Crafting a Resilient and Robust Supply Chain
An Empirical Case study of Volvo CE & Kapsch

Master’s thesis within Business Administration
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Abstract

Globalized markets, resources and means of communication reshaped the modern world. Today global supply chains are more agile and vulnerable to any crises. There is a need to have appropriate measures and strategies to dismantle and mitigate effects of any small or major disasters in the supply chains. Today supply chains are both directly and indirectly under influence of crises.

The purpose is to study how companies assess and avoid risk in their supply chains and how they mitigate risks.

Two cases have been used to explore the subject. Primary face-to-face interviews have been conducted with representatives from the two companies. Further secondary documentation from the companies has been analyzed.

Managers are well aware of the risks embedded in their supply chains. They have processes to forecast and handle disruptions. Redundant resources are used in various extents to prepare for unforeseen events. To ensure uninterrupted supply different techniques such as dual-sourcing is used. Even though they see themselves as prepared companies are having problems mitigating the impact of uncertain events and these disruptions can have a big negative impact on their supply chains.
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1 Introduction

1.1 Background

Modern supply chains seem to be more vulnerable than ever. Over the last decade almost all industries have seen increased competitive pressure in the business environment and globalization of the markets. The trends towards outsourcing both locally and offshore have been increasing dramatically throughout the developed economies of the world. The conquest towards cost reduction and greater efficiencies has forced many organizations to increasingly specialize in a limited number of key areas. Leading firms have been adopting more sophisticated outsourcing strategies and have been outsourcing core processes such as manufacturing, engineering and design (McIvor, 2008). According to Aron and Singh (2005) these enterprises have been benefiting greatly from assessing the specialist capabilities of suppliers in a range of business processes. According to Wagner and Bode (2008), these changes have compelled firms to make their intra-firm business processes and inter-firm supply chains either more responsive or efficient. For example by off-shoring and outsourcing many production and R & D activities, sourcing in low cost countries collaborating and leveraging more intensively with other supply chains and by reducing inventories. They also argue that such supply chain (re)design changes and SCM initiatives have great potential to make operations leaner and more efficient in a stable environment, but they simultaneously increase the vulnerability and fragility of supply chains to any kind of external or internal disruptions. Consequently it is a relatively unstable world on one hand and highly sensitive supply chain on the other hand (Wagner & Bode, 2008).

According to Svensson (2002) supply chain vulnerability is a relatively new and unexplored area. The term supply chain can be interpreted in many ways but according to Christopher (1992) it is defined as “the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of ultimate consumer”.

Supply chain vulnerabilities are widespread, for example Ericsson lost almost 400 million Euros after their supplier’s semiconductor plant in New Mexico caught fire in 2000. Land Rover laid off 1400 workers after one of their key suppliers became bankrupt in 2001 (Lee, 2004). Most recently in Sweden, Saab has suspended their operations due to payment problems to their suppliers, which consequently jammed all suppliers supply chains of Saab cars (GÖTEBORG TT, 2011). Ford closed five plants for several days after all air traffic were suspended after September 11 in 2001 (Tang, 2006).

With the increasing emphasis on supply chain vulnerabilities, effective mathematical tools for analyzing and understanding appropriate supply chain risk management are attracting much attention. There are numerous presenting risks to consider and tackle for many global supply chain networks that can comprise hundreds of firms with several tiers of suppliers and intermediate customers (Goh, Lim & Meng, 2007). They also pointed that at present with the growing emphasis on globalization, business process outsourcing and the need of control during terroristic attack, mitigation and recovery from any kind of disaster or disruption, there is a strong incentive to understand and handle the supply chain vulnerability already mentioned in trade and academic literature.
1.2 Problem
Companies and consumers have benefitted from the increased leanness and efficiency of today's supply chains. These changes have given the consumers’ better and cheaper products and the companies’ higher profits. But it can be argued that these changes come at a price. As supply chains are becoming more complex and vulnerable to their surroundings they are also exposed to a higher risk than before. Companies are having increasing problems with disruptions in their supply chains due to the pressure to make the supply chain as lean and efficient as possible. Even small disruptions in the chain can have huge economic impact that is not in correlation with the disruptions that occur.

There is a lack of focus on these problems in the literature and therefore it’s of interest to dig deeper in to this subject and make a contribution with this thesis. It’s of particular interest to see how companies assess the risk that they are exposed to in their supply chains and how they handle disruptions. Recent literature highlighting the problem and related subjects has reviewed in the theoretical framework.

1.3 Purpose of the Study
The purpose of this study is to research how companies assess risks in today’s supply chains and also how they try to avoid the disruptions that occur in their supply chains. It is also of interested to find out how a firm mitigates both seen and unseen risks and if/how they act proactively and informed.

1.4 Research Questions
The main focus is how firms view the risks they are exposed to in their supply chains. As they are exposed to risk it’s also interesting to see what strategies they have in place to tackle these risks. Further it’s of interest to explore how firms shall secure the delivery from their suppliers.

This leads to these research questions:

- How a firm assesses risks in its supply chain?
- Which robust strategies a firm employs to design resilient supply chain?
- How to ensure uninterrupted flow from suppliers?

1.5 Delimitations
There are a few delimitations to this thesis. The companies interviewed are both Swedish but are international businesses and they are subsidiaries of larger corporate groups. The study is limited to two companies in order to get a good view of these companies and understand the problems involved in creating a resilient supply chain. The problems are related these firms and other firms and industries might be exposed to different risks. There are time limitations and the scope of the thesis have to be kept at reasonable levels for a master thesis.
2 Frame of Reference

In this section there will be a presentation of the Frame of reference, which will be used later for the analysis.

Our world is increasingly uncertain and vulnerable. Over the last 10 years we have witnessed many types of unpredictable disasters including wars, natural calamities, terrorist attacks, devaluation of currency in Asia, Tsunamis, SARS, cyber attacks, computer viruses, now recently the 2007 regression (which is not yet over in many parts of the world, and many countries asked for bailout in this chaotic turmoil). According to two studies conducted by Centre of Research and Epidemics (www.cred.com) and other by the world’s largest insurer Munich Re (www.munichre.com), historical data indicates that the total number of disasters has risen dramatically over last years. Munich Re reported that the average cost of these disasters has increased by a factor of 10 since the 1960s (Tang, 2006).

Supply chain networks are global in nature, comprising of complex interaction and flows of information, goods and funds between companies and facilities are geographically distributed across countries and continents. Supply chains are currently in operations in a variety of industries such as automotive, consumer electronics, aerospace and pharmaceutical, etc. Most manufacturing supply chains are structurally similar despite of their complexity (Viswanadham and Gaonkar, 2008).

Many operations management principles and methods such as optimization techniques like linear programming and project management have their roots in military and government related activities. According to Natarajarathinam, Capar and Narayanan (2009), the lack of supply alternatives during crises times the inventory management principles used government and military organizations are based on just-in-case philosophies. Over the last three decades, the economic emphasis on speed and efficiency has caused member of supply chains to adopt concepts like just-in-time, build-to-order and vendor management inventories instead of just-in-case philosophies of old days.

Martha and Subbakrishna (2002) argue that supply chains of today have become leaner and more profitable. At the same time supply chains have become more global, resulting in longer lead times (Natarajarathinam et al., 2009). According to Norman and Jansson (2004) the onset of business trends such as reduction in lead time, number of suppliers, inventory and product life cycle as well as the increased use of outsourcing and long global supply chains has increased risks in the supply chains and making them more vulnerable to crises. These crises not only affect the flow of goods and information but also have a huge impact on its stakeholder’s wealth (Natarajarathinam et al., 2009). Based on anecdotal observation, most supply chains tend to break down during major disruptions and many of them cannot recover afterwards.

When disasters occur, major business disruption follows. In March 2011, Japan was struck by a heavy earthquake, which not only halted many business operations, but also put many companies in big economical troubles. This crises not only cost billions of dollars to Japan economy but also sent shock waves to those supply chains which are directly or indirectly dependent upon Japanese output. BBC reported on 18th march 2011, that Nissan is likely to be hardest hit, as factory it owns in earthquake zone supplies 12 models of its engines and problems at the Nissan are likely to be spill over to Renault, because of close relationship between the two. Impact of Japan earthquake felt on the other side of ocean, as General Motors shut production plant in the US state of Louisiana because of parts shortages. Sony Ericsson anticipated disruption to its supply chain operations. BMW, Daimler Pugeot-
ot, Fiat and Volkswagen were all identified as being affected. BBC also reported, quoting an analyst that Apple may have problems sourcing parts for its iPad 2. Among the iPad parts threatened are flash memory and its upper thin battery, which is produced exclusively by Apple Japan (BBC, 2011).

Other computer makers may be hit hard by shortages of laptop batteries after Sony shut down five of its factories in Japan. Malcolm Penn, CEO of Future Horizons (research firm) said that supply shortages are likely to hit hard only in about three months. In his words,

"This will start to hit home in few weeks’ time when first shortages start to appear, and hit hard even further about three months’ time when the production that isn’t being made today should have been coming online”. Financial crises of 2007 and oil spillover in Gulf of Mexico showed how this world has been interconnected; modern world is far more complex and hyper volatile than we normally comprehend it." (BBC, 2011)

Hendrick and Singhal (2005) investigated the long-term equity risk effects and stock price effects of disruptions and found that companies suffering from supply chain disruptions experience 33-40% lower stock returns relative to their industry benchmarks over a 3 year time period. The detrimental effects of various disruptions motivated to examine ways to identify supply chain strategies that are resilient to major supply chain disruptions.

Globalization of supply chains gives us new world accompanied by a high level of complexity and increased fragility. Therefore in order to secure supply chains robust strategies need more attention to create a more resilient supply chains.

According to Tang (2006) robust strategies need to be developed that serve two fold purpose. First these strategies should be able to help an organization to reduce cost and/or improve customer service. Second the same strategies should enable an organization to sustain its operation during and after major disruptions. According to Lee (2004) most companies don’t realize that in addition to unexpected changes in supply and demand, supply chains also face near-permanent changes in the markets.

2.1 Apprehension of Risk and Uncertainty

Of hundreds of thousands of professional involved in the economical system, including the prime public institutions such as International Monetary Fund, World Bank, central banks and governmental agencies, private institutions such as large corporations, insurance companies banks and academic departments, only a few individual considered the possibility of the collapse of financial system which started in 2007 and let alone economic consequences of such breakdown. Vicious kick of this spiral put many businesses into black holes (Taleb, 2009). According to Taleb (2009) not only single official forecast turned out to be close to the outcome experienced. Approximately 1000 financial institutions have shut down in 2007 and 2008 and recorded losses up to 3.6 trillion dollars, from the underestimation of the outsize market moves. The track record of almost all forecasters is dismal (Taleb, 2010b).

