ANALYSIS OF CHALLENGES IN EXISTING TEXTILE RETAIL BUSINESS FOR IMPLEMENTING SUSTAINABLE RESILIENT SUPPLY CHAIN

Master Thesis (01.09.2010)

Date of Submission: May 26, 2010

Submitted by

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ABSTRACT

The global retail business is always changing and this change brings new issues in front of us and deserves responsibilities to address these issues. The Textile Retail Business is also experiencing this change as the whole retail textile supply chain has already become globalized with the time especially in terms of sourcing of raw materials and production as well. This phenomenon has raised the questions of threats regarding sustainability and resiliency of the supply chain. Today’s retailers are working closely with these topics in a competition basis to achieve competitive advantages in their supply chain. This dissertation aims to sketch out the possible latent challenges for which the companies prefer to work with a scattered supply chain in terms of different geographical location as it involves lot of time, transportation and business risks. Additionally this scattered supply chain disputes the environmental and resilient approach of the total chain. Moreover, we try to shed light to validate the inter-relation between ecological sustainability and resiliency of the supply chain. Based on the case study on two companies having different sizes but similar values towards environment which are also located in different geographical region, we have tried to find out the answers. Companies build up supply chain firstly evaluating flexibility and resiliency of their own supply chain only by considering the technology availability, quality and pricing involved with the product and then they want to be sustainable and resilient by addressing other issues. The main challenges for the companies to alter their position are the product specific characteristics, availability of knowhow and the suitable process cost involved with product. It has proposed for the companies who are working with numerous supply chains located in different geographical location to do some adjustments among their nearby suppliers for a typical product on experimental basis especially providing technological and logistics support to their suppliers.
This thesis is written for the partial fulfilment of Master level Degree in Applied Textile Management at University of Borås, Sweden and is completed in May, 2010. It has been constructed during a certain period of time and these weeks have been instructive and fun, but at the same time intensive also. Moreover, it also demanded hard work and commitment in order to make our job something to be proud of and outstanding. We have had the opportunity to develop our skills and ideas within the field of Textile Management, especially on Supply Chain Management focusing some burning issues. And we believe that this work will contribute to already existing research and as well as ideas for further research. This thesis would not have been possible unless the tremendous support from the several persons of various corner like academic, company, friends and family.

First of all, we would like to say thanks to our supervisor, Rudrajeet Pal, Doctoral Student, The Swedish School of Textiles, University of Borås for his incessant guidance and constructive feedback to make this thesis a well structured one. We are simply grateful to our beloved Professor Håkan Torstensson, Vice–Director of The Swedish School of Textiles for some enlightening meetings with him that has shown us right ways during our thesis work. We owe our deepest gratitude to Professor Simonetta Carbonaro and David Goldsmith for their unconditional support during this time. It is a pleasure to thank to Jill Dumain, Director of Environmental Analysis, Patagonia, Inc., California, U.S.A, Peter Askulv, President and Eva Askulv of Klättermusen AB for giving us their invaluable time and to make our work more concrete one.

We would like to pay tribute to our parents, family and friends as well for their colossal support during this hard period.

Finally, we would like to make an endeavour to express our gratitude to University of Borås for nurturing our courage and knowledge to undertake such a project.

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1 Introduction

The textile and clothing industry is a diverse one; it uses as much raw materials as the technology it employs. The whole supply chain is also quite varied in terms of time and geographical location and the chain usually consists of distinct activities. The whole process involved from design of product and sourcing of raw materials to distribution and marketing of the product is considered as an integrated network where each and every activity is contributing value to the end product. This entire process is highly dependent on different variables like costs, quality, reliability of delivery, access to quality inputs, transport and transaction costs. A typical supply chain of global apparel sector is demonstrated in the Figure 1 where the dotted lines represent the flow of information, while the solid lines represent the flow of goods and the direction of arrow indicates a demand pull-driven system.

![Figure 1: The supply chain in textile and clothing sector](image)

How does the whole chain work? Here the information comes from downstream especially from customers and this articulates the product details and the production schedule. It is also noticeable
that information can flow directly from the retailers to the textile plants and vice-versa in many cases. At each link in the production network upstream to the distribution centre, there are several independent bodies who normally work as an individual company. To ensure smooth flow of goods, information, money throughout the chain a number of good logistics and different business services are truly inevitable. Say, yarns can be bought from South America, knitting and weaving can be done in China and the garments making can be in China as well and at last the ready-made products are displaying in a store of an European retailer and in this type of supply chain we will find a lot of actors and also controlling the chain is simply tricky and challenging (Nordås, 2004).

1.1 State of global apparel retailing

The global market of apparel retailing is in the process of adaptation. Traditional independent retailers are disappearing; whereas international multi-shop retailers with global product sourcing are grabbing the market share especially by promoting their own label collections. In the meantime, manufacturers are also becoming retailers themselves being vertically organized and enjoying complete control of the supply chain. Till now the physical store is the main structure of retailing though the several ways of retailing like e-retailing has introduced during the recent years. And at the same time, the retail sector is becoming more concentrated in terms of geographical location; competition is getting higher among the multi chain store and fewer players in the market. For example, Hennes & Mauritz, Lindex and Kappahl, the three retail giants together are controlling a major part of the Swedish apparel market. Now the companies are more focused on product innovation, upgrading of their product sourcing, merchandising and the outlook of their stores. The main means of competition has become brand strength, price, strength in logistics, customer service and store environment (Mattila, n.d.).

But the real challenge for the fashion retailers most likely is to sell more goods to the consumer who already has everything. At the same time they are also realizing that the consumer attitudes and shopping habits are changing with the time and the market becomes more volatile than ever. So, to be more consistent to acclimatize the unpredictable demand rising and falling, it’s the time for the retailers to rethink about their existing strategy to ensure the comfort of the consumers in the store and also to read out the latent needs of consumers (Mattila, n.d.).
1.2 Supply Chain Management

Supply chain is defined as “a network of organizations that are involved, through upstream and downstream linkages, in different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer”. Supply chains allow the goods to be produced and delivered in the right quantities, to the right places, at the right time by efficient and effective working condition in a cost effective manner. The supply chains are complex networks, in which the products and information flows within and between the different nodes (Christopher & Peck, 2004).

Today supply chain management is emerging in a new dimension by having the sustainability as its primary focus, but previously it was acted only as a back office role of managing the logistics of supply chains. All the market players and new entrants of different market segments have already started concentrating on the environmental and social transparency in their supply chain from their commitment to the society and the planet and on the other hand they believe that this will increase the value of their products. Business of each company is improved in terms of improved customer base and supplier relationship by means of having the sustainable supply chains. Companies are motivated to implement the systems which ensure access to strategic markets and guide them to control the supply chain partners (Business for Social Responsibility, 2007).

Supply chain vulnerability has also become one of the significant issues for the companies nowadays. Due to the global outsourcing and market fluctuations, the supply chain becomes more complex and the sourcing risk also increases. Since, the outsourcing from the low production cost countries has increased in order to reduce the operation cost; the manufacturing is taking place far away from the company’s headquarters. Proper communication and understanding between the suppliers and the company has become the challenges to run the business and to attain mutual benefit (Christopher & Peck, 2004).

The success of a business is not only determined by the shareholder value and customer loyalty and also by the external factors like the governments, media, civil society and consumers. These external forces are shaping the next generation of supply chain management. The products and services provided by the companies are expected to be more sustainable during using and
disposing. The products should be produced, packed and transported in an ethical way which should not harm social balance and environment as well. The companies are needed to be more transparent in their business practices and in their supply chain to their stakeholder by following the environmental regularities.

Now, the new challenges for the supply chain managers are to achieve an efficient and effective supply chain that will be resilient enough to bounce back from any disruptive situation and also will have sufficient vigilance to offer more sustainable products to its customers. And in order to fulfil all of these in a typical supply chain, the companies and their supply chain partners need to adjust their system effectively.

1.3 Definition of sustainable supply chain

A sustainable supply chain is

“A system of aligned business throughout the lifecycles of product that creates values for all stakeholders, ensures ongoing commercial success, and improves the well being of people and environment” (Business for Social Responsibility, 2007).

“Management of raw materials and services from suppliers to manufacturer/service provider to customer and back with improvement of the social and environmental impacts explicitly considered” (New Zealand Business Council for Sustainable Business Development, 2003).

Sustainable supply chain provides the focus for any organization, which is whether service or product based, seeking to improve the social, environmental and economical performance of its operations.

1.4 The Concept of resilient supply chain

Resilience is ‘the ability of a system to return to its original state or move to a new, more desirable state after being disturbed’ (Christopher & Peck, 2004). Resilient supply chain is the flexible supply chain which adapts to the external situation and makes the company to perform well in the market place. It may be different from the original state by using the market opportunities and by tackling the external turbulences.
1.5 Delimitation

In order to delimit our thesis work, we have followed the following strategy. It is mainly to delimit our research and focus on a particular element and get an in-depth knowledge and achieve good result. Out of three pillars of sustainability namely Ecological, Social and Economic sustainability, we are focusing only on the ecological sustainability.

WHY? Due to the global warming and increase in natural calamities, environmental focus is more important than others. There are various factors to measure the effect of environmental damages, like energy consumption, carbon footprint and wastages. To further delimit our work we concentrate only on carbon footprint related to transportation. So our focus is to analyse a typical supply chain through case study on companies and to find out the challenges that the companies face to achieve sustainability from ecological point of view and resiliency during demand fluctuations in their supply chain. Also try to figure out whether it is possible to connect sustainability with resilience or vice-versa.

*To sum it up:*

1. Sustainability in supply chain from environmental perspective which will be assessed in terms of carbon footprint due to different geographical location and resiliency in supply chain to address the disruptions in the demand side due to the unexpected demand rising or falling which is external to the company and internal to the supply chain.

2. Case study on supply chains of two different companies for two typical products; Polo-shirt from Patagonia Inc. and Enride Jacket from Klättermusen AB.
Reason to choose Patagonia, Inc.:

We were very interested to learn about Patagonia when Yvon Chouinard and Jill Dumain spoke at The Design of Prosperity Conference in November, 2009 at University of Borås. We were inspired to learn that Patagonia is both a well-known outdoor clothing brand and respected for its care towards the environment. Moreover it is the only company that transparently provides the carbon footprint details that enable us to begin with a usable base of information.

Reason to choose Klättermusen AB:

Klättermusen is a Swedish company working with environmental issues and also well known for its eco-friendly approach. For us, it is wise to have a study on several companies that have the similar ideology to get more close and precise scenario to develop concrete concept regarding our work. From this point of view, to get something remarkable we approached Klättermusen for our case study, since it is in different geographical location than Patagonia and also size of the company is dissimilar comparing to Patagonia.

And here we have made a comparative study on the supply chain of Polo Shirt and Einride Jacket of Patagonia and Klättermusen respectively.

2 Research Question

Why do even the companies who work with environmental issues prefer a supply chain that is scattered around the world knowing its possible environmental impacts and disruptions?

