have led to changes in coordination amongst members of the supply chain network.

7.1 What Was Researched?

This thesis has been written to basically compare three different supply chains viz the oil industry, consumer electronics industry and the fast moving consumer goods industry. It also provides the readers with a description of the main characteristics of the individual supply chains. It is an area of research which has found to be lacking although the topic is fairly important. Data for this paper was collected through extensive literature review and interviews with industry professionals. We also used case studies to highlight and address the main issues pertaining to each sector's supply chain. Although there are some similarities between the three supply chains there are also significant differences when it comes to managing the individual supply chains of the respective industries.

7.2 What Was Discovered?

What was discovered was the structure and functioning of the individual supply chains. Models were formulated and this was based on the literature review studying the characteristics and analysis of the individual supply chains and these models have helped in the better understanding of the way in which the individual supply chains function and how they can be compared to each other.

The case studies showed clearly examples of company's supply chain functioning. On the other hand interviews with supply chain industry experts and 3PL service providers have further helped in confirming the validity of the theory and models with that of the practical functioning of the individual supply chains.

The oil industry supply chain is very complex. The entire supply chain is separated into two distinguishable segments viz upstream and downstream. This is based on actions before and after the refining phase. There are six main stages in the supply chain which are again divided by the middle refining stage into the upstream and downstream parts of the supply chain. The six main stages are exploration, production, procurement, refining, distribution and marketing. One of the most important characters of the oil sector is its rigidity and the petroleum industry is a prime example of a sector which is inhibited by inflexible supply chains.

There are thousands of kilometres in distance between the end consumers and the oil exploration area. This is therefore the most important reason why the lead times in this industry are higher than in other sectors. This makes the oil industry supply chain rather inflexible. There is also an expensive and complex refinery process that crude oil has to undergo. The supply chain of the oil industry is vertically integrated and this offers it a great advantage by having superior control over the total value chain. Vertical Integration is a very well used system in the oil sector as the output of one company is the input of the other company through the supply chain. The oil industry is also an extremely capital intensive business.

The electronics industry is losing its vertically integrated nature. Customers are looking out for consumer electronics companies to manufacture customized products speedily and at cheaper prices. On account of this there is a great amount of pressure on consumer electronics companies to be very proactive to build supply chains that are low in costs and has a fast response time. In order for manufacturers of electronic commodities to increase profits, retain market share and to demand a top price they have to constantly introduce new products with new features. The above reason leads to very short product life cycles. This again causes complications in the predictions for consumer demand. On account of these reasons manufacturers must establish a very close relationship with retailers and resellers.

Increasingly manufacturers of product components are bringing to the market new and improved functionality at lower prices. In order to maintain a competitive advantage the manufacturers of whole products feel compelled to use these new parts into the manufacture of their products. On the other hand the manufacturers of whole products have to also make use of the old existing inventories to maintain the profit margins. Manufacturers who use collaborative development techniques are the companies which have the best chance to be successful.

FMCG sector's supply chain is very complex. This is because manufacturers produce goods which are almost immediately sold. So it is a very fast moving sector and therefore the sequence between demand and supply is more or less uninterrupted. The FMCG industry is very much dependent on the efficiency of its supply chains. Forecasting in the FMCG segment is becoming very important. The current most important issue in this industry is to give operational flexibility by reducing lead times. A lot of companies prefer to manufacture their products by contract manufacturers in order to keep the prices low and allow a larger mass of the population to afford their products. In trying to lower the costs of the supply chains vendors are increasingly taking the help of Information Technology to fine tune their supply chains to the demands of the retailers.

Cross-Docking plays a very important role by accepting goods and sending them on their way to their destinations on the same day warehouses can considerable reduce their costs. Here software plays a very important role in increasing the visibility of the supply chains. By keeping track of goods that sell fast on an everyday basis or products that sell fast during particular parts of the seasons and by getting the right inventory in

the correct position within the godowns, the picking process becomes quicker and the warehouse processes are optimised. Being responsive and flexible remains the crowning glory of a successful FMCG supply chain.