Makridakis and Taleb (2009) ask the question, in business and economics who predicted the collapse of Bear Stearns, AIG, Lehman Brothers, WorldCom and Enron, Northern Rock, Parmalat and Royal Bank of Scotland or the collapse of the entire Icelandic economy. In the area of finance who predicted the demise of Amaranth and LTCM or the hundreds of mutual and hedge funds and in area of economics who predicted the internet bubble, subprime and credit crunch crises, the Asian contagion, Latin American leading ca-
lamity, the real estate, saving and loan crises and other major disasters? The unknown future is a source of anxiety, giving rise to a strong human need to predict in order to reduce or ideally eliminate its uncertainty (Makridakis & Taleb, 2009).

We don’t live in the world for conventional risk management textbook prepare us. No forecasting model predicted the impact of the current economic crises. The crises has been compounded by banks so called risk-management models which increased their exposure to risk instead of limiting it and rendered the global economic system more fragile than ever. Because of Internet and globalization, the world has become a complex system, made up of tangled web of relationships and other independent actors (Taleb, Goldstein & Spitznagel, 2009). Taleb (2007) coined a term to explain low probability and high impacts events, which are almost impossible to forecast, as Black Swan events. He also said that these events are increasingly dominating the environment. Complexity not only increases the incidence of Black Swan events but also makes forecasting even ordinary events impossible (Taleb, et al., 2009). Instead they argue that Black Swan events are almost impossible to predict therefore instead of perpetuating the illusion that we can anticipate the future, risk management should try to reduce the impact of the threats we don’t understand. Risks keeps growing where they can be seen the least (Taleb, 2010a). Consequential problems or risks have no definitive solutions. They are by their nature unknown before they emerge (Peck, 2005).

The data presented in the figure 1 need to be interpreted caution because one easy fall prey of data interpretation. When interpreting disaster data one has to take into account the inherent complexity of human vulnerabilities and disaster occurrence. Developments in telecommunication and media increased the magnitude at which the disasters are reported particularly small ones (Spence, So, & Scawthorn, 2011).

2.2 Crises and Risk in Supply Chains

Crises is defined as according to Merriam-Webster (2012a), “an unstable or crucial time or state of affairs in which a decisive change is impending especially: one with distinct possibility of a highly undesir-
able outcomes”. According to Natrajarathinam et al. (2009) crises occur in a supply chain when one or more supply chain members’ activities are interrupted, resulting in a major disruption in normal flow of goods, services and funds. The scale and magnitude of the effects of these crises are based on numerous factors. According to Coombs (1999) crisis in a supply chain is unpredictable but may not be unexpected. The process of making proactive decisions are aimed to avoid the crisis and reactive decisions to overcome the crisis is called crisis management (Natrajarathinam et al. 2009, p. 537).

International Federation of Red Cross (IFRC) classifies an event as a disaster if that event is:

“…A sudden, calamitous events that seriously disrupts the functioning of a community or a society and causes human, material and economic or environmental losses that exceeds the community’s or society’s ability to cope its own resources.” (International Federation of Red Cross and Red Crescent Societies, 2011)

In supply chain literature the sources of a crisis are commonly referred to as risks (Natrajarathinam et al., 2009). Risks that endanger an organization in a schematic way are known as circle of risks, according to Paulsson (2007).

According to Jemison (1987) risk is an elusive construct that has variety of meanings, interpretations and measurements depending upon type domain under scrutiny. Wagner and Bode (2008) write that there is an extensive body of literature concerning risk in decision theory, finance, marketing management and psychology. They also pointed that several researchers in field of supply chain also have defined supply chains risk, but also in general discussion of risk there are two distinctive meanings. On the one hand risk is seen as purely danger and on other hand risk is seen as danger and also an opportunity (Wagner & Bode, 2008). They found that most managers tend to exaggerate its “downside”. Harland, Brenchly & Walker (2003, p. 52) concluded that supply chain risk is associated with the “chance of danger, damage, loss, inquiry or any other undesired consequences”. Wagner and Bode (2008, p. 309) define supply chain disruptions as the combinations of (1) an intended, anomalous triggering event that materializes somewhere in the supply chain or its environment and (2) consequential situation which significantly threatens normal business operations of the firm in the supply chain.

Peck (2005) has developed a multi-level framework for comprehension of risks in the supply chains, in which sources and drivers of supply chain risks operate at four different levels.

These four levels of supply chain risks are:

- Level 1: value stream/product or process.
- Level 2: assets and infrastructure dependencies.
- Level 3: organizations and inter-organizational networks.
- Level 4: the environment

Though each level reflects quite different perspectives, together these levels cover elements of a supply chain and environment within which they are embedded.
2.2.1 **Level 1: Value Stream/Product or Process**

Risks are principally the commercial or financial consequences of supply chain sub-optimal performance or inefficiencies, inability to react swiftly to volatility in demand and changing needs in the marketplace. The latter is described as the market risk; also called the risk of inertia (Peck, 2005).

At level 1 supply chain vulnerability is examined from the prevailing process-engineering based supply chain management perspective. This view relates to the demand driven logistics concept and lean manufacturing (Peck, 2005). According to Geary, Childerhouse & Towill (2002) with this approach companies aim to a perfect flow of information and materials between all the supply chain partners and their work is so integrated that it is hard to see the companies within the firms as the whole supply chain can be seen as one single entity. According to Peck (2005) supply chains therefore have to be visualized as a logistics pipeline flowing through and between organizations in these network. Logistics can spell the difference between success and failure in business and management cannot measure the importance of logistics in terms of cost alone (Heskett, 1977). The supply chain is seen as logistic pipelines where focal points are efficient, value-based, design and management of processes that are related in some way to the workflows and information that flows with these. Supply chain can use one or more of these value streams (Peck, 2005).

Peck (2005) argues that the analogy of supply chain as perfect seamless logistics pipeline represents the supply chain process management ideal but it is not a full story here. In the context of supply chain vulnerability it can be highly deceptive and seductive one. By promoting the vision of controllable, stable, self-transporting flow, linear and hermetically sealed from disruptive and vicious environmental forces. In reality supply chains are discrete, self-protecting or self-propelling and rarely fixed (Peck, 2005).

2.2.2 **Level 2: Asset and Infrastructure Dependencies**

This level represent the supply chain in terms of the asset and infrastructure needed to produce and carry the materials, information and the funds across the trading partners.

At level 2, nodes are fixed commercial assets like retail outlets, distribution centers, sites or facilities and fields etc. These same sites or facilities may house IT assets, which are nodes in communications networks. These networks in turn are connected through the links and nodes of international and national communication infrastructure. Examples of these are
roads, rail and waterways, pipelines, power grids, flight paths and shipping lines. Mobile assets such as truck, train, boats and planes ply the links in transportation networks (Peck, 2005).

Physical distribution remains an essential element of effective integrated supply chain management, despite supply chain management emphasis on substitution of information for inventory and business continuity management preoccupation with IT. According to McKinnon (2004), transport interference is a big source of supply chain disruptions. In the world of Internet and connected networks, elements of infrastructure are interconnected through commercial and technological links that connects between the actors.

As an example the malfunctioning of a satellite in may 1998 cut off approximately 90% percent of all pagers (in the US) affecting emergency services and business transactions. To make matters worse these kinds of disruptions are more common and are the increasing at an accelerating rate. Therefore the resilience of a network at any stage should be assessed in terms of the effects of the loss of links, nodes and other essential operating assets (Peck, 2005).

2.2.3 Level 3: Organizations and Inter-Organization Networks

This level relates to supply chains as inter-organizational networks. It moves supply chain vulnerability up to the level of business strategy, corporate risk management and microeconomics. Nodes in these networks are organizations both public and commercial sector. These organizations both own and manage the infrastructure and assets (fixed and mobile) through which the physical goods and information flow. The links between nodes in these networks becomes relationships, particularly in form of power dependencies between firms in these networks (Peck, 2005).

Risk could arise from faulty processes and uncertainties with in an individual company, from interaction between network partners. At the organizational level risk sources include operational uncertainties such employee strikes, machine related failures, communicable diseases, raw material shortages due to diseases such as mad cow disease, quality problems and spare parts unavailability. Organizational risk could originate from research and development activities that could result in delayed product launch. Opportunistic behavior between the partners in supply chain can also play a detrimental impact on the whole value stream. Organizations are vulnerable not only to attacks on their own assets, but also on attacks on their customers, suppliers, communication lines transportation providers and other elements in their eco system. Organizations are also vulnerable to irregular behavior to their network partners such as supplier sharing sensitive product or innovative design with the competitor firm (Gaonkar & Viswanadham, 2004). Consolidations whether vertical or horizontal, can lead to further network reconfigurations and disruptions at level 2.

2.2.4 Level 4: the Environment

The final and fourth level is the wider natural and macroeconomic environment within which organizations position their assets and infrastructure. This is where companies do their business and where the value streams flow. Critical factors for consideration in this domain are the political, economic, social and technological as well as natural phenomenon, such as meteorological, geological and pathological. These variables can affect the supply and flow at each stage of the first three levels of the model. Disruptions emanating at this level are likely to be beyond the direct control of business strategist and supply chain managers. The redrawing of boundaries after the collapse of Soviet Union, consolidation and expansion of EU, rapid emergence of China as stronger locomotive of present days supply
chains, have and will to have deep impact on international trade balances. The geopolitical shift in the world have had a big impact and opened up for global sourcing and supply (Peck, 2005). The BRIC nations are predominately strong pullers in modern days supply chains (re)configurations.

According to Peck (2005) complexity and limited managerial control are facts that the supply chain managers have to accept live with, if we accept the notion of supply chain as inter-organizational networks, embedded within an environment characterized by many uncontrollable forces. It’s therefore very important to recognize that in taking action to reduce the known risks, they are changing the risk profile for that organization and for others in the network of value chain. This dynamic and ever evolving nature of supply chain risks mean no system, however well managed, is invulnerable and no supply chain strategy is ever likely to be risk free.