3 Methodology

Our research has carried out based on various data and values from literature review in order to answer our research question. We also have done a case study analysis on supply chain of two
companies to figure out causes and impacts of existing supply chain and to develop a theory of adjustments suitable to existing supply chain with reduced environmental impact and resiliency. Here we are mainly focused on qualitative research analysis method to argue and find the results. But at the same time, we also have to use different methods in our research work and we going to state all these methods below step by step.

i) Archival method of data collection

Normally archival method is used when the data is available in collection or archive form. We have collected various data from Patagonia's Footprint chronicle, Klättermusen website and also from our literature review to analyse our addressed issues in the supply chain.

ii) Qualitative analysis

Qualitative method allows the subjects being studied to give much ‘richer’ answers to questions put to them by the researcher, and may give valuable insights which might have been missed by any other method. It is based on the theoretical data and provides valuable information to certain research questions in its own right (QSR international, 2010). Based on this information, we analyse the supply chain of Patagonia and Klättermusen for the products Polo Shirt and Einride Jacket respectively. This analysis is focused on the impacts of scattered supply chain and demand fluctuations to address the environmental sustainability and resiliency of the supply chain. Then we prepare questions to the companies for interview relevant to our research questions.

iii) Questionnaire method

In questionnaire method we set up a questionnaire relevant to our research work and ask the responsible personnel of the companies to answer those questions. This is very cheapest and flexible method. We have prepared two different set of questions to Patagonia and Klättermusen. We send the questions to Patagonia through Mr. David Goldsmith to the get their response and for Klättermusen we send it directly.

iv) Case study method

The case study method provides a systematic way of looking at issues, analysing information, and reporting the results. We carry out an in-depth investigation on the interview responses to
explore causation in order to find underlying principles. We get the reasons behind the happenings from the results and based on these results we try to test two hypotheses.

4 Literature Review

4.1 Sustainability and Current Global Environment:

Ever since humanity determined to fix to its business-as-usual growth path, global energy demand rose by 45%, the price of oil attained US $200 per barrel, greenhouse gas emissions increased by 45%, lead to an increase in the global average temperature up to 6°C. The world economy prolonged losses equivalent to 5-10 percent of global GDP and poor countries suffered costs in excess of 10 percent of GDP. Ecological degradation and water scarcity has dramatically increased. And according to a report from United Nations Environment Program three billion people will start to live on less than $2 a day in 2015, in 2030 over one billion people are living on less than US $1 a day (Design of Prosperity, 2009).

We are producing and consuming far in excess of what the planet can sustain. The planet is critically overloaded by the environmental impacts caused by our industrial economies and consumerist life-styles. The textile industry which led the Industrial Revolution in the 19th century is uniquely positioned to turn into one of the serious change drivers of the Sustainability Revolution (Design of Prosperity, 2009).

4.2 Carbon Footprint and its impacts:

Carbon footprint is defined in terms of the total amount of green house gases that produced directly or indirectly from human activities and it is expressed in equivalent tons of carbon dioxide (CO₂) (Up-To-Date, 2007).

Our everyday activities that consume fuel and then generate heat or energy create a certain amount CO₂. Say, when we buy food and goods, the production processes of food and goods also emit some quantities of CO₂ (Up-To-Date, 2007).
Actually carbon footprint is the sum of all emissions of CO\textsubscript{2} (carbon dioxide) which are induced by our activities in a given time frame and in practical a carbon footprint is calculated for the time period of a year (Up-To-Date, 2007).

Carbon dioxide emissions are calculated more precisely based on the fuel consumption. As for examples:

- 1 (UK-) gallon of petrol fuel consumed, 10.4 kg carbon dioxide (CO\textsubscript{2}) is emitted.
- 1 (US-) gallon of gasoline fuel consumed, 8.7 kg carbon dioxide (CO\textsubscript{2}) is emitted.
- If a car consumes 7.5 litres diesel per 100 km, then a drive of 300 km distance consumes 3 x 7.5 = 22.5 litre diesel, which adds 22.5 x 2.7 kg = 60.75 kg CO\textsubscript{2} to carbon footprint.

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Unit</th>
<th>CO\textsubscript{2} Emitted per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrol</td>
<td>1 gallon (UK)</td>
<td>10.40 kg</td>
</tr>
<tr>
<td>Petrol</td>
<td>1 litre</td>
<td>2.30 kg</td>
</tr>
<tr>
<td>Gasoline</td>
<td>1 gallon (USA)</td>
<td>8.70 kg</td>
</tr>
<tr>
<td>Gasoline</td>
<td>1 litre</td>
<td>2.30 kg</td>
</tr>
<tr>
<td>Diesel</td>
<td>1 gallon (UK)</td>
<td>12.20 kg</td>
</tr>
<tr>
<td>Diesel</td>
<td>1 gallon (USA)</td>
<td>9.95 kg</td>
</tr>
<tr>
<td>Diesel</td>
<td>1 litre</td>
<td>2.70 kg</td>
</tr>
<tr>
<td>Oil (heating)</td>
<td>1 gallon (UK)</td>
<td>13.60 kg</td>
</tr>
<tr>
<td>Oil (heating)</td>
<td>1 gallon (USA)</td>
<td>11.26 kg</td>
</tr>
<tr>
<td>Oil (heating)</td>
<td>1 litre</td>
<td>3.00 kg</td>
</tr>
</tbody>
</table>

(Up-To-Date, 2007)

To simplify the calculation we can bring more examples where as the each of the following activities adds 1 kg of CO\textsubscript{2} to carbon footprint:
- Travel by public transportation (train or bus) a distance of 10 to 12 km (6.5 to 7 miles)
- Drive with your car a distance of 6 km or 3.75 miles (assuming 7.3 litres petrol per 100 km or 39 mpg)
- Fly with a plane a distance of 2.2 km or 1.375 miles.
- Operate your computer for 32 hours (60 Watt consumption assumed)
- Production of 5 plastic bags
- Production of 2 plastic bottles
- Production of 1/3 of an American cheeseburger (yes, the production of each cheeseburger emits 3.1 kg of CO$_2$!) (*Up-To-Date, 2007*).

The world's population produces 16 million tonnes of carbon emissions every 24 hours and the concentration of carbon in the atmosphere has increased by 40% since the Industrial Revolution began. Globally, an unbelievable 26% of the total energy used is used by Americans, who constitute just 5% of the population (*Warwick University, 2005*).

### 4.3 Effects of CO$_2$

Radiations from the Sun pass through the outer atmosphere to reach the Earth. Some radiations escape out of the atmosphere but much of it cannot escape as the atmosphere acts as a one way valve. The amount of radiation escapes through the atmosphere depends on the concentration of greenhouse gases like carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbons etc. present in the atmosphere. This is called as greenhouse effect. In the absent of greenhouse effect the surface temperature of the Earth would be -18°C, instead of the present 15°C (*Warwick University, 2005*).

Carbon dioxide which is mainly generated as a by-product during the combustion of fossil fuels has been increased due to increase in transportation facilities, cutting of trees, population explosion etc. in its concentration in the atmosphere. This affects the amount of radiation which escapes from the atmosphere due to increase in the concentration of greenhouses gases. This lead to the increase in the Earth’s surface temperature by 0.6°C ± 0.2°C over the last century. Though this difference may not look much, the warming will increase with time, and could cause some disastrous consequences (*Warwick University, 2005*).
Global warming may cause the following effects,

**Rise in Sea level** – Melting of ice caps taking place due to the increase in surface temperature. This will affect the coastal plains and reduce the land area for inhabitation (*Warwick University, 2005*).

**Impacts on agriculture** – Affects the agricultural productivity (*Warwick University, 2005*).

**Reduction of the ozone layer** – The current warming will result in increase high cloud cover in winter, giving chemical reactions a platform in the atmosphere, which will result in depletion of the ozone layer (*Warwick University, 2005*).

**Increased extreme weather** – A warmer climate can change the weather systems of the earth and we will see more droughts and floods, and more frequent and stronger storms in the coming days (*Warwick University, 2005*).

**Spread of diseases** - Diseases would able spread too quickly to areas which were previously too cold for them to survive in and can brings new diseases on earth that was previously we did not experience (*Warwick University, 2005*).

**Ecosystem change** – The genetic behaviours of plants and animals may be changed and it can play a significant role to imbalance the ecosystem of a particular region (*Warwick University, 2005*).

### 4.4 Scattered supply chain and its impacts in terms of carbon footprint

The textile and apparel industry is a key sector for both the industrialized and developing countries and in the earlier section, we have seen that the value chain in textile and apparel industry comprises of a big number of dissimilar activities which may be confined within a single geographical location or spread over around the world (*Uluskan, 2010*).

In real life situation, the different components in textile and apparel industry are mostly geographically scattered. The industry is divided into mainly two groups: a) Manufacturing and finishing of primary textiles goods and b) Assembling the finished goods into a complete
product, e.g. Apparel. But these two groups have relatively different economic background as the textiles manufacturers are generally larger than the apparel producers and they are typically capital intensive firm. On the other hand, the apparel industry is more scattered and it mostly consists of small, labour intensive firms. Previously Short-Term Arrangements, Long-Term Arrangements, and Multi-Fibre Agreement placed restrictions on global textile and apparel exports; but in January 1, 2005, quota phase-outs were completed. And thereafter, there has been a shift in terms of textiles and apparels export amounts between developing and developed countries and in other words, developing countries started to become global leaders in textile and apparel export because of quota elimination. The developed countries were reshaping their existing supply chain to shift to the developing countries to enjoy the cost advantages. And the textile and apparel value chain were continuing to be geographically dispersed through the adjustment from the retailers in their outsourcing strategies (Uluskan, 2010).

Due to the globalization and changing nature of outsourcing, the number of geographically scattered supply chain partners has increased in a particular supply chain. At the same time, it has demanded a variety of infrastructure and transportation modes and the total travelling distances has also enormously amplified (Uluskan, 2010).

4.5 Impacts of transportation and carbon footprint on human life and current situation:

Carbon dioxide emissions from transport depend on three key variables:

I) Fossil carbon content of fuel consumed;

II) The fuel efficiency of vehicles; and

III) The distance travelled and the means of transport chosen (Amin, 2010).

According to a report from World Economic Forum, the logistics and transport sector is responsible for around 2800 mega-tonnes or 5.5% carbon footprint out of annual greenhouse gas emissions of around 50000 mega-tonnes. And it has also revealed that road transport has the most significant contribution to the total footprint, at around 57% and the ocean freight some way behind around 17%. But to consider an efficient mode in terms of emissions intensity per ton-km,
air freight is considerably more carbon-intensive than road and overall the most carbon efficient modes are rail and ocean freight (World Economic Forum, 2009).