7.3 Original Contribution To Knowledge:

In this thesis we compared the functioning of three different supply chains of the oil, consumer electronics and fast moving consumer goods. The thesis has given us a good understanding of how the three supply chains function through an analyses and characteristics study of the individual supply chains. This is a relatively new concept and field. It can help future researchers to compare other supply chains based on the findings in this thesis or using this thesis as a guideline. It can help in improving the functioning of different supply chains by introducing the best practices in different supply chains. It will also help in understanding the short comings in different supply chains.

7.5 Recommendations For Further Research:

This thesis could be seen as a pilot study in the comparison of the three different supply chains. It is an area of research which has found to be lacking although the topic is fairly important. On account of time constraints this research was limited to only three industries viz oil, consumer electronics and fast moving consumer goods. Further studies could revolve around exploring the differences and similarities between supply chains of various other industries like paper industry, metallurgy industry, beverages industry and the rubber and plastics industry. Besides the three individual supply chains of oil, consumer electronics and fast moving consumer goods leaves a lot of space for finding out how agile and lean supply chain methods could be applied to these supply chains to further improve and optimize the supply chains. In the future the emphasis of research could be on the optimization of supply chains.

Bibliography

Anderson, E (2003), "*Supply Chain strategy in the Oil and Gas Sector*", Supply Chain Management and Outsourcing Strategies, Exploration and Production: The Oil and Gas Review 2003, pages 108 – 111, 2003

Adexa Company Website (2012), "*The Electronics Supply Chain: Winning in a Virtual Environment*", Supply Chain Management Software White Papers, www.adexa.com/pdf/electronics.pdf, accessed 21 November 2012

Barloworld Logistics (2007), "*FMCG and Retail Report*", Supply Chain Foresight Study

Barloworld Logistics (2010), "*Growth in Adversity: Resilience and Recovery through Innovation*", Supply Chain Foresight Study

Beamon, B M (1998), "*Supply Chain Design and Analysis: Models and Methods*", International Journal of Production Economics, Vol. 55, No. 3, Pages 281-294

Banker, S (2012), "*The Apple Supply Chain: The Best in the World*?", Logistics Viewpoints, http://logisticsviewpoints.com/2012/07/02/the-apple-supply-chain-the-best-in-the-world/, accessed on 15 November 2012

Business Insights Website (2007), "*SCM Case Study – Supply Chain Model of Unilever Group*", available at http://nsrivastava.blogspot.in/2007/06/supply-chain-model-unilever-group.html, accessed 30 November 2012

Battezzati, L and Magnani, R (2000), "*Supply Chains for FMCG and industrial products in Italy: Practices and the advantages of postponement*", International Journal of Physical Distribution and Logistics Management, Vol. 30 No. 5, 2000, pp. 413-424, MCB University Press, 0960-0035

Barker, S (2006), "*FMCGs: Can your supply chain handle the pace*?" available at http://www.logisticsit.com/articles/2006/06/05/1991-fmcgs-can-your-supply-chain-handle-the, accessed 03 December 2012

Bottani, E and Rizzi, A (2008), "*Economical assessment of the impact of RFID technology and EPC system on the fast moving consumer goods supply chain*", International Journal of Production Economics, 112 (2008) 548–569

Bottani, E, Montanari, R and Volpi, A (2010), "*The impact of RFID and EPC network on the bullwhip effect in the Italian FMCG supply chain*", International Journal of Production Economics 124 (2010) 426–432

Beck, A, Bilby, C and Chapman, P (2003), "*Tackling Shrinkage in the Fast Moving Consumer Goods Supply Chain: Developing a Methodology*", Security Journal, Volume 16, Issue 2 (April 2003), pp. 61-75

Chopra, S and Meindl, P (2004), "*Supply Chain Management*", 2nd edition, Upper Saddle River, Pearson Prentice Hall

Chima, C M (2007), "*Supply-Chain Management issues in the Oil and Gas Industry*", Journal of Business and Economic Research, Volume 5, Number 6, Pages 27 - 36

Cafaro, V G, Cafaro, D C, Méndez, C A and Cerdá, J (2010), "*Oil-derivatives pipeline logistics using discreet–event simulation*", 2010 Winter Simulation Conference