2.3 Strategy for Robustness

Most relevant to the business world, is the case when one needs to make decisions based on whether or not future political, social and economic events occur. For example, whether a war breaks out or not. According to Taleb and Pilpel (2004, p. 5) many thinkers believed that, where the future depends not only on the physical universe but also on human actions, there are no laws- event probabilistic laws- that determine the outcome; one is always under uncertainty. As economist and thinker Keynes says:

“By uncertain knowledge… I don’t not mean merely to distinguish what is known for certain from what is only probable. The game of roulette is not subject, is this sense, to uncertainty… The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of the copper and the rate of interest twenty years hence, or the obsolescence of a new invention… about these matters, there is no scientific basis on which to form any calculable probability whatever. We simply do not know!” (Keynes 1937: 213–214)

Supply chain performance is inherently unpredictable and chaotic; supply chain practitioners must seek a safety mechanism to protect against unforeseen events. Risks have always been present in the process of reconciling supply with demand (Viswanadham and Goankar, 2008). Viswanadham and Gaonkar (2008) proposed that in order to handle these unforeseen events in the supply chain there are two obvious approaches, and these approaches require clear understanding of the undesirable events that may take place in the supply chain and also the associated consequences and impacts from these events.

• To design chains with built in risk tolerance
• To contain the damage once the undesirable event has occurred.

2.4 Triple-A Supply Chain

One fundamental problem most companies and expert seemed to ignore: Ceteris Paribus, companies whose supply chain became more efficient and cost effective did not gain a sustainable competitive advantage over the rivals and performance of those supply chains steadily deteriorated. Efficient supply chains often become uncompetitive because they don’t not adapt to changes in the structures of the market. Efficient supply chain is necessary but its not enough to ensure that a firm will perform better than rivals (Lee, 2004). According to Lee (2004), top-performing supply chains possess three very different qualities. These qualities are as follows.
2.4.1 Fostering Agility

Great companies create supply chains that respond to unexpected and sudden changes in the markets. Agility is critical because in most industries, both supply and demand fluctuate more widely and rapidly than normality. Agility has become more important in the past few years because sudden shocks to supply chains have become frequent. In many cases agile supply chain recover quicker from sudden setbacks. For examples H&M, ZARA and Mango have become most profitable fashion brands by building agility into every link of their supply chains (Lee, 2004). The lure for size embedded in “economics of scale” and Adam Smith factories have important risk consequences that have not always been properly defined or assessed at their proper cost (Taleb & Tapiero, 2010). Multiple sourcing (flexibility) also helps in enhancing resiliency in the chain, although managing single source is more easy and efficient but in times of crises it could hinder organizational responsiveness. For example, Li & Fung largest trading company manages Global network of more than 15,000 suppliers, which helps company to hedge against the major breakdown and shift sourcing to other countries in times of distress. Therefore having an appropriate portfolio of suppliers enhances agility and robustness (Tang & Tomlin, 2008).

2.4.2 Adapting Your Supply Chain

Adaptation can be thought, but it is critical in developing a supply chain that delivers a sustainable advantages. Great firms don’t stick to the same supply network when markets or strategies change. In contrast, these firms keep adapting their supply chains so they can adjust to changing needs. Unless the organizations adapt their supply chains, they would not stay competitive for very long. Successful companies don’t stick to the same supply networks when markets or strategies change. Rather such firms keep adapting their supply chains so they can adjust to changing needs. The best supply chains identify structural shifts, sometimes before they occur by capturing the latest data, filling out noise, and tracking key patterns. Then they locate key facilities change resources of supplies and if possible outsource manufacturing (Lee, 2004). The lure for size embedded in “economics of scale” and Adam Smith factories have important risk consequences that have not always been properly defined or assessed at their proper cost (Taleb & Tapiero, 2010). Building an adaptable supply chain requires two key components, first, the ability to spot trends and capability to change supply networks and second to identify future economic, technological and social patterns (Lee, 2004). David Ricardo theory of comparative advantage recommended that for optimal efficiency, one country should specialize in designing clothes and another in manufacturing clothes and so on. Arguments like this ignore unexpected changes. What will happen if the price of wine (cloth in the previous example) collapses? Many cultures in New Mexico and Arizona vanished because they depended on few crops that could not survive changes in the environment (Taleb et al. 2009).

2.4.3 Creating the Right Alignment

Misaligned interest can cause havoc even if supply chain partners are divisions of the same organization. Cisco had to write off 2.5 billion dollars of inventory in 2001. There were many factors at play but the main culprit was the misalignment of Cisco’s interest with those of contractors. If any firm interest differs from those of the others in the supply chain, its action could cause a demise of whole value chain. Top-notch firms take care to align the interest of all the firms in their supply chains with their own. Its very critical, because every firm, be it a supplier, assembler, distributor or a retailer only maximizes its own interest (Lee, 2004).
The best supply chains are not just fast and cost effective. They are also agile and adaptable, and they ensure that all their companies interest stay aligned and it is clear that these approaches increases supply chain resiliency (Lee, 2004; Tang & Tomlin, 2008).

2.4.4 Matching Supply Chain with Products

Never has so much brain power and technology been applied to improving supply chain performance. Concepts such as efficient consumer response (ECR), accurate response, mass customization, quick response, agile manufacturing and lean manufacturing offer models for applying technology to improve performance. The first step in devising an effective supply chain strategy is therefore to consider the nature of demand for the products one company supplies. Many aspects are important for example demand predictability, product life cycle, product variety and market standards for lead times and service. The root cause of the problems plaguing many supply chain is a mismatch between type of product or service and type of supply chain (Fisher, 1997).

According to Fisher (1997), for companies to be sure that they are taking the right approach, they first must determine whether their products are innovative or functional. The next step is to decide whether their company supply chain is physically responsive or efficient to the markets. Having determined the nature of products and supply chain priorities, one can employ a matrix to formulate the ideal supply chain strategy. Innovative products require a responsive process, while Functional products require an efficient process.

Many firms have pursued the lean thinking paradigm to improve the efficiency of their business processes. However most recently the agile manufacturing paradigm has been highlighted as an alternative to and possibly an improvement on leanness. Lean manufacturing is adopted where demand is stable and agile manufacturing is adopted where demand is uncertain and very volatile. However quite recently due to customer demands of low cost and shorter delivery time, new philosophy or strategy for supply chain have developed. It’s advisable to utilize a different paradigm on either side of the material flow decoupling point to enable a total supply chain. This new philosophy or approach is termed as Leagile paradigm (Mason-Jones, Naylor & Towill 2000, p.61). The decoupling point is the material flow streams to which the customer’s order penetrates. It's here where order driven and forecast driven activities meet (Hoekstra & Romme, 1992). According to
Naylor, Naim & Berry (1997), Leagile is the combination of the lean and agile paradigm within a total supply chain strategy by positioning decoupling point so as to best suit the need for responding to a volatile demand downstream yet providing scheduling upstream from the marketplace.

![Diagram](image)

**Figure 4**: Taxonomy of selecting global supply chain strategies (Christopher, Peck & Towill, 2006, p. 9).

### 2.5 Redundancy and Robustness in the Systems

When facing a disruption an established robust supply chain strategy would enable a firm to deploy the associated contingency plan effectively and efficiently. Therefore having a robust supply chain strategy could make a firm increase their resilience. According to Tang (2006), robust strategies should possess the following properties,

- A robust strategy will help a firm to sustain its operation during major disruptions.
- A robust strategy will enable a firm to manage regular fluctuations efficiently under normal circumstances regardless of occurrence of major disruptions.

Tang (2006) proposed nine robust strategies for a resilient supply chain, and key features of these nine robust strategies are given in the following table.
These robust strategies enable companies to deploy the corresponding contingency plans when disruption occurs, these companies would become less vulnerable if they could reduce their exposure to risk. On the contrary it is very difficult to reduce the likelihood of most stochastic breakdowns, but there are several ways to reduce the impact of disruption on the supply chain operations so that these supply chain become more resilient. Tang (2006) listed three possible ways:

- **Supply alliance network**, these alliance can serve as safety net for each member who will help from other members if disruption strikes. It’s a way of hedging across the network.
- **Lead-time reduction**, a supply chain is more vulnerable to disruption when lead times are long. To reduce the risk exposure, one can shorten the lead-times by re-designing the supply chain network.
- **Recovery planning systems**, ERP systems or other types of collaborative planning system could enable supply chain to gain visibility of sales, inventories, and all logistics operations across the supply chain. Supply chain visibility would enhance the capability of the supply chain can partners to coordinate their operations in an efficient manner.

Inherent complexity of the inter-organizational supply chains network, promotes the virtues of visibility, velocity and control as key elements of risk management (Christopher & Lee, 2001). This quest of greater visibility and corresponding control improves quality and allows managers to make their supply chains more responsive and manageable, thus preventing an undesirable accumulation of slack, in the form of buffer inventory or additional safety time built into logistics lead-time (Peck, 2005). According to Demchak (1996) in lean paradigm *slack* has become *waste*. Yet slack in the form of physical resources and particularly the specialist knowledge is essential if the complex systems are to remain effective. Without slack of redundant capacity and capability supply chain struggle to cope with the unpredictable effects of consequential problems and these consequential problems have no definitive solutions, famously quoted example is *Toyota problem*, when over-optimization of
processes demise the Toyota for long, still Toyota is facing a lot of problems since then. Over specialization hampers companies evolution and most executives don’t realize that optimization makes companies vulnerable to change in the environment (Taleb et al. 2009).

Therefore it seems that slack in the system, whether in the form of inventory, capacity, capability and even time plus constant vigilance and awareness are needed if supply chains are to become and truly remain resilient. In companies redundancy consist of apparent inefficiency, idle capacities, unused parts and money that is not put to work. By having redundancies a company can be successful by preventing losses while its rival go bust and it can then take market share from them. In Chess grand masters focus on avoiding errors while rookies try to win (Peck, 2005, p. 225 & Taleb et al. 2009).

“Remember that the biggest risk lies within us; we overestimate our abilities and underestimate what can go wrong. The ancients considered hubris the greatest defect, and the gods punished it mercilessly. Look at the numbers of heroes who faced fatal retribution for their hubris: Achilles and Agamemnon died as a price for their arrogance; Xerxes failed because of his conceit when he attacked Greece; and many generals throughout the history have died for not recognizing their limits. Any corporation that doesn’t not recognize its Achilles’ heel is fated to die because of it.” (Taleb et al. 2009, p. 80)
3 Methods

In this section it will be describe how the research was conducted and executed based on methods of research.

In social science there are traditionally two different approaches to research. These are positivism and post-positivism. Positivism is when you use the evidence to create new knowledge. The researcher is collecting facts to prove his position, in the tradition of nature science (Finch, 1986). On the other side there is post-positivism in contrast to positivism in which researchers are to evaluate the experiences of people and the meaning that it has. In post-positivism you describe the reality and the social constructs rather than objective facts (Easterby-Smith, Thorpe & Lowe, 1991). Denzin & Lincoln (1994) argue that in social science there are often cases where you want to gain insight, discovery and interpretation into a problem instead of just proving and testing hypothesis. Therefore a qualitative method might be to prefer over a quantitative method.