Figure 2: Emissions Share per Logistics Activity (World Economic Forum, 2009)

The freight transport carbon emissions are growing every year. The freight transport tonne-km grew in the period from 1990 to 2004 by an average of 3% per year in the OECD [Organization for Economic Co-operation and Development] countries. The continuing shift to more globalised supply chains, combined with the underlying economic growth is still likely to continue. The diesel consumption in the transport sector grew by 1.5% every year from 1990 to 2006 in India. During the same period in China, the number of tonne-km of freight carried by road increased by a huge 14% per year (World Economic Forum, 2009).
Today’s consumers want to become ‘greener’ putting the impact of carbon footprint on top of their minds. In a recent survey, it has shown that 85% of consumers are either ‘extremely’ or ‘somewhat’ concerned by climate change and 81% of them think it will directly impact their lives (World Economic Forum, 2009).

Moreover consumers are unable to show their direct response due to the limited availability of information; few products are carbon labelled and there is not yet a global labelling standard. Consumer awareness campaigns are mostly focussed on the emissions impact of manufacturing location, not to the impact on product lifecycle emissions (World Economic Forum, 2009).
Another research from Carbon Trust has revealed that 64% of consumers in the UK are more likely to use a business marketing itself as low-carbon. 67% of consumers in the UK are likely to buy a low-carbon product, and similar trends are also seen across much of the EU. In the USA, the data is less compelling as the retailing in USA is mostly focused on price-driven marketing. If we look at an analysis from the Carnegie Mellon University’s Green Design Institute model, it is evident that the carbon footprint of products varies significantly in dollar value terms. For basic industrial commodities, such as iron and steel, emissions are three to four tonnes of CO₂ per US $1,000 of value. For consumer electronics like laptops and phones, the figure is considerably less than half a tonne (World Economic Forum, 2009).

![Figure 4: Lifecycle Emissions in Dollar-Value Terms with Transport Highlighted](image)

*Figure 4: Lifecycle Emissions in Dollar-Value Terms with Transport Highlighted (World Economic Forum, 2009)*
It is going to be apparent that changing consumer awareness around carbon emissions will impact on demand for products in different ways, particularly if carbon calculation and labelling schemes bring footprint information to the forefront. The effects of changing consumer demands, combined with a supporting response from the large global retailers, could therefore have a profound effect on supply chains. Retailers and distributors increasingly see carbon emissions performance as a source of competitive advantage, on the supply side and on the demand side. So, carbon management can be a route to lower costs and greater visibility of the cost base to reduce emissions by making obligatory by the retailers directly and also to pass back it to the upstream of a supply chain (World Economic Forum, 2009).

4.6 Recent Development:

Today’s retailers and Environmental wings from different levels are trying utmost to change their existing business practices associated with transportation to reduce GHG emissions. Though to become sustainable, especially in transportation demands challenging approaches from the business organization, still some of them have attained a significant improvement (American Meat Institute, 2009).

Recently Wal-Mart has publicized to source its products that produce closer to its stores to reduce its fuel costs curtailing its transportation distances. Moreover, Wal-Mart has adopted a comprehensive approach to sustainability in its supply chain strategy to realise cost and carbon reduction opportunities across logistics, production and innovation. Through internal initiatives and engagement with its suppliers, the world’s largest retailer will make its truck fleet ‘25 percent more efficient in three years, double in 10 years’. It plans to share its innovations throughout the supply chain, which it believes will create a ripple effect and magnify these solutions on a global scale (American Meat Institute, 2009).

EPA (Environmental Protection Agency) of USA has developed ‘SmartWay Transport program’ that will offset the costs of installations for lowering truck emissions by using more efficient tires, diesel particulate filters, improved aerodynamics, automatic tire inflation systems, speed governors and auxiliary power units to avoid engine idling during extended stops. EPA aims to lessen as much as 18 million metric tons of carbon-equivalent and up to 200,000 tons of nitrogen oxides annually by 2012 (American Meat Institute, 2009).
And they have got huge calls from the shippers, carriers and logistics providers and only the companies that use 100 percent SmartWay compliant carriers qualify to include a SmartWay logo on their consumer packaging. They have introduced a tool named as SmartWay Savings Calculator that helps the fleet owners to compare the costs and savings of various technologies, allow the owners to enter different values for fuel use, fuel cost, and to adjust the number of trucks, the fuel amount and the quantities for each technology that the company wish to use. EPA also has a Voluntary Diesel Retrofit Program that provides information on various diesel emission control technologies, program contacts, and federal and state funding sources to offset the cost of retrofitting trucks, buses and construction vehicles (American Meat Institute, 2009).

In USA, there is a dedicated site from the Department of Energy’s Alternative Fuels Data Centre that provides information regarding alternative fuels, alternative fuelled vehicles (including heavy duty vehicles), refuelling sites and more information on public-private partnerships that deploy alternative fuel vehicles and build supporting alternative fuel infrastructure. Moreover, the American Trucking Association has come forward to sponsor GreenTruck in cooperation with the Transportation Environmental Resource Centre (American Meat Institute, 2009).

4.7 Vulnerabilities and disruptions in supply chain

Today’s textile supply chain is more complex than ever due to global sourcing and consequently it has become vulnerable in terms of uncertainties. Geographically, coping with the dissimilar nature of various issues regarding environmental, technical, political, social, economical, national and international security has become a most crucial challenge for the existing supply chain of textile business. And apart from this, the existing supply chain is also experiencing frequent disruptions due to attack of different forces from inside and outside of the organization and ultimately the number of disruptions is endless. As for example, retailers can suffer from the manufacturer’s disruptions and the manufacturing can be disrupted directly because of some problem in their plant, disruption at their supplier’s plant, malfunction in the transportation system, interruption to the communication and information system, or snag with customer and it can also be disrupted indirectly due to disruptions of intermediate suppliers that take capacity out of the supply chain (Sheffi, 2005).
Any company who involves in this type of supply chain; be it automobile manufacturer, shoe maker or an apparel retailer- the chain has three main sections:

- The inbound or supply side of the supply chain includes all activities of all tiers suppliers to deliver the raw materials, intermediate parts or finished products to the next hand.
- The internal processes or the focal organization are responsible to integrate and communicate with upstream and downstream.
- The outbound side of the supply chain comprises with all the distribution processes and the customers of the company.

So, disruptions can be realized in companies and processes due to the disturbances of any section of this chain that connect raw materials sources to the ultimate end-user of the finished product (Sheffi, 2005).

4.8 Disruption in supply

Disruption of supply can happen due to the consequences of the disruptions not only the suppliers but also the supplier’s supplier. And the notion of this disruption may be seen due to various reasons like natural disaster, accidents, lack of information sharing, unexpected demand rising or falling, capacity shortage of the plant, prolonged lead time etc. As for example, in 2004 Japan’s second largest car maker NISSAN suspended three of its four Japanese plants due to shortage of
steel. This shortage was caused mainly by the huge demands created by over-heated Chinese economy (Sheffi, 2005).

4.9 Disruption in internal processes

Internal disruptions which happen within the company have a special dimension because in many cases they involve company personnel who are in harm’s ways. It may be the internal infrastructure like production facility failure due to the attack of a powerful tornado. Or it may be the unexpected loss of the key personnel of the company due to tragic accident or some other reason. For example, Akami lost its co-founder and chief technology officer in the 9/11 tragic plane crash. The bond trading company Cantor Fitzgerald of U.S.A experienced a disruption of a different magnitude when it lost 658 people in the collapse of the World Trade Center. In addition to the human toll, it relates to the loss of relationships with employees, customers and suppliers which are really crucial to recover (Sheffi, 2005).

Nowadays, we are heavily dependent on information technology to be interconnected with our all networks but sometimes this can be vulnerable to computer viruses, software problems, and other technology outages. In January 2003, a computer worm named as SQL Slammer spread directly to vulnerable computers on the internet and needing no human intervention, Slammer infected 90 percent of vulnerable hosts within 10 minutes of its first appearance. Slammer downed Seattle’s 911 call centre, American Express’s customer service, and Continental Airline’s computerized reservation system (Sheffi, 2005) & (O’Harrow & Cha, 2003).

4.10 Disruption in demand

Disruption in demand is largely experienced by a company when it faces massive, unpredictable declines in the demand for its products or services. These may come up due to the technological changes, new entrants, disruptions to a major customer, or the sudden loss of customer confidence. But if anything happen all on a sudden from customer side like customer losses confidence on a certain product or if the customer himself or herself entangled with commotions, then it will be really catastrophic for a company (Sheffi, 2005).
Equally, demand imbalances which may be considered as unexpected spikes in demand have a slight impact on a company’s existing structure though it can lead to lost sales, bad service, and even lost customers (Sheffi, 2005).

In 1982, Johnson and Johnson (J&J) enjoyed a 37 percent share of the non-prescription market with its popular pain reliever, Tylenol. But in late September of that year, seven people died when someone placed bottles of cyanide-laced Tylenol capsules on store shelves and on this consequences J&J pulled off all their 31 million bottles of Tylenol bottles from the market and it caused J&J’s share of the market to drop to 8 percent and its stock market capitalization to drop by 7 percent. But by the end of second quarter of 1983, as a part of aggressive marketing, J&J came back to its market and regained its original position with heavy promotions by redesigning the packaging and switching from powder filled capsules to solid caplets (Sheffi, 2005).

4.11 Categorizing the supply chain risks

The supply chain network is innately vulnerable to different risks entangled in all the ways of a chain in a dissimilar form and the failure of any one element or any disruption in any node of a chain can cause the whole network to fail. So, the categorization and mapping out the likelihood and impact of risks are the challenges of today’s organization to figure out how to deal with.

According to Mason et al. (1998) and Cristopher and Peck (2004) the supply chain risk is subdivided in five different categories:

- Process risks internal to the company;
- Control risks internal to the company;
- Demand risks external to the company and internal to the supply chain;
- Supply risks external to the company and internal to the supply chain;
- Environmental risks external to the supply chain.

As we know, a company is the unification of different processes and activities and its main aim is to ensure incessant value creation to its products as a part of its business strategy. Here the process risks include all activities that a company does in its various operations connected to manufacturing, warehouse management to transportation and at the same time the control risks
are apparently connected to process risks. Say, the warehouse management is functioned by using inventory control policies; in fact each process within a company has specific rules and controls and the breakdown of any of these act as risks which affect the performance of the company and also its resilience. Wrong demand forecast methodologies, inadequate production planning, mismatch of corporate culture and implementation of quality methodologies and systems are some of the attributes that are causes of process and control risks for a company (Longo & Ören, n.d.).

Demand risks normally add up the flow of products, information and finances from the next customer of a focal firm and it is in downside of a chain regard as external to company activities but connected with its activities as a part of a chain where the supply risks indicate all disruptions as like demand risks but in this case, it happens in the upstream of a supply chain (Longo & Ören, n.d.).

Finally the environmental risk is considered as uncontrollable and sometimes unpredictable event that strongly affect the supply chain vulnerability and resilience. It also influences the total network being not a part of a chain (Longo & Ören, n.d.).