Chavosh, A, Halimi, A B, Edrisi, M A, Hosseini, S B, Esferjani, P S (2011), "*A Model for Supply Chain Performance of Electronics Industry in Malaysia*", 2011 International Conference on Social Science and Humanity, IPEDR vol.5 (2011), IACSIT Press, Singapore

Christopher, M and Peck, H (2004), "*Building the Resilient Supply Chain*", the International Journal of Logistics Management, Vol. 15 Iss: 2 pp. 1 - 14

Chiles, C R and Dau M T (2005), "*An analysis of current supply chain best practices in the retail industry with case studies of Wal-Mart and Amazon.com*", Master of Engineering in Logistics Thesis, Massachusetts Institute of Technology, U.S.A.

Dhekne, R and Chittal, S (2011), "*Supply Chain Strategy for the Consumer Electronics Industry – Future of Manufacturing*", www.wipro.com, accessed 21 October 2012

David Wood and DWA Energy Limited Company Website, available at http://www.dwasolutions.com/DWA/DWTrainingOptions.htm, accessed 29 October 2012

DHL Supply Chain (2012), "*Building a flexible FMCG supply chain: How consumer goods manufacturers can fight back against volatility*", DHL Supply Chain White paper, https://www.dhlsupplychainmatters.dhl.com/insights/whitepaper/108/building-a-flexible-fmcg-supply-chain, accessed 28 November 2012

Dhawan, E, Goodman, E, Harris, S and Mitchell, C (2010), "*Unilever and its Supply Chain: Embracing Radical Transparency to implement sustainability*", 15.915, S-Lab Final report, May 12, 2010

El-Tawy, N and Gallear, D. (2012), "*Exploring the supply chain agility attributes in fast moving consumer goods industry: A case study in the Middle East*", European, Mediterranean & Middle Eastern Conference on Information Systems 2012, June 7 – 8, Munich, Germany

Guajardo, M, Kylinger, M and Ronnqvist, M (2012), "*Specialty Oils Supply Chain Optimization: From a decoupled to an integrated planning approach*", Norwegian School of Economics, Department of Finance and Management Science discussion paper no. 2012/3, Norway, March 2012

Gainsborough, M (2006), "*Building World-class supply Chain Capability in the Downstream Oil Business*", Business Briefing: Oil and Gas Processing Review, pages 29-32, 2006

Gilaninia, S, Taleghani, M, Mousavian, S J, Tajani, T K, Ghoreishi, S M, Shahidi, S F, Seighalani, F Z (2011), "*Comparative Study of Lean and Agile Supply Chain Management along with the Optimal Model Presentation of Agile Supply Chain Management*", Kuwait Chapter of Arabian Journal of Business and Management Review, Vol. 1, No.4; December 2011

Güleş, H K, Çağliyan, V and Bedük, M (2012), "*The strategic impact of information technology on supply chain and business performance*" Journal of Business Research-Türk, pp 183 - 200

Iyer, S. and Devalla, B (2007), "*Knowledge applications enabling competitiveness for consumer electronics manufacturers through supply chain information management*", Infosys – Electronics Supply Chain Management, SCM White Paper

Jasuja, A, Sowmya, A, Chaudhary, A, Kanade, S and Panda, S (2009), "*Supply Chain in the Petroleum Industry*", power-point presentation, May 29, 2009, http://www.slideshare.net/amitabhjasuja/supply-chain-petroleum, accessed 20 November, 2012

Jenkins, G P and Wright, D S (1998), "*Managing Inflexible Supply Chains*", the International Journal of Logistics Management. Volume 9 Iss 2 pp. 83-90

Juneja, M and Rajamani, D (2003), "*Consumer Electronics Supply Chain Management*", Power-point presentation lecture series, Center for Intelligent Supply Networks, UTD 2003

Koo, L Y, Chen Y, Adhitya A, Srinivasan R and Karimi I A, (2006), "*Evaluating Refinery Supply Chain Policies and Investment Decisions through Simulation-Optimization*", 2006 Winter Simulation Conference