3.1 Research Approach

In order to develop a better understanding on how companies are handling disruptions and crisis in the supply chains the author have conducted a qualitative study to get the each company’s view of the problem. The reason to choose a qualitative method over a quantitative is that there are not much data to be gathered about the subject. The subjects have not got much attention until the last couple of years, post-financial crisis. Further a qualitative approach also give a deeper insight into the problems that companies are facing during the financial crisis and most recent the natural catastrophe in Japan. Also the fast changing characteristics of modern supply chains made a strong case for a qualitative approach. The same insight would be hard to be gathered form quantitative research. In order to make an in depth analysis of each specific case, qualitative research is a good tool to use.

For the study a qualitative method have been used with an explanatory approach to describe how companies evaluate and manage risks.

3.2 Research Strategy

The qualitative research is used and the author has chosen to divide it into two separate cases for comparison. In a multiple-case study there should be a replication of the research in order to get more reliable results. This will create more confidence of the overall result. The researcher is using two or more cases as he predicts to get similar result from all the cases. When having replicable result over several cases it can be seen as a robust finding (Yin, 1993). Case studies enables one to understand the problem and gain a lot of information. This can be done in a few examples and give a great understanding of the subject (Patton, 1994). Further case studies are apt to get better understanding into organizations and their activity and especially when their processes are changing fast (Hartley, 1994).

Yin (1994) presents six different approaches to gather data for case studies; these are (fig. 7) documentation, archival records, interviews, direct observation, participant observation, and physical artifacts. According to Yin (1994) the combination of three of these approaches (triangulation) of data collation increases the reliability of the research.

The approaches used in this thesis are documentation, interviews and archival records. These different sources are chosen to increase the reliability and also the understanding of the subject.
In order to have a good sample to the study fifteen companies have been chosen that apply to the criteria’s that follows. The goal was not to interview all of these but to choose two or three from the prospected companies. The companies were selected by taking into consideration their position in the supply chain. It is important to have interview companies that are continuously managing their supply chain in order to get a deeper understanding of the problems. The companies shall continuously manage their supply chain and be medium sized or big companies. It’s important to get interviews with people with the right competence within the company in order to get the most insight from the interviews.

It ended up with two interviews with two persons with key positions having good insight into and experience from their respective companies supply chains and business.

The choice to use a smaller number of cases were deliberate as it makes it possible to have a more in depth study of the cases and is in this case more suitable.
3.4 Design of interview guide

In order to get answers of research questions an interview guide have been developed to have a structured way of conducting the interviews (Appendix 1). The interview guide was developed to answer the questions in the problem description. The questions deal with the current state of their supply chain and how they define their supply chain. Further they are asked to define risk and how their supply chain is exposed and also how they handle disruptions when they occur in the supply chain. In order to prepare the subjects to the interviews the Interview guide was sent via e-mail before interview. In addition to these questions the interview started with general questions about the company, such as numbers of employees, size of the company etc. Some additional information have also been gathered from their respective web-sited and company brochures. The interviews were semi-structured and the interviewer gave the respondents some space so answer the questions in order to give maximum input for the questions. To get the most out of the interviews the discussion were recorded for later use in the analysis.

3.5 Data collection

There are two types of data used when executing the research; these are primary and secondary data. Primary data is the data that is collected by the researcher for the specific research performed. Secondary data is the data that already exists and gathered for some other purpose. The researcher shall look into as much secondary data as possible before starting to search for primary data. Secondary data answer many questions more quickly and also at less effort to the researcher than primary data (Wrenn, Stevens, & Loudin, 2006).

3.5.1 Primary Data

Primary data is collected through questionnaire, interviews etc. (Wrenn, et al., 2006). Before the primary data was collected through interviews research of Secondary data have been conducted to get the most out of the interviews and dig deeper into the subject.

The primary data was gathered by face-to-face interviews. They were conducted on two different occasions with representatives from Kapsch Jönköping and Volvo Construction Equipment.


3.5.2 Secondary Data

Secondary data can consist of magazines, newspapers, scientific articles, agencies, the Internet etc. Wrenn et al., 2006). To gather secondary different Internet sources and material from the respective companies have been used, this also includes the annual reports from both companies.

Volvo Website (Volvo, 2011a).
Kapsch Website (Kapsch, 2011a).
3.5.3 The Interviews

To collect information for the cases two face-to-face interviews have been conducted with representative from the two companies Volvo Construction Equipment and Kapsch TrafficCom.

There are several ways to structure an interview and all have its own advantages and disadvantages. The most common way to chose the type of interview is to determine the amount of structure you want in the interview. The types range from unstructured to highly structured interviews. The interview structured can be divided into the following categories (figure 7) (Merriam, 2009):

**Highly Structured/Standardized,** in this type of interviews the questions and the orders they appear in are predetermined and the interview is highly structured (Merriam, 2009).

**Semistructured,** this kind of interview are a compromise between the structured and unstructured types of interviews. The questions are usually more open-ended than in the structured interview to allow the interviewee to elaborate more about the subject and gather more insight (Merriam, 2009).

**Unstructured/Informal,** this type of interview is used when the researchers do not have enough data to create relevant questions. The interview is structured more as a conversation than in interview. This interview type is often used early on in qualitative research (Merriam, 2009).

The type of choice for this thesis is semistructured interviews as they provide the characteristics that are apt for the research. As Merriam (2009) notes it provides a structured base in the predefined question but also allow the participant to elaborate and explore the subjects discussed during the interviews.

The open questions that characterize the semistructured interview format allow the participant to define the world according to his views. The researchers can also respond to the situation and ask follow up questions to dig deeper into the participants view of the subject and also to new ideas and topics (Merriam, 2009).
The first interview was conducted with Valter Turesson, who is the Head of Supply Chain Management at Kapsch, Jönköping. The second interview was conducted with Peter North. He holds the position of risk and capacity manager at Volvo Construction Equipment located in Braås outside Växjö. He has core competence in risk and capacity management at VCE.

### 3.6 Literature Review

To gather data for the literature a verity of sourced have been used. The author have primary used Google Scholar to search for scientific articles from a variety of sources related to the subject. In addition to this books that are relevant to the subject have been used. The Internet has been used as a source to gather resent news and additional complimenting data. The author has used search word such as supply chain, risk, mitigate, resilience, logistics etc.

### 3.7 Data Analysis

After interviews a case study analysis have been conducted of both companies separately, answering the question described in the problem description using the theoretical framework.
Towards the end there is a cross-case analysis of both companies. The author outlined similarities and differences between their respective approaches towards creating a resilient supply chain.

3.8 Validity

In the research there have been several sources used to increase the validity. Different sources that were used are interviews, documented data and archival records. For this thesis the main source are interviews with company representatives, documentation and archival records. Although the main information gathered has been form the Interviews.

Scholars have criticized case studies that are the choice of research method in this thesis; some argue that case studies are not being general enough. Some have criticized case studies as they as they are not scientific enough in their view (Johnson, 1994). On the other hand other argue that case studies get a deeper insight into the subject that is studied. This enables the researcher to gain a holistic view of a particular problem within a company (Patton, 1994). This study aim to a deeper insight into the field of research and therefore a case study approach has been chosen.

3.9 Reliability

The fact that semi-structured interviews were used raises questions about reliability. The nature of the semi-structured interview form makes it impossible to standardize. There interviewer is also exposed to possible personal bias when interpretation the answers. To minimize the bias and increase the reliability the interviews were recorder for the analysis and minimize the bias.

Although different sources have been used they have all been from representatives from the specific companies. The interviewees have answered to the questions during interviews and highlighted problems that they have. Despite this the author is aware that there might be certain bias in their answers to the questions in the interviews and also in the material from the respective companies.
4 Empirical Findings

In this chapter the data collection is presented. It includes data from the interviews with representatives from the respective companies as well as additional information from several sources such as annual reports. Each part contains a company presentation and the company case.

4.1 Volvo Construction Equipment

4.1.1 Company Introduction

Volvo CE’s products and services are offered in more than 125 countries through proprietary or independent dealerships. Customers are using Volvo machines in quarries & aggregates, energy related industries (oil & gas), heavy infrastructure, utilities, road construction, building, demolition, recycling industry, industrial material handling, and forestry industry.

Volvo CE’s product range includes wheeled and crawler excavators (diggers), articulated haulers (dumpers, dump trucks), scraper haulers, wheel loaders, pipe layers, demolition equipment, waste handlers, motor graders, pavers, compactors, milling equipment, tack distributors, road wideners, material transfer vehicles and a range of compact equipment such as mini loaders, mini excavators, backhoe loaders and skidsteer loaders.

Through our global distribution network Volvo can offer world-class after-market support with Volvo parts, service and support agreements, as well as used equipment sales and leasing. Financial offerings via Volvo Financial Services are also available through our dealers.

Manufacturing facilities are located in Sweden, Germany, France, Poland, the US, Canada, Brazil, Korea, China and India.

Volvo Construction Equipment’s rental initiative, Volvo Rents continues to develop favorably, primarily in North America and Europe (Volvo, 2011a).

4.1.2 The Case

Volvo has increased their focus on risk the group is exposed to in recent years when communicating with the stakeholders through the annual reports. In the annual report from 1999 Volvo had no separate section related to risks, recently in the 2010 financial report they have a whole section related to risk called "Risks and Uncertainties". Further the word risk (171 hits) is used more extensively through the report (Volvo, 2000, Volvo, 2011b).

According to P. North (Interview, 2011-05-20) VCE define risk as the probability of an unwanted event:

- High risk - high probability or low probability but with serious outcome

North continue to describe how VCE measure risk in 3 different areas:

- Financial risk - the probability of a supplier going bankrupt and therefore stopping deliveries.
- QDC (Quantity Delivery Cost) - risk calculated from performance of quality, delivery etc.
- Subjective risk - taking into account information not specified above such as media information, suppliers own information, gut feeling etc.
This is in contrast to the Volvo Group that defines the risk in these three areas (Volvo, 2011b):

- External-related risk - the competition and the cyclical nature of the business etc.
- Financial risk - related to the currency fluctuations, the share price and other financial instruments.
- Operational risk - this includes the relation to the suppliers, market reception of the products etc.