Moreover, it is quite difficult for any organization to have a clear scenario of the likelihood and consequences of each disruption and to work with it. So, to adapt and have advanced preparedness, the company needs to prioritize these dissimilar attributes of disruption and it can be sketched out in terms of disruption probability versus consequences in the following two axis diagram:
As we know, still most of the companies only work on their own vulnerability but the above map depicts the whole global scenario and helps the company to focus its planning efforts on sensitive region and also helps to spot a problem area at a glance to respond quickly.

4.12 Resiliency in supply chain to cope with the disrupted global supply chain and to reduce vulnerability in the business

Still many companies rely on luck to overcome from a disastrous supply chain disruption. But in today’s business environment, it is imperative for an organization to build up a supply network that is well equipped with comprehensive security measures and is as well resilient enough to bounce back from any disruptions. As in reality, luck can hardly save you and show you the right
way to manage your business. It means the supply chain has advanced security processes and procedures in place, while at the same time it is resilient enough to respond to unexpected disruptions and restore normal supply network operations; as a secure supply network does not guarantee a resilient supply chain, and vice versa (Rice & Caniato, 2003).

Resilience is considered as a competitive advantage than the competition; following a disruption and it helps a company to capitalize on opportunities to serve its competitors’ customers when its competitors fail to adapt with the embarrassed market situation. Even in some cases where the disruption affects the company and its competitors equally, companies can compete on their resilience capabilities. In early 2000, Nokia and Ericsson experienced such type of disruptions as the both competitors depended solely on Philips Electronics for radio-frequency chips (RFC) and were thus equally affected by a fire in the main Philips RFC plant. But to react with this situation, their responses were quite different as Nokia immediately sensed the disruption and responded aggressively, dedicating 30 employees to work with Philips and other suppliers to maintain a steady RFC supply. Ericsson, on the other hand, did not sense the seriousness of the disruption and ultimately mounted only a modest effort to restore supply. The net effect was that Nokia achieved its sales plans, while Ericsson missed a critical new product introduction that amounted to an estimated $400-million-revenue loss and Ericsson ultimately exited from the business of making cellular phones (Rice & Caniato, 2003).

A company can achieve resilience in its supply chain by adapting numerous practices, but of all the ways to become resilient, two methods hold the greatest potential; one involves redundancy and the other is flexibility. And here the company needs to decide the right approach that fits with its strategy and organizational structure.

4.13 Resilience through Redundancy and Flexibility

Redundancy helps companies to respond to disruptions and continue its services during the recovering period after a disruption. Companies mostly practice to protect themselves by keeping spare inventory and in some cases by maintaining production lines or facilities in excess of capacity requirements, committing to contracts for material supply (buying capacity or sub-contracting), and maintaining a dedicated transportation fleet (Rice & Caniato, 2003). But nowadays companies are working to cut costs by eliminating exactly this type of inventory rather
than more focused on tightly connected supply chains and higher quality of products and services. In some extent, some companies decide to keep a lean supply chain with little inventory and a single supplier, even for a critical paths based on the rationale that the full cost of handling several suppliers and keeping safety stock is to be too high (Rice & Caniato, 2003) & (Sheffi, 2005).

In real time situation, safety stocks work as a tool of resiliency and offer companies enough space to plan to continue its business, even a small amount of inventory can do so. Sometimes redundant capacity is really beneficial for a company to face a critical situation but it depends on the nature of business though we know a high level of redundancy is too expensive. Say, in case of information technology, company should keep complete redundant capacity as the stakes are especially high and the costs of extra capacity are relatively low here (Rice & Caniato, n.d.) & (Sheffi, 2005).

On the other hand, flexibility also increases resilience by building capabilities within the organization to respond quickly to disruptions. Companies develop these types of capabilities through the investments in infrastructure and resources in beforehand. Developing a multi-skilled workforce, designing production systems to cope with multiple products with real time changes, and adapt with different sourcing strategies to switch to a new supplier are some examples of such capabilities. But these capabilities will not function until you ensure fundamental changes to your entire company as well as its supply chain relationships. It means close partnership is only with suppliers who will work with you more firmly as per your changing demands in troubled times (Rice & Caniato, 2003) & (Sheffi, 2005).

In due course, company will likely adopt a mixture of these flexibility and redundancy alternatives, depending on different cost and service characteristics as well as on specific business and industry factors.

4.14 Challenges to implement sustainable resilient supply chain in all level of a business

Strategies that companies wish to implement in its supply chain to achieve resiliency are opposed by different forces from various levels of business and mostly comes within the organization.
4.14.1 Trade-offs between cost and benefits

To some organizations, it’s sometimes a challenge for them to balance between the additional costs to implement strategies to achieve a more resilient supply chain and its feedback during the troubled time. Theoretically, these approaches optimize the company’s competitiveness especially when its supply chain is more vulnerable to disruptions but at the same time quantification of the value of its competitiveness is really imprecise. Moreover, it is viewed as “insurance premiums” that will safeguard the supply chains from major disruptions (Sheffi, 2001). In other sense, additional facilities can reduce efficiency and sometimes lower the competitiveness. Here the challenge is to choose the right set of strategies and trade-offs between the losses caused by reduction in efficiency and the benefits that a company gets from increased robustness. And it is not clear as to which strategies can reduce risks without hurting efficiency (Sheffi et al., 2003) & (Stecke & Kumar, 2006).

4.14.2 Strategic fit

To mitigate risks and probable disruptions in a critical moment, an organization must think about the strategies that fit with its business policies and as well as its communicating message which used in its mission. Say, a company work on postponement principle and to lessen risks if it decides to reduce its product variety as a way to rationalize its lines, then the value of postponement strategy is diminished. We can mention another example here, say a retailer has a slogan “every day low price”; but in a critical moment if it moves for dynamic pricing and promotional strategy, then it is simply incongruent to its strategic position in the market place (Tang, 2003).

4.14.3 Proactive execution

An organization has to be practical enough to respond beforehand in a proactive manner; otherwise robust strategies will not bring expected benefits for it and even in some cases, competitors have the opportunities to be profitable by utilizing this advantage (Tang, 2003).

4.14.4 Leadership over the organization

During the catastrophes, most internal and external operations of an organization have become decentralized and then it is crucial to play the role from the management side to have direction
and control on overall situation. Here the management tasks are to identify emergency services that needed to tackle the situation and ensure its implementation. The management also has to take steps to meet up post emergency period and quantify the amount of existing resources. Above all, centralization and integration of materials and information is a must here (Tang, 2003).

4.15 Recent disruptions and different scenarios from different business sectors

Iceland Volcano was a recent incident that started on April 14, 2010 and all we know that it had a tremendous impact especially on Airlines companies as they had to pay a lot. But the reality was that it not only crumpled airline business, the overall global business also experienced a dissimilar effect. We can recall the total synopsis of different business sector from different corner of the world (Callus, 2010).

Peter Grundhoefer, a top produce wholesaler in Frankfurt, said: "This affects all of us in the fruits business. We will lack beans and pepperoni from Egypt and fresh herbs from Israel, exotic fruits like mango, kumquats and physalis (cape gooseberry) once stocks have been used up in the next one or two days." Barbara Hennings, who works at Frankfurt sushi restaurant Iroha, said exotic vegetables were a bigger problem than fish. "So far we're not experiencing any supply bottlenecks and we do not have to take dishes off the menu." She told that tuna was delivered frozen once a month from Spain so there was no impact (Callus, 2010).

Tense IKEA AB only transports its goods by ship, rail and truck, so the Swedish furniture retailer is not experiencing any supply disruptions. German fashion brand Hugo Boss AG expects a delay in showing its pre-spring collection to retailers such as Macy's Inc and Nordstrom Inc, but a U.S. spokesman said there would be no impact on stores since those clothes would not actually ship until the 2010 holiday season (Callus, 2010).

Dutch mail group TNT NV said it had switched to road transport in Europe and was incurring higher costs. Anita Gupta, Asia Pacific spokeswoman for rival DHL in Singapore, said the group had "increased its trucking capacity to minimize delays for shipments within Europe. A 3 to 5 day delay is expected for shipments moving between Europe and the rest of the world" (Callus, 2010).
"Many hotels have been booked out since Friday," said Petra Winter, a spokeswoman for the Frankfort tourism office. Of 140 hotels with more than 34,000 beds in Frankfurt, only 20 still have vacancies. Car rental companies are seeing a surge in demand as travellers try to find substitutes for flights. "We are buying new cars for this" by taking on sooner than planned deliveries of cars the company already agreed to buy, a spokeswoman for Europcar in Hamburg said (Callus, 2010).

Japans’ Fujitsu Ltd said its notebook PC shipments to Europe have been halted temporarily due to the disruptions. It said there was enough inventories in the region to ensure there would be no impact on earnings at the moment. Sony Corp, Sharp Corp, Hitachi Ltd and Panasonic Corp said they were experiencing no impact (Callus, 2010).

International Air Transport Association (IATA) said the economic impact on airlines would be greater than the Sept. 11, 2001 attacks (Callus, 2010).

The global Civil Air Navigation Services Organisation (CANSO) said the air traffic control sector was losing up to 25 million Euros ($35 million) a day due to the closure of European airspace and warned of a significant impact on future investments (Callus, 2010).

4.16 Recent development and current scenario of companies that are working with resiliency

The retail environment is a complex and dynamic one; every day brings new challenges and opportunities to this sector. To address these challenges and bounce back from these disruptive events all are doing their best. This is really incredible, varied and innovative in respect of the nature of the challenges, organization’s strategic position, and geographical location.

4.16.1 Wal-Mart recent development

The need to have a resilient supply chain for the world largest retailer Wal-Mart is not merely theoretical but mostly it is a challenge for the company as it moves enough inventories to support $1.1 billion in daily average sales, $12,747 per second (based on total sales for the fiscal year ending 2009) everyday. On a weekly basis 200 million customers pass through the doors of its 7,800 retail and wholesale outlets in 16 countries on four continents, and its tens of thousands of suppliers source goods from around the globe. With this many moving parts, disruptions due to
transportation issues, natural disasters, political instability, environmental conditions and hundreds of other causes are an everyday’s incident (Koon, 2009).

It is simply amazing that Wal-Mart is successful in this battle. So, how it is managing these mammoth jobs, what are their strategies behind this success? That is really a matter of deep understanding and investigation (Koon, 2009).

Firstly, Wal-Mart is consistently focused on removing logistics cost connected to production and transportation of products. In their last annual report, it was revealed that Wal-Mart increased its yearly sales by $27 billion (an increase of 7.6%), while reducing inventory by $648 million (a reduction of 1.84%). We know that this type of reduction leads to greater profits and at the same time increase the vulnerability. So to meet up the needs of emergency period, Wal-Mart has set up nine disaster distribution centre located around the countries to store supplies that are vital to communities during a disaster – such as water, batteries, flashlights and generators. This helps to ensure more immediate availability of essential products for its customers. Previously Wal-Mart responded to the needs of citizens in an impacted area through multiple channels: through the normal means at stores and clubs, but also through in-kind donations to charitable organizations such as the American Red Cross and Salvation Army, and through sales of merchandise to emergency management agencies at the local, state, and federal level (Koon, 2009).