Kato, Y (2011), "*Sony Electronics S and OP Journey*", CSCMP's Supply Chain Quarterly Company Website, http://www.supplychainquarterly.com/topics/Strategy/scq201101sony/, quarter 1 2011, accessed 9 November 2012

Kampani, M. (2013), "*Supply chain: Boosting the visibility within the organization*", The Economic Times, January 17, 2013, page 9

Larson, C (2005), "*A Just-In-Time Supply Chain?*", A UPS Supply Chain Solutions White Paper, Columbus, Ohio

Logisticsit Website (2009), "*Unilever Supply Chain Efficiency*", available at http://www.logisticsit.com/articles/2009/05/05/4342-unilever-supply-chain, accessed 30 November 2012

Li, Y (2011), "*Walmart Business Model Study*", International Journal of Advanced Economics and Business Management, Volume No. 1, Issue No. 2, 093 - 097

Mazumder, S. and Chatterjee, A. (2010), "*Green Supply Chain as a competitive advantage enabler in the FMCG sector*", Business Process Council World Conference, September 2010, Mumbai

Mckinnon, A. (2004), "*Supply Chain Excellence in the European Chemical Industry*", Results of the EPCA-Cefic Supply Chain Excellence Think Tank Sessions, Edinburgh, October 2004

Manzano, F S (2005), "*Supply Chain Practices in the Petroleum Downstream*", Master of Engineering in Logistics Thesis, Massachusetts, U.S.A.: Massachusetts Institute of Technology

MOL Company Website (2012), "*About MOL*", available at http://www.mol.hu/en/about_mol/, accessed 06 November 2012

McCullen, P and Towil, D (2002), "*Diagnosis and reduction of bullwhip in supply chains*", Supply Chain Management: An International Journal, Vol. 7 Iss: 3 pp. 164 – 179

Modgil, S, Patyal, V S and Agrawal, T (2012), "*Technology Evolution in Supply Chain Management: Barcode to RFID*", International Journal of Technology, CPMR-IJT Vol. 2, No.1, June 2012, ISSN: 2277-4629 (Online)

Niu, J and Dartnall, J (2008), "*Application of fuzzy MRP II in Fast Moving Consumer Goods Manufacturing Industry*", 2008 Winter Simulation Conference

Nagarjuna, B and Siddiah, T (2012), "*Changing Phases of SCM – A Study with reference to FMCG Distributors in Bangalore*", IJEMR, January 2012 - Volume 2 Issue 1 - Online - ISSN 2249 – 2585 - Print - ISSN 2249 - 8672

OPEC Website (2012), "*OPEC Mission Statement*", available at http://www.opec.org/opec_web/en/about_us/23.htm, accessed 28 October 2012

Phillips Electronics Company Website (2012), http://www.philips.com/about/company/businesses/suppliers/aboutsupplymanagement.page, accessed 21 November 2012

QAD Inc. (2004), "*Successful Risk Management in the Electronics Supply Chain*", White Paper Item #73-1960A

Ribas, G., Leiras, A. and Hamacher, S. (2011), "*Tactical Planning of the Oil Supply Chain: Optimization under Uncertainty*", XLIII Simpósio Brasileiro de Pesquisa Operacional, pages 2258 – 2269, Rio de Janeiro, Brazil

Szucs, D and Hassen, K (2012), "*Supply Chain Optimization in the Oil Industry: A case study of MOL Hungarian Oil and Gas PLC*", MSc Thesis, Jönköping International Business School, Sweden

Sony Supply Chain Solutions Inc. Website (2012), available at http://www.sonyscs.co.jp/english/business/index.html, accessed 09 November 2012

Sony Supply Chain Solutions Malaysia Website (2012), available at http://www.sscsm.sony.com.my/, accessed 9 November 2012

Schlacter, G and Yehiav, G (2008), "*How OEM Consumer Electronics Companies Can Dramatically Improve Profits through Downstream Supply Chain Collaboration Directly With Retailers*", an Oracle White Paper, February 2008

Sarac, A, Absi, N and Dauzère-Pérèz, S (2008), "*A simulation approach to evaluate the impact of introducing RFID technologies in a three-level supply chain*", 2008 Winter Simulation Conference