The three risk areas that North described (financial risk, QDC and subjective risk) are then compiled to an overall risk level. For the top risk suppliers in each area and overall level they then make a mitigation plan to mitigate known risks or prevent an event to occur if they can (e.g. helping a supplier financially to stop them from bankruptcy). This was created in the beginning of the downturn and launched February 2009. Many of VCEs suppliers went bankrupt and new partners had to be found rather quickly of parts moved to existing suppliers. The efforts made North and VCE more prepared for this with both proactive and reactive tools and processes. In the upturn this has created a capacity shortage in many areas.

“During financial downturn around 20 suppliers went bust. We had to find those suppliers before they went bust to start preparing or had to find new ones. Or help them to get out of crises. We could help them in cash flows by paying them a little bit earlier, in very some case raised the prices little to keep them in flow, because it cost more to change the suppliers, this also help in having good business relationships because went when favorable conditions come they will onboard and will help us. However majority of them went off the business, they were not key suppliers. Key suppliers also had their own troubles but they stood quite strong. Mainly it was smaller suppliers with 30-40 employees who went bust. The biggest problem in finding new supplier is time. Some suppliers need 2 to 3 years to change. They are designed into our system. To change any one of these suppliers would cost a lot time, money and other resources and luckily none of those suppliers had to be changed.” (P. North, Interview, 2011-05-20)

VCE differentiate their products into two main categories

- Standard part (even flow, used on all machines of a certain type)
- Option parts (ordered by the customer when machine is ordered) with a much more fluctuating demand.

When VCE source from Asia the lead times becomes very long, further the communication becomes harder and the risk is higher. Therefore there have to be a substantial price difference (at least 20%) to take that risk. They mitigate these risks to some extent with consignment stock (hub solution) in Europe and higher buffer levels to take up the variations in demand, but there is still a quality risk - if they would fill the supply chain with faulty parts. If that occur they have to fly parts at an extremely high cost from Asia to Europe.

“One of our supplier is located in Korea and once we found a defect in the component, when we asked them to fix it, they informed us that shipment had been dispatched and it was thousands miles far off in the sea on its route to Sweden. This cost us a lot, sometimes it becomes really difficult to have tight control on supply chain due to due to geographical and cultural remoteness.” (P. North, Interview, 2011-05-20)

VCE analyze risk in their critical supplier lists where they are evaluated. The trends are followed and a proposal for action is sent out. North describe that they have a business continuity process that includes all the tools and parameters discussed above.
VCE's supply chain is not very resilient according to North. Many suppliers will take years to change due to design reasons. They work on this aspect and the aim is that key suppliers should have a mitigation plan in place to reduce that risk (downtime). North points out that they have (partly) personnel to screen these risks.

The Volvo group has many different suppliers to their products. The internal policy is in many cases to single-source. Depending on the component this has different effects if there would be interruptions in the delivery. Some of the parts are standard for the industry and others are internally designed requiring customized tools to manufacture and will take time to replace when needed (Volvo, 2011b).

North describes the strategy for total supply chain as Leagile. They have a general demand to their suppliers to be able to change +20% within 12 weeks on total volume. North put forward that they generally have a lean philosophy though in some cases they have dual or even triple sourcing which gives us some more flexibility in case of disturbances. This is only done for parts with long lead times, in their case castings. VCE are aiming towards Just-in-time (part of VPS, Volvo Production System) but they are not there yet.

“*When we source from Europe to Asia the lead times become very longer and communication harder with bigger risks involved. Therefore there is need to be substantial savings involved (20% on price) to take that risk. It is mitigated somewhat with consignment stock (hub solution) in Europe and higher buffer levels to take up the variations in demand but we never get away from the quality risk when we fill the supply chain with faulty parts. We then have to fly parts at an extremely high cost from Asia to Europe...our strategy for total supply chain is Leagile. We have a general demand to our suppliers to be able to change +20% within 12 weeks on total volume. This is often discussed. Generally we have a lean philosophy though in some cases we have dual or even triple sourcing which gives us some more flexibility in case of disturbances. This in only done for parts with long lead times, in our case castings. We are aiming towards Just-in-time (part of VPS, Volvo Production System) but we are not there yet.”* (P. North, Interview, 2011-05-20)

North says that they don’t switch their supplier very often (not at all) but they are currently trying hard to reduce VCE:s supplier base significantly to increase business with key partners and to lower administration costs. They have a Volvo sourcing process where suppliers are chosen with regards to QDC performance and many other factors. New suppliers are always audited before approval. Right now Volvo have something called “Project 20 turns” where we are trying to increase the stock turnover (material) to 20 times/year, including in transit.

Personally North sees more of a risk than opportunity in global-sourcing. He believes the prices will even out globally over time, leading to higher landed cost for globally sourced parts. North points out that with the increased risks and communication problems the landed cost is already higher today for parts sourced from China (if you include disturbance costs and extra man hours). In times of major crisis when a Volvo AB common supplier is highly affected for example a fire the different Business areas within Volvo (Trucks, Construction, Powertrain etc.) join forces and split the responsibility of making sure all consignees get what is needed to keep the production running no matter what (Fair share process).

North see a world in which different markets react to changes on the other side of the world, which didn’t happen as much before. Business cycles are still different but getting more and more the same all over the world. VCE are now more prepared for a crisis than
they were in 2008 with a lower breakeven point, better tools and processes in purchasing to deal with supply chain issues and more flexibility in VCEs workforces. During the beginning crisis VCE did their regal forecasting but they did not believe in the drastic downturn that the figures pointed to – they instead choose to ignore them.

“Just before the onset of crisis, we forecasted high demand for our products and our suppliers also followed us and produced components according to those figures. But when crises hit the globally we were really in worse positions we did not believe in the signs of financial dooms day. Our suppliers accumulated extra piles of stock and they could not pay their bills. This was one of many reasons that many suppliers bankrupted. This shaken suppliers’ trust on us. But now we are working very closely with our suppliers to align our interest with them. We regularly share forecast with them and after every three months held an online conference with all our suppliers. So we can make them assure that these numbers are very secure and valid…our business is very sensitive to business cycles… I must say we changed CEO three years ago. He did a lot of restructuring for the organization. Due to these restructuring we become more resilient to another down turn is that we lowered the breakeven point. Currently we are in much better position than before to cope any rapid fluctuations in demand. Now we can get by with lot less machines and making lot less machines than we were before. We are making more money on the machines than we did in past.”

(P. North, Interview, 2011-05-20)

Volvo points out that the commercial vehicles industry is cyclical. The demand for their product undergoes significant changes when the world around them fluctuates. They argue that the result of the operations depend on the groups ability to adapt to these changes in demand. The most important aspects to control are the ability to adapt the production levels and operational expenses (Volvo, 2011b).

North see a big risk of a Chinese collapse (as they have too rapid growth) since they are building up more and more dependency both on the customer and supplier side in China. If China growth collapses (which it will one day, according to North) then whole world will be in black hole. Therefore VCE need to vigilant and product to foresee signs of that end.

North do not think we should always aim for no stock and no “spare” resources. He believes they should have the right amount of stock and the right amount of spare resources. He argues that this is going to be more economical in the long perspective. North points out that they do have a tool that they call Business impact assessment where different scenarios can be simulated in terms of how long they will be affected, what replacement there is and what the different costs would be in this scenario. This in turn will trigger the need to make a mitigation plan for that particular supplier.

“I don’t think we should always aim for no stock and no spare resources. I believe we should have the right amount of stock and the right amount of spare resources. This is going to be more economical in the long perspective… being lean is not always about being as lean as you can. Because being lean you need to have appropriate level of buffer, you must be clever as well. So we don’t think that over-optimization is good approach…If I was the director of purchasing, I think I would go more for security, more for dual sourcing, more for local sourcing rather than global sourcing, being more prepared for any eventualities. Of course you always are pressurized for lowering the cost, and today what we are doing and most of other companies do as well, that most of areas are sub-optimized and need work on it to make it more optimized. But this optimization or over-optimization could hurt someone else on other side. So we need to get an umbrella perspective to cover that. I would like work more across functional; of course we work today as well, but not on very large scale. Because there is so much pressure to reach the targets. At least I would try…”

(P. North, Interview, 2011-05-20)

Volvo is exposed to macro economical risks that are out of their control. The Volvo group is engaged in daily work to identify, measure and manage risk. Macro economical events are
many times out of control of the group and they are trying to minimize the consequences of such events (Volvo, 2011b).

North points out that VCE are more prepared to handle supply chain disruption now than before the economical crisis. During the Earthquake and Fukoshima disaster in Japan VCE deployed their contingency plan to minimize the disruption and North argue that these actions reduced the impact on VCEs operations. 

“I would not say that we do things perfectly, not at all, but I am certainly working towards that we should have mitigation plans for all key suppliers. No matter if they are not financially weak, there could be other reasons. We need to have a plan. For example, a supplier's factory could burn down any day, we need to be somewhat prepared for that. Because we cannot just stand there and say well it gonna two years to find a new suppliers and we cannot build machine. This is not acceptable. It is not on the map. We need to prepare when that happens. Its good if we have our plan in drawer, so we don't need to start from scratch when that happens. We are not quite yet there, because it takes hard for organization to focus on that. Right now we are really hunting for capacity. We are back on the volumes when we were on the peak.” (P. North, Interview, 2011-05-20)

4.2 Kapsch

4.2.1 Company Introduction

The company was founded within the SAAB Group in 1991. At the beginning of year 2000 the company became part of Kapsch AG, an Austrian company founded over 100 years ago with a main focus on telecom and the use of telemetric in complex transport systems such as the Nation Wide Truck Tolling System in Austria (Kapsch, 2011a).

Kapsch TrafficCom is an international supplier of innovative traffic telemetric solutions. The company develops and delivers primarily electronic toll collection systems, especially for Multi-Lane Free-Flow traffic and offers technical and commercial operation of these systems. In addition Kapsch TrafficCom offers traffic management solutions focusing on traffic safety and control, electronic access systems and parking management systems. With 250 references in 41 countries in Europe, Australia, Latin America, Middle East, Asia Pacific and in South Africa, with about 42 million on-board units (OBUs) and 17,000 equipped lanes, Kapsch TrafficCom has positioned itself as one of the world's leading suppliers in this specialized arena. Kapsch TrafficCom is headquartered in Vienna, Austria and has subsidiaries and representatives in 27 countries. Kapsch TrafficCom Sweden has its residence in Jönköping (Kapsch, 2011a).

4.2.2 The Case

The Kapsch TrafficCom Group is aware of the risks and provides a section in their annual report to these issues. Further a search in the annual report for the word “risk” result in 89 different occasions of the word (Kapsch, 2011b). Further the word “risk” is more used (9%) in the 2010 annual report compared to the annual report form 2007/2008 annual report (Kapsch, 2008).