Secondly, continual communications throughout the supply chain, both internally and externally are vital to the success of Wal-Mart's efforts. Many of its suppliers have offices in Bentonville, Arkansas, where Wal-Mart's headquarters is located. This co-location helps to ensure that suppliers are able to maintain a rhythm on the company's current and future operations and to adjust their supply of product accordingly (Koon, 2009).

As a part of Wal-Mart’s sustainable approach, the company has decided to reduce the packaging size of the thousands of products and this initiative has enabled Wal-Mart and its suppliers to have an extra capacity on each shipping container and each truck and to utilize it during surges in demand, adding to the resiliency of the entire system. The company is also reducing its reliance on fossil fuels, in its trucking fleet and at its stores and Sam's Club locations. By reducing the dependency on any single source, the resiliency of the entire system is improved (Koon, 2009).
As a part of its enhancement of resiliency within the supply chain, Wal-Mart is planning to use GPS transmitting device and other information system in its transportation system where the information system will track weather conditions around the country, the status of emergency merchandise orders during a disaster, road conditions or will provide real-time notifications based on pre-defined parameters to take necessary steps instantly in a disastrous period (Koon, 2009).

Finally, Wal-Mart is trying to be more focused on the continued integration of the private sector into the emergency management efforts in its operating countries and this will allow them to take better decision during planning and operational levels. Ultimately these insights will once again move the system toward greater resiliency, by being able to issue all available information into its operation. At the same time, the company is also working on supply chain visibility to be more resilient and as a part of its work, the company has recently announced to provide product rating system that determines the environmental costs of production and it will encourage educated purchasing decision and will initiate a new level of transparency throughout the supply chain (Koon, 2009).

4.16.2 McDonald's business strategy in India

McDonald’s launched its business in India in 1996 and it was in profit after it broke even in 2008; on that fiscal year the total losses were Rs. 211,41 Crore ( USD 45,19 billion). But at that moment, it was thought that India and China would continue to be high-growth markets for McDonald’s and the top management also cloud realize the tremendous brand success. So, in September 2009, it came to introduce a new pricing strategy for its lunch and dinner menus; reduction in prices by almost 25%. On that moment, it was surprising as it came at a time when food prices were increasing day by day. Others thought that cutting prices in such times did not make sense. But the management in India was convinced that tweaking the prices of it combo meal offering would help customers prefer McDonald's as a lunch and dining destination (McDonald’s, 2009).
4.16.3 SAS’s social media utilization in a crisis

Social media can be a great asset in communicating with customers when all is become quiet, perhaps the full power of this tool comes as the best way to bring light in times of disaster, when up-to-date and current information is crucial to get out to as many as possible and as soon as possible (Husdal, 2010).

New launches are always accompanied by time demand. But for Scandinavian Airlines (SAS) the timing of the launch of its Facebook page could not have been better planned as it was launched on April 14; the day before the volcanic ash cloud paralyzed both European and much of global air traffic. At the end SAS fully utilized the power of social media to keep its passengers informed on the latest developments, and answer all sorts of questions from stranded travellers. The Facebook page also had a link to the latest update on flight departures, something that otherwise is hard to get by (Husdal, 2010).

4.17 Dissimilar attributes of disruptions in the demand side of a supply chain

To go for a decision to make products or to place an order before reaching the actual demand from the downstream is really challenging for retailers and also the toughest part of supply chain operations. We know that too much products will have impact on inventory carrying costs and ultimately lead to discount offer. Equally the shortage of inventory causes lost sales and finally directs to lose customers. Actually, the retail supply chain is truly vulnerable to demand related
risks that are primarily transpired due to demand variability and unpredictability, where both are connected with several independent trends.

4.18 Demand Variability

Normally, general marketing campaign or advertisements connected to promotional offer can affect short- to medium-term demand from customers for the product. On the other hand, news about product hazards (for example, allergic reaction for animals, human body, susceptible to children) can be infrequent but has a large impact on the demand. As for example, in the middle of 2007, two Chinese toy manufactures were banned from exporting by the Chinese Government as they were warned and recalled by the overseas buyers from Asia, Europe and USA due to lead contamination in toy paints. The government came to that decision to safe and warn its other’s businesses and by which the whole toy business of china was in some way disrupted (*Msnbc*, 2007). On January 5, 2007 it came to news that Samara Brothers, a Chinese Garments Manufacturer was recalled by the US Consumer Product Safety Commission due to the coatings on the snaps of the garments which posing a serious risk of lead poisoning and adverse health effects to young children (*Samara brothers*, 2007).
Recall Alert
U.S. Consumer Product Safety Commission

Office of Information and Public Affairs
Washington, DC 20207

January 5, 2007
Alert #67-516

Samara Brothers Recalls Children’s Two-Piece Overall Sets, Snaps Contain Lead

The following product safety recall was voluntarily conducted by the firm in cooperation with the CPSC. Consumers should stop using recalled products immediately unless otherwise instructed. It is illegal to resell or attempt to resell a recalled consumer product.

Name of Product: Starting Out Shirt and Overalls

Units: About 200

Manufacturer: Samara Brothers LLC. of New York, N.Y.

Hazard: The coatings on the snaps in the overall and shirt contain excessive amounts of lead, posing a serious risk of lead poisoning and adverse health effects to young children.

Incidents/Injuries: No incidents or injuries have been reported.

Description: This recall involves two styles of children’s overall sets. One set is a red plaid denim overall with a white shirt trimmed in red, sold in sizes 12 through 24 months. The other set is a navy blue corduroy overall with a white shirt trimmed in green, sold in sizes 3 through 5 months. Both styles have decorative train appliques on the front of the overalls. The collar tag of the overalls reads, “Starting Out.”

Sold Exclusively at: Dillard’s nationwide during October 2006 for about $20 for the red overalls set and about $25 for the blue corduroy set.

Remedy: Consumers should stop using the products immediately and contact Samara to obtain a full refund.

Manufactured in: China

Consumer Contact: For additional information, please contact Samara Brothers at (800) 985-9975 between 9:30 a.m. and 5 p.m. ET Monday through Friday, or visit the firm’s Web site at www.samararecall.com, or e-mail the firm at info@samararecall.com

CPSC is still interested in receiving incident or injury reports that are either directly related to this product recall or involve a different hazard with the same product. Please tell us about it by visiting https://www.cpsc.gov/cgibin/incident.aspx

The U.S. Consumer Product Safety Commission is charged with protecting the public from unreasonable risks of serious injury or death from thousands of types of consumer products under the agency’s jurisdiction. The CPSC is committed to protecting consumers and families from products that pose a fire, electrical, chemical, or mechanical hazard. The CPSC’s work to ensure the safety of consumer products - such as toys, cribs, power tools, cigarette lighters, and household chemicals - contributed significantly to the decline in the rate of deaths and injuries associated with consumer products over the past 35 years.

To report a dangerous product or a product-related injury, call CPSC's Hotline at (800) 638-2772 or CPSC's teletypewriter at (301) 595-7654. To join a CPSC e-mail subscription list, please go to https://www.cpsc.gov/cpssclist.aspx. Consumers can obtain recall and general safety information by logging on to CPSC's Web site at www.cpsc.gov.
During the usage of clothing products quality issues like colour fading, unravelled hem, loose button, jammed zip and so on can create a negative impact on the particular brand and sometimes that retail brand may lose a big number of its customers. On 2\textsuperscript{nd} February 2009, it was reported in a British newspaper named ‘Mail Online’ that a total of 14,390 disgruntled shoppers called the Government’s consumer helpline about problems with clothing they’d bought - up 22 per-cent from 2007. Most of them were reporting either that they’d bought a defective garment or that they’d suffered substandard service. Frank Shepherd, spokesman for the helpline, said: ‘Women have complained about many things like clothing shrinking, buttons falling off, seams splitting, colour dyes running and sequins coming off’ (Fisher, 2009).

![Figure 7: Properties change after washing (Fisher, 2009)](image)

Ban on certain ingredients by some countries restricts selling the products that contain the ingredients in those countries thereby affecting the global demand. US Customs and Border Protection secure the homeland by preventing the illegal entry of people as well as goods that are prohibited by the local laws. The items which would injure community health, public safety, American workers, children or domestic plant and animal life, or those that would defeat their national interests are prohibited (CBP.gov, 2009).
4.19 Unpredictability in Demand

To meet and decipher the demand from the downstream, companies frequently use forecasting techniques mainly based on statistical model and make order or produce products according to it. But the reality is like that if we use the most sophisticated forecasting models; forecasts are inaccurate and even less positive for predicting low-probability events that has high impacts. This uncertainty has enormously boosted up in the recent years due to ground-breaking customers expectations, more global competition, longer and more complex supply chains and greater product variety with shorter product life cycle.

IBM experienced this type of demand imbalances during the launching of its laptop computer product line named as ‘ThinkPad’ in two different models T20 and A20 in mid-2000. To predict the expected sales figure, IBM was conservative enough as it lost $ 800 million in 1998 and $ 571 million in 1999 and kicked off a major ad campaign during the release. However, the new Think Pads became an instant hit with customers and sales soared, leading immediately to product shortage. The problem was no quick solution in the hand of IBM as the component suppliers were geared for the original forecast and could not quickly ramp up their production of DVD and CD-RW components. Due to this “under-forecasting” IBM didn’t even know how many potential sales it lost to its competitor. On the other hand, over-estimating demand, however, can also be detrimental as items may have to be sold at discount, robbing the manufacturer or the retailer of its profit margin and even forcing it to sell at a loss. Such discounts are common in both fashion apparel, which is subject to teenagers’ whims, and consumer electronics products, which lose their appeal when a new model or gadget comes on the market. But even in mature products, like automobiles, discounting is common. For example, in 2004 American manufacturers were offering $3,000–$4,500 rebates on sales of sport-utility vehicles when demand ran below forecast, in part because of high gas prices (Sheffi & Rice, 2005).