Scribd Website (2012), available at http://www.scribd.com/doc/50140512/5/CH-2-2-CHARACTERISTICS-OF-FMCG-MARKET, IIPM/FW/08-10/MUM/HR/148, accessed 03 December 2012

Sangam, V (2010), "*Supply Chain Optimization: Push versus Pull Supply Chains*", available at http://vijaysangamworld.wordpress.com/2010/07/06/push-vs-pull-supply-chain/, accessed 05 December 2012

Unilever Company Website (2012), "*Introduction to Unilever*", available at http://www.unilever.com/aboutus/introductiontounilever/, accessed 29 November 2012

Wilkerson, M (2010), "*Consumer Electronics Industry is King of Innovation in Supply Chain Information Technology*", the Supply Chain Information Technology Blog, June 25, 2010

Wikipedia Website (2009), "*Supply Chain Management*", available at http://en.wikipedia.org/wiki/Supply_chain_management, accessed 16 October 2012

Wikipedia Website (2012), "*Fast Moving Consumer Goods*", available at http://en.wikipedia.org/wiki/Fast-moving_consumer_goods, accessed 29 November 2012

Whitehead, A (2012), "*FMCG Supply Chains: Post Recession Trends*", White Space, Oxford

Zeng, D D and Sycara, K (1999), "*Dynamic Supply Chain Structuring for Electronic Commerce Among Agents*", Appeared in Intelligent Information Agents, Chapter 10, Springer, 1999, eds., Carnegie Mellon University, Pittsburgh

Appendices – Questionnaires Submitted to Industry Professionals

Appendix 1 - Oil Supply Chain Questionnaire:

Question 1:
How does effective supply chain management help oil companies to maintain a competitive edge?

Question 2:
Why is the supply chain of the oil industry complex?

Question 3:
Why is the lead time higher in the oil sector than in other industries?

Question 4:
Why is the supply chain of the oil industry inflexible?

Question 5:
Why is the supply chain of the oil industry vertically integrated?

Question 6:
What is the typical structure of the oil industry supply chain or how does the supply chain of the oil industry function?

Appendix 2 - Consumer Electronics Supply Chain Questionnaire:

Question 1:
Why are consumer electronics companies using postponement strategies? That is they will finish manufacturing a product only after the receiving an order.

Question 2:
How does the short product lifecycle of consumer electronics affect the supply chain?

Question 3:
Why do consumer electronics companies using Just in Time (JIT) have a better competitive position over the others that do not adopt JIT?

Question 4:
Why are the supply chains of consumer electronics highly complex?

Question 5:
What is the typical structure of the consumer electronics supply chain? How does the supply chain of the consumer electronics sector function?

Appendix 3 - Fast Moving Consumer Goods Supply Chain Questionnaire:

Question 1:
What are the important attributes for achieving supply chain agility within the Fast Moving Consumer Goods (FMCG) business industry?

Question 2:
Why do FMCG companies outsource their manufacturing activities to contract manufacturers?

Question 3:
In trying to lower the costs of the supply chains vendors are increasingly taking the help of Information Technology (IT) to fine tune their supply chains to the demands of the retailers. How does IT play a role in improving the supply chain visibility?

Question 4:
How useful is Cross-Docking when it comes to reducing inventories, handling costs and cut on delivery times in the FMCG supply chains?

Question 5:
Does using tracking devices like Radio Frequency Identification (RFID) help in order to comprehend how better tracking of products will affect manufacturing plants, distribution centers and stores?

Question 6:
What is the typical structure of the FMCG supply chain? How does the supply chain of the FMCG sector function?

Appendix 4 - 3PL Questionnaire:

1. What are the types of services that Schenker provides to the consumer electronics industry?

2. Since how many years has Schenker been providing these services?

3. Does Schenker consider the consumer electronics sector a growth market and if yes why?

4. How would you rank the services your company provides to the consumer electronics industry, in terms of contribution to profit?

5. Which service within the consumer goods supply chain, in your opinion, shows the greatest growth potential for a company like Schenker?

6) Could you elaborate how Schenker takes care of warehousing and distribution function for the consumer electronics goods sector?

7) What are the softwares that Schenker uses and what are their functions?