The Kapsch TrafficCom Group operates in an ever-changing environment and risk is a part of the day-to-day business. They define risk as “The possibility of deviating from company objectives”. This is both positive and negative for them. These deviations from their objectives are positive (opportunities) and negative (risks). Kapsch continue to describe their risk management system. They do not try to avoid risk but to manage it in a
“controlled and deliberate way and to “recognize and realize” opportunities when the occur in order to make contributions to the management of the company (Kapsch, 2011b).

V. Turesson (interview, 2011-05-12) argue that Kapsch would have big risks in their business if they don’t know how to mitigate them, but so far Kapsch think that they have been doing it quite well. Any interruption or event, which could halt Kapsch’s operations, they consider as risks. There is no sharp boundary what to include and exclude when it comes to risks. It could be anything like natural disasters, as Kapsch see in Japan, and financial crises which none predicted. So risks have different means for the company, but Turesson believe that these could harm the company, but it also brings opportunities. For example in the in financial crises Kapsch were doing well. Turesson argue that they were doing even better than before the financial crisis emerged.

Kapsch product (system) has two parts, one of which is fixed on the roads (portals); it carries camera, sensors and computer and other components, and second part, (that they call) Transponder is fixed in automobiles, as in cars, trucks and busses etc. The company’s main customers are the road operators.

Kapsch sell around 30 to 40 fixed units for a project, but in terms of transponder the numbers are around to 4 million a year, and it is the demand is growing year after year. The portals demand is very stable, for example if Kapsch sell 40 portals for a project, and after the first installation it is highly possible will not sell any more portals for the project. But the demand of transponder is not dependent on the portals, and normally it rises afterwards. Therefore Kapsch are mostly focused towards risks in transponders line of delivery and it is also very important for them to mitigate any kind of risk in transponders business. That is important for Kapsch, because its transponders business from where they get their “real” income, that’s why Kapsch put more emphasis on mitigating risks in transponders delivery, because if anything goes wrong it would hit company hard.

For the transponders the company have two supplies (dual-sourcing) because it’s very sensitive to disruptions, so if something happens they get delivery from the other source. Kapsch have extra facilities for production, and extra automatic machines that assemble transponders. During normal times they don’t run them at full capacity, but in any case if one of them stops working they could shift production to other machines at use the full capacity. Kapsch always ensure to have extra capacity in their supply chain, so that they can hedge against if any supplier would have to stop production; in that case they switch to the other suppliers and utilize their redundant resources.

Turesson notes that they company always have two supply lines for each of their components. But in some critical components, which are very capital intensive they cannot afford to have two supplies, then they use other methods to ensure the uninterrupted flow of those critical components. For example Kapsch maintain extra stocks and have some special arrangements with suppliers. Turesson argues that Kapsch have very good flexibility on their suppliers’ side. But at the moment they are facing a very big problem with batteries, due to the earth quake in Japan, because the electrolyte manufacturer are mainly based in Fukushima area, which is ruined by the tsunami just some month ago. The company, which is supplying battery to Kapsch had to look for new electrolyte suppliers, they found one and they started up producing again. Kapsch lost a month of delivery. They have a second supplier for that type of battery, but in the end it had a negative impact on Kapsch supply chain. Kapsch did not loose any customer due to this delivery delay, but they lost some cash flow. Overall it did not hurt as them much. Turesson continues to explain that it took a lot of effort from them in terms of logistics planning, for example from whom new
suppliers should the company get these batteries and in how large quantity and also the terms of delivery. Kapsch believe that it was a tricky job that had to do.

Turesson argues that Kapsch don’t have any future plans for any upcoming crises, because they will always have double supply lines, if one gets affected then they switch to the other one. The supply problem with the batteries did not cause them too much worry, because Turesson argue that they are launching a new generation of their battery and they will not need these old batteries any more after about month. They had already phased out one supplier of old batteries. But when this crisis happened they started up looking for other supplier of these old generation batteries. Kapsch think they have been a bit unlucky because the Japan crisis happened when they were phasing out old generation batteries. Otherwise they argued that it would not have been hurt this much. Therefore they did not want to focus too much on this battery supply issues for any new crises management planning. For their new generation battery they have to look for new suppliers.

There are different people who analyze risks according to Turesson, and in the total system Kapsch have a dozen of people who are looking for risks in terms of failures and other technical aspects. Different department or functions analyze their own risks, for example IT take care of their field and the people at the supply chain department, try to find second source to mitigate any kind of both seen or unseen risks. According to Turesson Kapsch don’t have any central strategy or department for analyzing risks, however everyone takes care of its own area with strong wit and diligence. It is kind of gut feeling which develops after long years of practice.

This is in contrast to the annual report form the Kapsch group where they describe risk management system within the group. This is based within the financial department of Kapsch TraffiCom AG. This institutional function is being developed gradually to become a company-wide opportunity and risk management system. The goal of this is to deal with risks and to see opportunities (Kapsch, 2011b).

Kapsch have the philosophy that “we shall always have second source for our supplies”. “Of course it is costly and it cost us millions but its worthy.” (V. Turesson interview, 2011-05-12)

For supplier selection Kapsch go through the financial statement and industry references and many other things but for a completely new supplier the company first develop short-term strategic partnership.

Turesson notes that Kapsch invest a lot of money in their own optical fiber to connect their systems. There are a lot of data to send between the sites and it have to be reliable. The current systems that are available in the market are not up to the standard that Kapsch demands for their infrastructure. The use of their own optical fiber will enhance the security and they are also less dependent on other firms to deliver communications services.

Kapsch try to do most of their operations in-house and not outsource too much in order to have control.

“They mitigate risks at organizational level by having mostly operation in-house, so that if any failure arises they could identify the source easily, otherwise it is very hard to keep track from where failure originated, design department will blame production, production will blame on procurement and they will put all burdens on suppliers. So it is easy and rewarding to keep all things in tight hand, then you can say it is your fault.” (V. Turesson interview, 2011-05-12)

Turesson believes that they biggest risk in terms of suppliers is if the supplier would run out of money or go bankrupt. If one selects a poor performing supplier then one will have
a poor quality product. But usually this is not the biggest risk; one can improve the supplier quality by sending your people from the company’s team, working closely with the suppliers, helping them in improving their processes. But when a supplier goes bankrupt or fire lightens in the supplier’s factory, some thunderstorms or earthquake, then one cannot do anything for your suppliers. These are risks with at high impact, but when this happens Kapsch have contracts with their suppliers that say that certain catastrophes and interruptions that cannot be controlled by the supplier they will not have to pay any penalty for delay in deliveries.

During financial crises one of Kapsch key suppliers for transponder who do assembly for Kapsch went bankrupt. Because their supplier was not in position to make payment to their sub-suppliers, so sub-suppliers stopped the delivery of components to their supplier. Then Kapsch had to make a move and started paying to sub-suppliers for the deliveries. So their production never stopped. Kapsch supplier afterwards restructured their company and now they are back in business and they still work with them. But during this time Kapsch switched to their second source to complement production.

Turesson argue that they have both just-in-time and just-in-case mind set in their business. For example during crises they need just-in-case, and also when they get big orders, their customer don’t want to wait long for delivery. So they manage this by just-in-case approach. Therefore they ensure extra capacity in their processes both in production and inventory level.

The company is purchasing from China and it’s very difficult to manage due to long transportation time. If they fly material from china then it would cost them as much as if they produced those components here. The only way to benefit from sourcing from China is to use sea transportation. The second problem is to have control over the outsourcing to China. Once they bought some plastic component from China and they found some defects in the printing quality. When they asked the supplier to fix these quality issues, the supplier informed Kapsch that components are thousands mile out in sea and it takes eight weeks to ship from China to Sweden.

Turesson argues that global sourcing carries more risks than benefit, but it is something that you have to weigh with benefits to get the low prices. There is a balance with prices and there is need to determine what is most important to your customer either lower price or fast delivery time. Most of customers would say they want both according to Turesson. Therefore it is pretty much depend on what kind of products one are dealing with. For example road fixed portals are not critical or sensitive to prices and delivery timings, because they are not produced in large volumes. Hence cost of portals is not a big worry for them and further they produced these portals within Europe. The transponders on the other hand are very critical in cost and are very price sensitive. Therefore Kapsch have to take risks of outside sourcing to put cost low as possible. They made some efforts to reduce cost and delivery time by having assembly suppliers in eastern European countries such as Romania and Latvia. These suppliers use automatics machines to lower the costs.

Turesson describe lean philosophy as a necessity to reduce lead-times, and in the future Kapsch will see it more in practice. He continues to argue that they need to be very careful when it comes to sourcing and investing in other countries. Kapsch need to be very prudent in terms consequences of political and economic turmoil in other countries. For example in Europe there are some issue rising regarding control over mass movements across the border, particular Schengen area. Kapsch need to be very careful in screening the government actions regarding currency appreciation or depreciation, interest rate, tariff and
taxes. So they have to follow what is happening around the world, keep track of what is going on. Hence one must be prepared and not put all the risk in one country.

Kapsch don’t switch their supply side very often, for example if they develop a new product they might look for a new supply base. Turesson note that they induce competition between companies by having two suppliers; they believe that if they have one supplier they might have to raise the price with the absence of competition to pleasure the price down. By having two companies manufacturing the same component they actually get fair price according to Turesson, because if one supplier would raise the price then they will go and source form the other. Kapsch have a lot of suppliers in their supply chain, around 100 including suppliers’ suppliers and further down. Normally they keep track of their 25-30 major suppliers.

According to Turesson the company does audits of our suppliers and categorize them into different groups, like A, B and C group suppliers. They work very close to Kapsch suppliers. They do FME (Failure mode and effects analysis) simulation to analyze any possible failures in our transponders production and operations lines. Kapsch evolve both incrementally and sometime take big leaps, for example cost cutting is incremental process and completely new generation products are big leaps. Turesson notes that over-optimization could be very costly in the long run. Both the company’s suppliers and Kapsch think that they are room for improvements in their processes. Kapsch supply chain has been very flexible, because their customer requirements change all the time, so Kapsch have to continuously change to meet the customers’ demands.
5 Analysis

In this section there will be an analysis of each company in the light of the proposed frame of reference. After the individual analysis of each company there is a cross analysis or comparison between the companies.