4.20 Forecasts’ characteristics

To mitigate the uncertainty in demand which mentioned in the previous section, companies are using different forecasting techniques based on dissimilar characteristics and the result is also varied here.
o **Inaccuracy:**

The clearest attribute of all types of forecasts is that they are invariably wrong as it is simply a statistical reality. For example, forecasting the monthly sales of a certain yellow women’s blouse in size 8 at a given price is bound to be wrong because there is a certain probability that it will equal almost any number. Since the forecast is a single number, the probability of the actual sales matching exactly the forecasted demand is practically nil (Oke & Gopalakrishnan, 2009).

o **Improvement with aggregation:**

A second characteristic is that the aggregate forecasts are more accurate than disaggregate forecasts; for example, forecasts can be aggregated over time, geography, or products. With aggregate forecasts, errors tend to cancel each other out, leading to more accurate forecasts. It is difficult to forecast the sales of a blue colour men’s blazer size 42R on a given day in a given store. But it is easier to forecast the monthly sales of that blazer in that store, and even easier to forecast the monthly sales of that blazer throughout a particular region (Oke & Gopalakrishnan, 2009).

o **Time Horizon:**

Like weather forecasting, long-range forecasts are less accurate than short-range ones since fewer factors are known when longer the time frame is. The sales trajectories can diverge further and further from a projected forecast as time progresses. New fashions, economic changes, and competitors’ actions make the distant future more unclear than the near future. But many supply chain operations require long-term demand forecasts since orders involve long lead times.

o **Reliance on history:**

Forecasting methods normally use historical data and experience to get more accurate information on a typical matter. But when the competitive environment drives manufacturers and suppliers to introduce new products and new versions of old products continuously and also when companies enter in a new market, data would be scarce. The scarcity of data would make the forecasting procedure difficult (Oke & Gopalakrishnan, 2009).
o **Reliance on trading partners:**

History, however, is not the only source of data; trading partners often have information that can help in forecasting and planning. For example, retailers can give their suppliers data on sales patterns throughout their stores. So the suppliers can base their forecasts on actual consumer behaviour rather than the retailers’ order pattern.

o **Risk sharing:**

We know that sharing of data may lead to more accurate forecasting and companies can also share the risk of forecasting simultaneously. Even though this will not improve the forecast itself, the practice can help supply chain partners mitigate the consequences of wrong forecasts and increase the profits of all trading partners (*Oke & Gopalakrishnan, 2009*).

So, taking into consideration the inherent variability of demand and the limitations of statistical forecasting, company use these characteristics to design their supply chains to be flexible enough and to respond to ever-changing demand patterns. Thus it will make them less dependent on demand forecasting. The flexibility to respond to demand fluctuations, created by these supply chain designs, also increases these companies’ resilience to disruption—be it an unexpected demand surge or unexpected problem with their supply lines (*Oke & Gopalakrishnan, 2009*).
5 Case Study
5.1 Case Study 1: Patagonia, Inc.

Supply chain of Polo Shirt - 100% Organic Cotton of Patagonia

About the company

Patagonia is a branded retailer in the clothing and apparel sector based in Ventura, California, U.S.A. In 1972, it was established by the noted environmentalist and climber Yvon Chouinard. The company has a huge assortment of products from T-shirts to shoes, though it is well developed in outdoor segment. The company shows a great commitment to the environmental health connected to social life and as well as to the planet. It does its business in a best possible way comparing to yesterday and is implementing the same view throughout its whole value chain. As a part of its work, Patagonia donates its time, services and at least 1% of its sales to hundreds of grassroots environmental groups all over the world. And the company works always keeping up the slogan “Build the best product, cause no unnecessary harm, use business to inspire and implement solutions to the environmental crises” in their mind (Patagonia, 2010).

The company focuses to be more transparent to its customers and even to its competitors through their website by making available some sophisticated information regarding CSR (Corporate Social Responsibility) and environmental cost of the products. It has recently introduced a mini-site named as the Footprint Chronicles to track the impact of specific Patagonia products from design through delivery (Patagonia, 2010).

Products

Patagonia has developed a versatile collection in its product segment; products are firstly classified as by category, sports & activity and collection. It has clothing items, shoes, luggage & packs and accessories for men, women and kids. It has already developed a wide range of organic cotton products and is currently working with recycling of polyester and nylon products as well. (Patagonia, 2010)
Based on the interview with Patagonia, we are inferring the following:

Patagonia is working on the organic cotton products way back from eighties. It took a long way for them to find the suitable organic cotton suppliers and garment production units. It is now
quite satisfied with all their suppliers. It is having deep long term relationship with all its suppliers in its supply chain.

It just wants to have very deeper long term relationship with the existing suppliers. It already has good flexibility and understanding with its suppliers. It is also not interested to work with new suppliers. Its idea is that if it approaches new suppliers to produce its products, it has to start all the processes from the very beginning and the understanding between the new suppliers and Patagonia will not attain quickly. It also thinks that its relationship with the old suppliers may fade away.

This shows that Patagonia does not treat the business only as trade like just buying and selling; it considers its business as family and treat its suppliers as its family members.

It measures the environmental impacts created by its business through carbon footprint. To calculate the carbon footprint values, it does not calculate individually for every process of every product. It just averages the total energy spent on each process of production in the entire value chain.

First it takes the total energy spent in a factory per year, from that it calculates the total energy spent per year for a particular process of a typical product. Then it averages to find the energy consumption per product. By adding the average energy consumption of each and every process of the product, it finds the carbon footprint value.

During the unexpected rise in demand from the customers for its product, it does the production for the shortage only if it has the greige fabric and puts some push in the supply chain for earlier delivery. Otherwise it does not proceed with the production, since this situation may affect the employees of its suppliers’ factories by means of unnecessary pressures. Patagonia feels that it is not right to pressurize the factories for the mistake of sales team and fashion forecasters as it goes against its CSR policy. This shows that it is not only cautious in the environmental issues; also it is very keen in the social issues.

Even though cotton has higher carbon footprint than the man-made fibres or some blend fibres, Patagonia prefers to use cotton for its products for the comfort and functionality properties of
cotton. It argues that people also will not prefer to buy a product only because the product is an environmental friendly one; the product should satisfy the needs and wants of the consumers. An environmental friendly product which is not useful at all is considered as the environmental enemy since it has undergone a lot of operations and taken much energy during the development and production processes. So, Patagonia takes care just to make the best cotton products with reduced environmental impacts and not in replacing the cotton.

5.2 Case Study 2: Klättermusen AB

Supply chain of Enride Jacket - 100% Organic Cotton of Klättermusen

About the company

Klättermusen is a Swedish brand marketing company which was founded by Peter Askulv in 1984. It manufactures outdoor clothing and accessories for its customers with high demands on strength and reliability. The company is doing business in 18 countries around the world and its net sales worth is SEK 17 million. The company’s head quarter is situated in Åre and its major markets are Sweden, Germany and Norway. The company is taking greater initiatives in environmental work and it also allotting 1% of its sales amount to the environmental projects. It runs some environmental projects and its main projects are rECOVer and ECO-index (Klättermusen, 2010).

Products

It has a wide range of products and the main products are Jackets and Trousers for men and women, textile accessories, and bags (Klättermusen, 2010).

Eco-index

The degree of impact on environment of a particular product is expressed by a typical figure named as ECO-index and it is developed by Klättermusen by considering ten environmental criteria against which each product is assessed in order to calculate percentage. The percentage actually reveals how far the product is entirely environmentally-friendly and it is in some extent easier for the customers to compare with others as well (Klättermusen, 2010).
**Calculation Method:**

The ECO-index is based on ten criteria like lifetime of the product, environmental-friendliness of the impregnation and membrane, biodegradability, raw materials like natural non-fossil materials, recyclable in an existing system, etc *(Klättermusen, 2010).*

Say, to calculate the ECO-index of TJATSE SOFT SHELL JACKET, Klättermusen has set 4 criteria out of 10 criteria considering the product’s overall properties and the product here only fulfils 2 criteria out of 4 and as a single criteria carries 1 point, the total point carried by the product is 2 *(Klättermusen, 2010).*

So, the Maximum point is 4 (as the total criteria is 4)

The product’s total point is 2 (as it satisfies only 2 criteria)

ECO-index (%) = \((2/4)\times100\)

\[= 50\]

The result is 50% and it means there is another 50% remaining until it fulfils all the environmental criteria set for it *(Klättermusen, 2010).*

**RecoVER:**

‘RecoVER’ is another initiative from Klättermusen as a part of its environmental approach towards the planet. Under this program the company encourages consumers to bring back its products to the shop and they will get 1,5,10 or 20 Euros mentioned against on a typical label. And these returned products are recycled in an environmental-friendly manner or sometimes donated to charity *(Klättermusen, 2010).*
Based on the interview with Klättermusen AB, we are inferring the following:

Similar to the Patagonia’s Polo Shirt, in the Klättermusen’s Einride Jacket supply chain, the material movement is taking place around different parts of the world. It sources organic cotton fibre from USA, yarn spinning and fabrics weaving are done in Switzerland and garments sewing in China. It has specific fabric quality requirements for the product. The fibre which it uses for the jacket has long staple length. Moreover the yarns should be tightly spun and the fabric
contains three different strength of yarn and that also needs to be tightly woven and even. These requirements demand special technologies; as far as its knowledge only two factories in the world have the knowhow to do the weaving for this product; one in UK and another one in Switzerland.

Even though cotton creates more environmental harm than any other fibre, Klättermusen is reluctant to change the fibre for the environmental issues as it is apparent that if it changes the fibre means that the product itself will become different.

The supply chain of Einride Jacket takes six months for production from greige booking till the order in-house. Normally it makes extra quantities than its requirement. So, in case of increase in demand, it covers the lost sales with those surplus stocks of the product.

Technological knowhow of the yarn and fabric suppliers is the key player in the supply chain of Einride Jacket. Since the technology is not available to rest of the manufacturers, Klättermusen has to go for this supply chain in which the materials transportation is very huge. And it is also quite comfortable in working with this supply chain.

6 Results & Discussions

Based on our case study we try to collect all information against the questionnaires for the companies (see Appendix 1 & 2), discuss it with the support of our literature review and then finally we come to the results.

From the case study, we have come to understand that the companies prefer to work in smooth way. They want to avoid unnecessary risks related to supply chains by means of deep understanding among different nodes of the chain. If a company alters its supply chains even for an issue which has not tremendous impacts on supply chain means that may make its work more complicated for less or no advantages. It may take some extra efforts for the company to make its supply chain streamline and the company may also lose its credibility with its current suppliers. The transparency of the whole system may also become dubious and the suppliers may start doing some malpractices in order to retain the company for their businesses. This ultimately leads to the trust and relationship lose for the little benefits. So, the companies always try to retain their
existing supply chains even though they have the scopes to get the environmental benefits and financial advantages by adjusting the supply chain.

In general, changing or modification of supply chain involves lot of processes that can be stated below:

i. Analyze the current supply chain in terms of environmental impacts and costs involved.
ii. Find the flaws in the current supply chain like the pollution, non-value added processes, etc.
iii. Try to rectify or reduce the issues in the current supply chain itself.
iv. Find the alternate supply chain in case of unresolved problems and implement it.

Whereas, companies choose to build up a typical supply chain for a specific product considering several parameters that only fit with their business strategies to enjoy maximum flexibility and comfort in working.

The parameters can be summarized as below:

i. Source from an established market where technology is available; well established enough for a typical product and manufacturing cost should also be suitable enough for the company. This is the first point of consideration for a company during building up a supply chain.
ii. Then they go for mapping out the geographical location, transportation distances, lead time as their secondary agenda.
iii. Thirdly companies, who care for environment, work with environmental impacts related to products and disruption propensity of its supply chain.