5.1 Volvo Construction Equipment Analysis

5.1.1 Apprehension of Risk and Uncertainty

VCE defines risk as “the probability of an unwanted event with high risk with high probability or low probability but with serious outcomes”. This definition of risk is very comprehensive and carries more meaning than normal scope and limitation of risk consideration. VCE definition of risk also takes both seen and unseen risks in their value chain to make them more ready for any kind of eventualities. This definition of risk is in sharp match with Taleb (2007) definition of a Black Swan. However this also in coherence with the others definitions of risk laid by Merriam-Webster (2012b), Natrajarthiram et al. (2009), Paulsson (2007), IFRC, Wagner & Bode (2009) and Harland et al. (2003).

5.1.2 Crises and Risk in Supply Chains

VCE analyses their risk at four different levels as proposed by Peck (2005) risk analysis model. VCE supply chain has more than 800 suppliers and they work closely with many of them. In order to make sure the constant flow of materials, information and cash, they regularly conduct audits of their suppliers to check their vulnerability level. They have different supplier capacity development processes, which enhances trust level and increases collaboration between VCE and their partners in supply chain. VCE try to limit their exposure to risks associated with infrastructure dependencies of other firms. For example to carry logistics operations, VCE utilizes the services offered by Volvo logistics (a logistics company within Volvo Group). VCE also have their own warehouses, which also reduces their dependency on other firms. For only few components they utilize others’ warehouse, for example tires.

VCE have considerable control over their supply chain network. But they are also vulnerable to any ripple effect in the supply chain network. Due to global sourcing and long lead-time it is bit challenging to have tight control over the flows and others’ processes. In one example North points out the lead-time from Asia creates problems when they found defects in products that are already shipped and that cost a lot for VCE.

During financial crises risks in the VCE network were quite dispersed. None of the entity was free from any setback in its corresponding network link. Whole system was under severe threat of collapse. According to North they had problems with a number of suppliers that went bankrupt during the financial downturn. They had to find new suppliers or help them get out of crisis. They did help some suppliers financially as it would cost more to find new suppliers than to help out the existing ones.

VCE is also cautious about these kinds of network risks and have appropriate measures for mitigation. VCE measures risk in 3 different areas in their supply chain network, financial risk, QDC and subjective risks. These comprehensive levels of risk measurement cover all perspectives of organizational, inter-organizational network and outliers’ risks embedded in the environment.
VCE does not have any tool or process which could quantify impact of large macro factors such as political, economical, natural and social. However they are largely under the constant flux of them. The rapidly growing market of China, India and Brazil influenced a lot in positioning VCE’s resources in these countries.

“This is both good and bad for VCE’s facilities at Braås. Because we have high margin product and the risk I see is the location. First it is in Europe, the market is booming in Asia and secondly we don’t have hauled production in Asia, and if we start production in Asia, the high risk that this location eventually would be closed down. That is risk, because it’s more expensive to build machines here.” (P. North, Interview, 2011-05-20)

The natural calamity of Fukushima also halted operations of VCE, as the first tier supplier failed to deliver critical component. The VCE responded to this by using consignment stock solution provided by Japanese suppliers. However during this time lesser number of machines was produced.

The Volvo Group does recognize that the industry is cyclical and they need to adapt to the world around them. VCE are now able to make profit at a lower level of production than just a couple of years ago.

5.1.3 Strategy for Robustness

VCE realize that they are exposed to risks and the Volvo group and VCE have strategies to handle these risk. They work in close cooperation with their key suppliers with forecasting and they have systems to audit their suppliers. Further they have been reminded to keep up the surroundings as an effect of the resent financial crises and as an effect of this they have taken measures to be able to adapt to world around them. As VCE use single-sourcing in many cases they are exposed to the risk that supplier wont be able deliver on time (or not at all), if this happens they will be forces to halt production. VCE have designed their supply chain in order to contain the damages in the case of a disruption instead of having built in risk tolerance.

5.1.4 Triple-A Supply Chain

Lee (2004) named three qualities for a top forming supply chain. According to Lee (2004) these top performing supply chains foster agility, adaptable to surrounding business environment and creates right alignment with the partners in the supply chain. During the financial crises VCE growth declined more than what they expected and they were puzzled by vicious downward spiral of world demand. They did not believe in the forecast and that resulted in a stockpiling of components at the suppliers. This lesson made VCE to improve their operations to be more resilient and they do realize that they are sensitive to business cycles. Today they can break even with significantly less sold and produced machines than before the crisis.

From this observation the inference that VCE is moving towards for Triple-A supply chain can be made. This finding also substantiates statements made by Lee (2004), Tang & Tomlin (2008) and Taleb et al. (2009).

Multiple sourcing (flexibility) also helps in enhancing resiliency in the chain, although managing single source is more easy and efficient but in times of crises it could impede organizational responsiveness (Tang, 2008).

“We mainly use single source, this is strategy, to keep supplier base short, to reduce admin cost. We have multiple sourcing in tires and steel casting. In terms of risks, I would prefer dual source-
This observation is in sharp contrast with Tang (2008). North also accepts that

“Our supply chain is not very resilient. Many suppliers will take years to change due to design reasons. This is worked on and the aim is that key suppliers should have a mitigation plan in place to reduce that risk (downtime).” (P. North, Interview, 2011-05-20)

VCE differentiate their products into two main categories and deploys appropriate logistics and supply chain strategy corresponding to the nature of product.

• Standard part (even flow, used on all machines of a certain type)
• Option parts (ordered by the customer when machine is ordered) with a much more fluctuating demand.

When sourcing from Asia VCE needs to have a substantial financial incentive to do so, they need to be able to do substantial savings to take the risk. They do have some stocks to minimize the risk, but they can never get away with the risk of filling up the buffer with faulty parts. If that occurs they have to fly in parts at a very high cost. They have a lean philosophy but in some cases they have dual- and triple-sourcing strategies to have flexibility when disturbances occur. This is however only done in the case of parts with long lead-times.

As said by Fisher (1997) the root cause of the problems plaguing many supply chain is a mismatch between type of product or service and type of supply chain. VCE successfully matched the DNA of their supply chain with their products after the crises now they hunting for extra capacity to meet the alluring demand. This is also proposed by (Christopher, Peck & Towill, 2006). These observations validate statements made by Fisher (1997), Mason-Jones et al. (2000), Hoekstra & Romme, (1992), Naylor et al. (1997) and Christopher et al. (2006).

5.1.5 Redundancy and Robustness in the Systems

Thanks to the restructuring and the lesson learned during the last crises VCE supply chain strategy enabled them to absorb shocks sent to their operations by earthquakes and Fukushima disaster in Japan. VCE did to some extent effectively deploy the contingency plans to mitigate risk of first tier supplier’s production breakdown. These findings also substantiated by Tang (2006) that a robust strategy will help a firm to sustain its operation during major disruptions and it will enable a firm to manage regular fluctuations efficiently under normal circumstances regardless of occurrence of major disruptions. VCE is aiming to have mitigation plans for all major suppliers. VCE need to have plans not only for financial risks but also other risks such as if a supplier’s factory is burning down. It will take two years to find a new supplier and that is not an option to VCE. They are working to be prepared for these kinds of risks.

According to Demchak (1996) in lean slack has become waste, but in case of VCE the author observed that VCE do not aim to minimize stock and spare resources. They want to have the right amount of stock and spare resources. P. North (Interview, 2011-05-20) believes that there is an overexposure of risk in single-sourcing and global sourcing strategies pursued by VCE. He continues to argue that going for more dual- and local sourcing to lower the exposure to risk. He believes that there have to be an umbrella perspective of
the organization, cutting cost in one place might hurt someone in the supply chain, there needs to work more across functions.

This observation validates the statements made by (Peck, 2005, p. 225 & Taleb et al. 2010) that slack in the system, whether in the form of inventory, capacity, capability and even time plus constant vigilance and awareness are needed if supply chains are to become and truly remain resilient. In companies redundancy consist of apparent inefficiency, idle capacities, unused parts and money that is not put to work. By having redundancies a company can be successful by preventing losses while its rival go bust and it can then take market share from them. In Chess grand masters focus on avoiding errors while rookies try to win.

5.2 Kapsch Analysis

5.2.1 Apprehension of Risk and Uncertainty

Kapsch considers and defines risks in its broad meaning and take a system wise holistic approach when it comes to mitigation of those both seen and unseen risks. They define risks as “any interruption, which could halt our operations, we consider as risk”. This defines of risks is in coherence with the others definitions of risks laid by Merriam-Webster (2012b), Natraja-rarthinam et al. (2009), Paulsson (2007), International Federation of Red Cross and Red Crescent Societies (2011), Wagner & Bode (2009) and Harland et al. (2003).

5.2.2 Crises and Risk in Supply Chains

Kapsch analyze its risks at four different levels as proposed by Peck (2005). At first level, the Kapsch considers that their supply chain is comprised on many players. These players integrate themselves through the flow of information and materials and cash. Any interruption at any point of this pipeline of supply chain would destroy the created value for the customers. Kapsch makes sure that all the players stay synchronized with the value chain stream.

Kapsch avoids risks, which are associated or hidden with utilizing assets and infrastructure of other firms (level two). They do this by investing largely in their own capability and capacity enhancement program. For example they have their own optical fiber to transfer data within the Kapsch larger system and maintain tight vigilance over cyber threats. They say that although it cost them very much but on other hand they reduce their dependency on other firms.

Kapsch try to have strong control on both organizational and inter-organizational networks (level three) but they are not free from the dangers, which arise from the embedded firms in their network. Kapsch keeps track of its suppliers’ performance and perform regular audits.

However Kapsch is also vulnerable to inefficiencies, which arise due to global sourcing, which causes long lead-time, and give very narrow margin to fix those problems. Kapsch rigorously perform analysis regarding possibility of their suppliers’ bankruptcy. Sometimes they mitigate this risk by giving credit to their suppliers for short who is on the verge of bankruptcy, to get them back into operations. Parallel to this they maintain their dual sourcing strategy, which equips Kapsch with great ability of maneuver during any uncertain outcome in the value chain. Hence hedges Kapsch from any possible nightmare.

"During natural calamity like earthquakes, thunder storms, fire in factory due to lightening, these are things which are cannot do anything. You have to live with them, because there is no quick fix recipe” (V. Turesson interview, 2011-05-12)
The Fukushima crises hit Kapsch slightly, when they run out of supply of batteries. Although Kapsch recovered from it quickly and quite well, due to Kapsch dual sourcing philosophy and management regarding logistics issue in this crisis. According to Turesson, “We continuously monitor and flow the events happening on other side of world. One should be very cautious and regularly flow the news, like tight border control, increase in taxes and tariffs or anything happening in country of sourcing.” (V. Turesson interview, 2011-05-12). Besides these four level, each function/department scrutinize risks in their own area of concern, for example IT, design, production and logistics & procurement, each takes care of their own area and make appropriate strategy on individual basis. This can make Kapsch as a company stronger, when individual entities are more observant and responsible for their result.