So, when we deeply look into the supply chain and the requirements of the companies, it is not feasible to change the supply chain only because of far away geographical position of the factories and to address the unexpected demand as well. It may also create problems like lack of transparency in the system, quality issues and unnecessary delays.
6.1 Hypothesis 1:

The companies having scattered supply chain due to its own comfortability and flexibility.

The companies having scattered supply chain have various convincing reasons as mentioned above. Like in case of Einride Jacket of Klättermusen; fibre from USA, yarn spinning and fabric manufacturing from Switzerland and garments manufacturing from China, it needs specific materials for this product. If we change the materials, then the product itself completely changes.

Moreover, in case of Klättermusen, it does not have many options to choose its suppliers since its requirements are very specific and very special. It needs long staple length fibres so that it procures from USA. The spinning and weaving also require special technologies which already discussed in the result section, so it goes to Switzerland to source the fabric. Our suggestion to Klättermusen is that it can source the fibre from Turkey like Patagonia since Turkey is offering wide variety of organic cotton fibres including long staple length fibres. We cannot suggest any alternate source for yarn spinning and fabric weaving since the technological knowhow may not be possible in all other options. Since the jackets production requires some skilled labours, we cannot ignore cost benefits and simply suggest any source other than China. It is better that it can continue with the existing garments manufacturer to produce the Einride Jacket.

And in another case, for Polo Shirt, Patagonia sources fibre from Turkey; yarn spinning is being done in one factory in Thailand and knitting and garment manufacturing is being done in another factory in Thailand. It would be better, if all the suppliers are nearer to subsequent processing factory as this would reduce the environmental impacts due to transportation; time and more over save a lot of money. This ideal situation may not be possible to all the cases. Patagonia prefers Turkey for organic cotton because it offers wide variety of long staple length fibres. Moreover Patagonia has long term relationships with the farmers which give some flexibility and comfort in working. We cannot simply move the fibre sourcing from Turkey to Thailand or nearer countries in South East Asia because we do not have the organic cotton cultivation in those areas and moreover the long staple fibres not produced in those areas. From the interview with Jill Dumain we can understand that Patagonia is doing some garments manufacturing from Turkey itself. But it does only for some simple knitted products; not for the Polo Shirt or other products which have little bit more complexity regarding quality issues and more work intensive. What we can suggest
is that Patagonia can train the existing suppliers in Turkey to manufacture its Polo Shirt and it can source some other products from its Thailand suppliers. In this case, the fibre, yarn and fabric suppliers will be nearer to each other sourcing countries. This will not affect its policy much and also reduce its transportation time. Since the complete supply chain is geographically located in the same region, this will reduce the carbon footprint due to transportation considerably.

![Figure 12: Geographical position of suppliers in the supply chain of Polo Shirt (Patagonia, 2010)](image)

One more reason to work with the existing supply chain is that the labour cost per hour in Turkey is more than the labour cost per hour in Thailand. As per a report on 2003, the labour cost is more by 3 SEK in Turkey than Thailand. So, it is our assumption that Patagonia considers this factor to retain the same supply chain (Andersson, 2003).

So based on our discussion, we conclude that our hypothesis is true and the companies have scattered supply chain only for their comfortability and flexibility in working.
6.2 Hypothesis 2:

*Scattered supply chain has delimited the flexibility of companies to response the unexpected demand and reduced the resiliency of that supply chain as well.*

From the result, it shows that the responses regarding demand fluctuation from the both companies are almost in similar position. Patagonia shows response to meet unexpected demand from its customers only when it is manageable without altering its existing supply chain strategy. This is very common and regular strategic plan like to postponement; go for further production from greige fabric and just put extra push for earlier delivery. And if nothing to do within its supply chain capacity, it just leaves the matter and tries to adjust it in the next order. In other way, company is relying on its suppliers by means of its close relationships like suppliers will make room for its emergent requirements; the notion of flexibility. Previously in literature review, we have shown supply chain vulnerability can be well managed by creating flexibility in its supply chain. It has also shown that lot of tools expedite this flexibility and it works based on the level of partnerships among different partners of its chain.

For Klättermusen, to manage its unexpected demand surge from its retailers, it takes safety measures at beforehand. It uses very ordinary formula like add some extra quantities to its regular order. It is the notion of redundancy in supply chain to manage the disruptive situation and always maintain a good relationship with upstream and downstream of the value chain. Redundancy is also a quite good weapon to manage vulnerabilities in a certain scale that we have seen in literature review section.

Qualities issues in supply chains are strongly focused by both the companies and they are committed to offer best possible product to their customers. It is a perfect strategy to tackle demand drop due to losing customer confidence on a specific brand.

Though there are several options to tackle the unpredicted demand, like adding a new supplier in a supply chain, switch to nearby production, building in-house production facility etc. companies are bound to work with a scattered supply chain limiting other issues that connected to resiliency of that supply chain. This is due to the product’s special characteristics, availability of manufacturing technology and price strategies.
It is very obvious that our hypothesis is true and the companies have limited flexibilities to alter the supply chain, cannot respond immediately to the sudden demand for their products and also the resiliency of the supply chain has reduced.

### 6.3 Inter-relation between sustainability from ecological point of view and Resiliency in supply chain during demand fluctuations

![Image of Sustainability and Resiliency relationship](image)

*Figure 13: Relationship between Sustainability and Resiliency*

In order to be a supply chain continuously sustainable from ecological point of view, it should be flexible in operation during the increase and decrease of the consumers demand and the supply chain should also be resilient as well.

In normal situation, consistency in demand from the customers is mostly dependant on the customer’s confidence or trust on a particular product and it’s indisputably connected with visibility of the supply chain of that product. Today’s customers are more conscious about environmental issues and they also want to know the environmental cost of the product as well. To address the sustainability issues from environmental perspective, companies are working on carbon footprint, eco-index, and product rating system and so on to measure the environmental cost of a particular product. So, when this data regarding the environmental cost of the product will be available in a company’s supply chain, it will encourage educated purchasing decision from consumers and also try to bring consistency on demand for this product. So the fluctuations in demand will be enormously reduced and the supply chain will be resilient enough.

Conversely, if a company experiences demand fluctuations due to its wrong forecasting and if it is over forecasting in regard to actual demand, at first it will cripple the company financially. It
will increase the company’s inventory cost and bound the company to offer reduced pricing. Even then the products are not finally sold, they will be discarded. This over production will cost the environment in that sense, the energy used during manufacturing and transportation that goes in waste. It is ultimately troubling the resiliency power of the company and that in addition destroying the ecological balance of the environmental sustainability as well.

6.4 Recommendation for Future Research

1) Develop and suggest an alternate supply chain for the case study companies with reduced carbon footprint.

2) Find the technology knowhow in the yarn spinning and fabric weaving for the Enride Jacket of Klättermusen and try to find better alternate suppliers.

3) Deeper studies in environmental impacts and money involved for the scattered supply chain.

4) Develop the upgraded models to tackle the demand fluctuations.

5) Find the various combinations of supply chains suitable for western buyers in terms of reduced environmental impacts considering the quality and cost factors.
7 Conclusion

In our research work, we have tried to figure out some embryonic reasons for which the companies prefer to work with a scattered supply chain knowing its possible negative impacts to environment and disruptions. After analysing the case studies we have got an idea that companies always give preferences to the factors like technology availability, costs of production involved with the product to choose a supply chain. And they only believe to adjust in its existing supply chain, if it is possible by the force of relationships with its supply chain partners to attain sustainable and resilient approach. Moreover it is also clear to us that companies are more focused to work with environmental friendly raw materials to attain ecological sustainable approach rather than processes and transportation involved with it. Here the both case study companies have the same views as stated above and they are reluctant to do the alternation in their supply chain as it will cost their time, money and also their business risks will increase.

Our suggestions to those big companies are to do some adjustments among their different product’s supply chain that belongs to same or nearby location to each other on an experimental basis and try to provide logistics and technological support to develop its new suppliers. In the long run, this strategy will reduce the total environmental impact due to the goods movement and will help the companies to attain more flexibility in the supply chain to address the demand fluctuation of the products. This will also be time and cost effective to the companies.

8 References


Appendix

9.1 Interview with Patagonia, Inc.

An edited version of interview with Jill Dumain, Director of Environmental Analysis, Patagonia Inc.; 21st May, 2010; interviewed by David Goldsmith, Chanchal Kumar Kundu & Rajesh R through Video Conferencing (Skype).

The following questions are related to Patagonia's supply chain for their 100% organic cotton Polo Shirt.

1. What are the reasons behind sourcing fibre from Turkey (not for example the USA) and then transporting it to Thailand for spinning, knitting, cutting, and sewing?

In the early days of organic cotton, we had to go out and find cotton projects. We didn’t know who was even growing organic cotton and who was manufacturing or willing to manufacture. There was no internet. There was no email during that time. We would send faxes, out to people in China and out to people wherever. I found my ways to track try to people down. Turkey has been a grower of organic cotton in a pretty big way from the beginning as has the US. But this is where the business pressures starts to come. So, what type of fibre are you choosing for the yarn or choosing for fabric that comes in at price point and that your spinning mill might have a business relationship for getting that fibre to them. So it was really tempting early on, as we met farmers, to say to them, "Hey, we don't need any middlemen. They're just going to take a commission." But then you quickly realize as you sit in the cotton field in California with the farmers, that the farmers and we didn't know how to get the cotton to Thailand. In fact, the brokers really did play an important role.

Some of our supply chain developed very very early on in the organic cotton industry. We have a lot of loyalty to our suppliers. If they are meeting the price and meeting the quality, we don’t tend to switch a lot. The U.S. started to really decreasing the amount of cotton they were growing as compared to Turkey, which was increasing the amount they were growing, so we also have the ability to have a broader range that we chose from.

The Polo Shirt, we started as Rugby shirt in the US with organic cotton. The businesses were very different in the US as compared to Asia. In Asia they were already moving, 20 years ago, to full package deals. They would find all your trims. If you think about Polo Shirt, you have the knitted collar and knitted piece on the sleeve sometimes. They have to match; they have to be dyed together. Knitting mills in the US weren’t willing to do all the pieces. So we had to go find the fabrics, find the collar, try to get them to match, try to get them to fade evenly. So as the garment wore it didn't have this dark blue cuff in a light blue shirt, for example.

So I guess I’m giving a lot of reasons why, but at the end of the day it goes backs to balancing the environmental impact with what we need to do as a business and the quality
of our product. So we often choose factories that are going to build the best product for us from a quality standpoint, and try to fill in back from there: where is the fabric coming from, where is the best yarn coming from.

Cotton is the very very global business. Sometimes we have found with our environmental work, you can make changes in some places, but it is good to follow where business has developed in other places. So, for example, if we tried to find a knitting mill close to a cotton source in the US, because we could do it close by, locally and environmentally, we probably were going to compromise our quality. A lot of times in business you just don’t have the luxury of time to develop what would take a couple of year’s time to develop the ideal supply chain. It is not easy to move supply chains. So, as our organic cotton developed, we developed deep supply chains accordingly. Turkey, we've done a lot of production as well as buying a lot of fibre there. There have beautiful beautiful fibre out of turkey. It is long staple, and lot of it is still handpicked and it preserves the quality of the fibre unlike the US’s cotton which has been mechanically picked all along. You can get a cheaper type of fibre in Turkey like an Upland or Acala, compared to the Pima in US, but you preserve that long fibre length. So those are the some considerations that we go into and then you bring price in on top of it all. That’s the real reality that we are dealing with.

We did simultaneously lot of production of knits in Turkey as well. In our experience, Thailand was better at the more complicated knits and Turkey was better at more simple styles. We could do some of our yoga line and t-shirts and simple things in Turkey, but as you got into plackets with non-woven or woven interfacing and collars, then Thailand was doing a better job for us. And as we started bringing in mixed fibres, bringing them in for performance—were we have a lot of double knits such as where we have polyester on the inside for wicking and performance and cotton on the outside so it looks like a normal t-shirt—Thailand had more technology available to them at the time as well.

2. How do you calculate the carbon footprint—what kind of formula do you use? For example,

   a. Fibre transportation from Izmur, Turkey to Bangkok, Thailand;

   b. Transportation in Thailand for knitting;

   c. Finished goods transportation from Bangkok, Thailand to the distribution centre in Nevada, U.S.A.

We look at the energy required for whatever’s happening in each location, for example, where there’s growing of cotton, spinning of yarn, and then how much transportation energy does it take to get from the fibre to the yarn mill?

So, it’s looking at the overall usage and right now we are doing in averages because we don’t have meters for specific machinery. So, we are taking the spinning mill’s overall production per year—how many kilos they are producing, how many kilos we are using and just averaging and dividing it at this point, because we are not metering individual machines.
3. *How do you respond to an unpredicted demand for a product? Vice versa, how do you respond to lack of demand for a product?*

We try to do what we call "chase products: and if the mill has a position on greige goods, or have extra dyed and finished goods, which is usually not the case, then we might be able to chase goods within a time frame that we needed. And if we can’t, we just miss out on those sales. We order a whole bunch much the next year—in time.

That actually brings up a potentially very big issue around social issues and labour issues because as we try to chase, what pressure does that put on a factory to sew?, because there's always a sales window that needs to be met. In our Footprint Chronicles website, in the digging deeper section, there is a new video that was uploaded a few weeks ago on quality. There is really great little segment in that. A man speaking about this very topic, where it is very easy to see a story about workers who were exploited and forced to overtime. And you will really be mad at the factory manager for forcing his workers to do that. When in fact, it could very well be the designers fault who is sitting in San Francisco or Santa Barbara that made a last minute change that just shifted all the schedules in the supply chain and the end pressure is on that factory manager trying to sew.

4. *Do you work to develop new suppliers to make your supply chain more flexible?*

We have couple of challenges. One is, we are very very specific about what we want our suppliers do, and it takes a long time to get a supplier up to a level where they are working to our satisfaction. And we are often making specialized products. Again from our earlier conversation, going back all the way to our raw materials, we don’t have the luxury to be able about the switch very easily. In addition, our quantities are not that large. So, we often don’t need to talk to the factory about their capacity, because they have plenty of capacity for us. We don’t have usually large enough programs to split into more than one factory because our quantities aren’t huge. So, we are actually on a consolidation track right now of our suppliers. I think we have dropped from over eighty down to sixty five or sixty seven. We are really working very hard to consolidate, yet have enough flexibility built in all the different kinds of products that we are making but still keep it really tight and try to reduce it so that we can have these deeper longer relationships with them.

5. *You know all your organic cotton products have a higher carbon footprint than the man-made or blended fibres; do you have any plan to work on it to reduce the carbon footprint of organic cottons, and if so, how? What about recycling of organic cotton products like you are doing for polyester garments?*

Personally I don’t think consumers choose their products based on carbon foot print. We wear cotton because it is comfortable. I like cotton t-shirts and I don’t like polyester t-shirts. Even the polyester t-shirt is better for the environment, I don’t think that I’m going to choose it. I don’t think that you will wear polyester jeans because it is better for the environment than your cotton jeans. Jeans are cotton that’s what the product we know and love.
There are so many fibres and we choose it for its performance, whether it’s comfort to skin, whether it has dry ability, durability, or whatever it is. So they use they are using these products for a reason.

So, my opinion is that we have to give the consumers what they need or want. Not to their fantasy level, but basically we do what people want to use and we make it the best we can. So if all the environmental companies switch to polyester t-shirts due to better carbon footprint, then they'll always be of this guy over here selling the cotton t-shirts and doing it as badly as possible because he doesn't care anything about the environmental issues.

So, if we stay on admitting that people like cotton t-shirts, how do we make it the best cotton t-shirt we possibly can, because that’s the product people want to use. And again, if we make the perfect environmental product that doesn’t work, it’s the worst product in the world and it’s a really bad environmental product at the end because we used lot of resources on something that is not useful at the end of its production.

If you consider the environmental impact of a virgin polyester product and a recycled polyester product in terms of carbon footprint, the difference is significant, but not as significant as making it or not making it. So if you make a virgin polyester product that is going to last 10 - 15 years, versus a recycled polyester that might last only two years, you should always go with that regular (virgin) polyester.

6. Are you working on any special innovations that you can tell us about?

Well, I'm not working directly now in that area, but I can tell you that what I am working on is how we put tools in place that ensure a good environmental product, but are useful to the designers and encouraging to the designers instead of being this sort of oppressive environmental thing and you should do. Bluesign [bluesign® environmental certification] is a very good example. They have put a protocol in place that in essence is invisible to the designer, but gives the mill the tools to keep within environmental guidelines. My goal is to get these sorts of tools in place in the industry that makes environmentally responsible work interesting and encouraging.

7. What is the lead time for the production of the Polo Shirt?

Lead times for the sourcing of Polo Shirt are as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabric</td>
<td>73 days</td>
</tr>
<tr>
<td>Production</td>
<td>59 days</td>
</tr>
<tr>
<td>Transportation (ocean)</td>
<td>30 days</td>
</tr>
</tbody>
</table>

Total: 162 days
9.2 Interview with Klättermusen AB

An edited version of telephonic interview with Peter Askulv, President, Klättermusen AB; 20th May, 2010; interviewed by Rajesh R & Chanchal Kumar Kundu

Questions are related to the supply chain of Men’s Jacket (EINRIDE 100% Organic Cotton) of Klättermusen.

1. *Could you describe the supply chain (Fibre production to Distribution centre) for the above product?*

We are sourcing fibre from USA, yarn and fabric with colouring and finishing from Switzerland and garmenting in China. We have only one yarn supplier, only one fabric supplier and only one garment supplier for this product.

2. *You are using Eco-Index for your product and actually what does it mean and what are parameters of your evaluation? Do you measure the environmental impact of a product in terms of carbon footprint?*

It is very simple. When we do in eco-index, we can go into deeper. But, it’s only simple. We do it this way, that we have 10 different criteria of evaluation. Some of them are not applicable to all products. In this case, the Enride Jacket gets 1 for being made of ecological cotton, gets 1 for fluorocarbon free impregnation, 1 for bio-degradable material and so on.

[NOTE: The above product satisfies 6 criteria out of 7 criteria set by Klättermusen and each criteria carries 1 point, so the ecoINDEX for EINRIDE 100% Organic Cotton Jacket is 86% (6/7)]

- Fluorocarbon free DWR • PFOA free DWR • Natural material or non fossil carbon source, more than 70%
- Organic certified material • Biodegradable, more than 70%• 1% to the environment projects (6/7) (Klättermusen, 2010)

a. **DWR-Double Water Repellent**
b. **PFOA-** Perfluoroctanoic acid (PFOA, Molecular formula - C₈H₁₅O₂), also known as "C₈," is a synthetic chemical that does not occur naturally in the environment. It has special properties that have many important manufacturing and industrial applications.

EPA (Environmental Protection Agency) has been investigating PFOA because it:

- Is very persistent in the environment
- Is found at very low levels both in the environment and in the blood of the general U.S. population
o Remains in people for a very long time
o Causes developmental and other adverse effects in laboratory animals (*Epa.gov, 2010*)

And we don’t calculate the carbon footprint.

3. *Are you working with the recycling of organic cotton products? If yes, how and where are you doing and what is the recycled product?*

No, we are not working with the recycling of organic cotton. We are planning to set that up. We are discussing and that is the final goal that we do that.

4. *You know all your organic cotton products have a high impact on carbon footprint comparing to the man-made or blend fibres; do you have any plan to work on it to reduce the carbon footprint of organic cottons and how?*

Yes, when we calculate the carbon footprint of Cotton and Polyester, Polyester is better than the Cotton in terms of environmental friendly. In our strategy, we do both ways. We do recycle polyester fabrics and we do cotton fabrics and the final decision has to be made by the end customer. We do the best possible product in every segment. It is not possible to make Eniride Jacket completely in recycle polyester, and then it would be a different product.

5. *What is the lead time for the bulk production of this Jacket?*

Lead time is 6 months. Lead time is calculated from Greige weave to final product. We normally make a forecast that the weaver always booking some greige material above we place the final order to do the dyeing and finishing and send it out.

6. *How do you work with your supply chain in critical situations like fluctuations in demand from your customers?*

We work like this, we sell mainly to retailers. We bring the order from them and we have a tolerance. We forward it back to sale order. It is an order demand production function system. We get big orders for the production. It is not problem for us to increase the order quantity. We normally order 20% percent more than the actual order which we received.

7. *What is the strength of your supply chain?*

I don’t know the advantages, but we started like this and it works well. We have no problem with it.

8. *Why do you want to source fibre from only place, spinning and weaving in another country and sewing in China? Why don’t have them in China itself.*
In an ideal situation we should have close production, like spinning, weaving and sewing in the same place because we save a lot in transport. But the world is organized either, not quite possible. It could be possible to move some of weaving to other place. But the problem is we are buying the extremely densely woven cotton which only 2 factories in the world that can do it. We actually tried with some Asian factories but they are not able to do this product.

9. **Why are you so particular about this kind of yarn? Why can’t you change the yarn?**

It is because the yarn is made up of extremely long staple fibres and the weaving is very very tight. It is difficult production. The fabric is made up of yarns of three different strengths and they should be extremely even. It is typically difficult production and especially the weaving part. Only two factories can able to make it, one in UK and another one in Switzerland, so far I know because I’m very particular about this. Probably the weaving is quite possible in some other factories.

11. **What are the main focuses in your supply chain to ensure the on-time flow of the products?**

Our focus is of-course quality and checking and environmental issues. In this product we are working with organic cotton, carbon free impregnation, weaving and dying process as well. In other products we are working with recycling.