5.2.3 Strategy for Robustness

In a world full of risks and opportunities, Kapsch secured their supply chain with the strategy of dual sourcing and also by having redundant capacity and capability in their supply chain. For example during financial crises when profits of most of the companies were squeezing, Kapsch was able to make more money than before. They utilized their redundant resources more strategically while having long-term perspective for the firm. In this way they have been quite successful in designing a supply chain with built in risk tolerance, and have enough resources to mitigate aftershocks of any unpleasant event as proposed by Viswanadham and Gaonkar (2008) and Taleb and Pilpel (2004).

5.2.4 Triple-A Supply Chain

Lee (2004) named three qualities for a top forming supply chain. According to Lee (2004) these top performing supply chains foster agility, adaptable to surrounding business environment and creates right alignment with the partners in the supply chain. The author also observed that Kapsch to a very large extent possess these qualities of a triple-A supply chain. They foster agility in their transponders line of operation, which requires shorter lead-time and continuously cost reduction. Agility has become more critical in the past few years because sudden shocks to supply chains have become more frequent. Kapsch transponders are vulnerable to acute disruptions in the supply chain. Therefore they promoted agility in each link of their supply chain. They accomplished this by multiple sourcing which enhanced resiliency in their chain. According to Turesson, “Managing a single source is more easy and efficient but in times of crises it could impede organizational responsiveness.” (V. Turesson interview, 2011-05-12). Kapsch have long list of suppliers due its dual-sourcing approach, and having enough buffer and portfolio of suppliers enhance flexibility, resiliency and robustness (Tang, 2008).

According to Lee (2004), continuous adaptation is critical in developing a supply chain that delivers a sustainable competitive advantage. Great firms keep adapting their supply network when markets and strategies change. Kapsch dynamically adapts to changing needs of the market. But they seldom switch their suppliers’ base. They only switch when they are going to develop new generation product. But most of the time they work collaboratively with already existing supplier in their supply chain. They spot modern trends along side with their suppliers and develop their resources mutually for long-term relationships. Kapsch supply chain adapts as whole to the new markets needs and challenges. This validated by Lee (2004) that unless the organizations adapt their supply chains, they would not stay competitive for very long.

Kapsch has been very successful in aligning its interest with those of suppliers. Kapsch also induced dual-sourcing strategy into its suppliers to make them more flexible and resilient
against any setback. For example when one of their key supplier had financial troubles they gave them monetary help. Hence enabled its supplier to make payment to its sub-suppliers, and got them back in business. This is vindicated by Lee (2004) and Tang & Tomlin (2008), that best supply chain are not just fast and cost effective but they are agile and adaptable and they also make it sure that interest of all companies in the chain stay aligned. This approach increases supply chain resiliency, which holds true for the observations regarding Kapsch.

Kapsch designed their supply chain based on the nature of their products. For portals they employs lean and efficient supply chain strategy, as the demand of these portals is very stable and not sensitive to prices. Portals come in-between innovative and functional products. Whereas transponders are innovative products, and Kapsch regularly launch new generations of the product. The demand for the transponder is very sensitive to prices. Most of the supplier customers want low cost and short delivery time for the transponders. In response Kapsch exploit global opportunities of sourcing into low cost country (LCC) such as sourcing from China and having assembly unit in eastern European countries. Kapsch adopted leagile supply chain strategy for transponders to keep cost low and respond quickly to customers’ orders. As said by Fisher (1997) the root cause of the problems plaguing many supply chain is a mismatch between type of product or service and the type of supply chain. Kapsch successfully matched the DNA of their of supply chain with their products. This is also proposed by Christopher, Peck & Towill (2006).

5.2.5 Redundancy and Robustness in the Systems

Kapsch supply chain strategy enabled them to sustain their operation during major disruptions, for example during Fukushima earthquake and financial crises; Kapsch deployed the contingency plan effectively and efficiently. These findings also substantiated by Tang (2006) that robust strategy will help a firm to sustain its operation during major disruptions and it will enable a firm to manage regular fluctuations efficiently under normal circumstances regardless of occurrence of major disruptions.

As said by Demchak (1996) that in lean paradigm slack has become waste. But in case of Kapsch they ensure redundant resources at every link of supply by having multi-sourcing for their suppliers and as well as sub-suppliers. They have both just-in-case and just-in-time philosophies in practice. Kapsch has redundant resources in form of extra stock, extra machines and premises. They have vigilant and prudent people who diligently monitor any risk in the chain. This is observation validated by (Peck, 2005, & Taleb et al., 2009) that slack in the system, whether in the form of inventory, capacity, capability and even time plus constant vigilance and awareness are needed if supply chains are to become and truly remain resilient. In companies redundancy consist of apparent inefficiency, idle capacities, unused parts and monetary resources that is not put to work. By having redundancies a company can be successful by preventing losses while its rival go bankrupt and it can then take market share from them. In Chess grand masters focus on avoiding errors while rookies try to win. As said by Turesson, “although having two sources of supply cost us little more but it is worthy to have both than having nothing during major breakdown. It is bit tricky game, but it is good one.” (V. Turesson interview, 2011-05-12).

5.3 Comparison

It is hard to make comparison between the VCE and Kapsch due to sheer difference between the scope and nature of their operations. However it is possible to draw some inferences from the observations about their businesses.
There are certain similarities in the supply chain strategy of both firms, however there are profound differences as well. Unpreparedness of the VCE during the crises cost them a lot, while Kapsch enjoyed greater flexibility and maneuverability and pocketed good fortune. The extent to which the firms foresee future crises has increased after the crisis. Today both are struggling to have mitigation plans for any kind eventualities that might disrupt the supply chain, although Kapsch acted proactively to a larger extent than VCE before the crisis. Both firms provided financial assistance to financial weak suppliers who were on the verge of bankruptcy. Major restructuring has been made in VCE the recent years, which made them more resistant and adaptable to sudden fluctuations in demand. Currently VCE is back in business and are producing at pre-crisis level and now they are searching for extra capacity. The danger could be that it is easy to get blinded by the speed and volume and not see the signs if the demands go down again. Both firms fairly well understood the possibility of suppliers’ bankruptcy and are working hard to audits suppliers and have hence launched supplier capacity development program to make them more prepared for any major disruption. The firms rigorously use their own internally developed models and processes to assess the vulnerability of their suppliers. Both companies have low level of dependencies on others firms infrastructure. Kapsch has its own optical fiber to secure its communication lines, while VCE uses the services of Volvo logistics to perform and synchronize its logistics flows. During the crisis VCE was struggling with low demand and it created a lot of turbulence affecting the supply chain, but they have now returned back to pre-crisis production levels. Whereas Kapsch enjoyed good time when other businesses were going down and short-listing employees.

Both firms see risks of global-sourcing in terms of long lead-time, high transportation cost, weak control over the quality and flow of materials. But they also believe that global opportunity of business lies on the side of European continent. The firms agree that one need to be careful and vigilant in mapping opportunities and danger in these emerging markets of China, India and Brazil, because it is really hard to predict any storm when sea is calm. Both believe that supply chain has become more vulnerable than ever before to any small disruption. Now supply chains are more exposed to the dangers, which are hard to quantify due to their unknown nature and second they are spread out around the globe. Financial crises encouraged VCE to see the need of resiliency in their supply chain operations. But the danger for VCE is that now they are producing large volume of machines, they could suffer from time and attention deficit thus ignoring any new signs immersed in large volume production. But for Kapsch things are different, they have more stable supply chain, high shocks absorption capacity and ability to recoil in more strategic ways.

VCE has a single-source strategy, but in few cases they use double-sourcing, it seems that are now they are well aware of risks embedded in single-sourcing strategy. VCE also had a flaw in their forecasting process, they did not believe in looming signs, hinting about the future ahead. Initially VCE failed to foster agility in its supply chain due to extreme fluctuations in demand and could not adapt to rapidly changed business situation and misalignment in the interests reported when piles of stocks accumulated at the suppliers premises. The suppliers produced according to VCE forecasted number, which later on proved disastrous for the whole supply chain. Whereas Kapsch not only fostered agility in its supply chain but successfully adapted to new business situation and aligned its interest with those of suppliers and sub-suppliers as well.

Both firms are aiming towards Just-in-Time, but Kapsch also have embedded philosophy of Just-in-Case in their supply chain culture. Both firms have agile supply chain strategy. Kapsch play FMEA scenarios to see impact of any possible failure or defects in the system.
VCE also creates different scenarios to understand and learn any eventuality, so they could respond proactively. VCE are trying to cut the suppliers base to reduce complexity and administration cost. They believe that dealing with strong but less number of suppliers is more efficient.

Kapsch views that having redundant resources in the supply chain is very important and effective in these highly vulnerable business cycles, although the cost is a bit high, but it secures the supply chain effectiveness and efficiency during any setback. VCE also came to the same conclusion regarding having extra capacity or slack in the systems, but they are at early stages of distilling this philosophy into their organization. However VCE is very well aware of risks embedded in optimization/over-optimization of the supply chain process, because it impedes the organizational responsiveness. VCE has mostly has a single-source strategy, but it seems that are now they are well aware of risks embedded in single-sourcing strategy.
6 Conclusion

Both VCE and Kapsch show the challenges that are present in todays supply chains. There have been both commonalities and distinct differences. The empirical findings gained some valuable insight that follows.

Apprehension of Risk and Uncertainty, the firms are aware of the risks that the supply chain is exposed to. After the crisis they have become more aware of it as it’s in recent memory.

Crisis and Risk in Supply Chains. Infrastructure are important to companies and they try to secure they flow to lower the risks. This is related to logistic infrastructure, IT infrastructure and possibly other types of infrastructure. The inter-organizational networks are of great importance to control. Facilitating communication and benchmarking suppliers is crucial in order to manage the supply chains. Macro factors possess a threat to organizations as they have little possibility to predict them. They are rather in a constant flux of them and little effort is put to predict or quantify them.

Strategy for Robustness. Different strategies are used by firms to become more robust. One is to facilitate the communication with the suppliers in order to mitigate problem, the strategy that VCE uses. They try to contain the damages once they occur rather then the strategy to use redundant resources, such as dual- and multi-sourcing and stockpile supplies that is used extensively Kapsch.

Triple-A Supply Chain. VCE had some problems adapting to the situation when the crisis hit. But they believe that they are much more prepared and Agile today after the restructuring and are more able to adapt to the current market climate today that a few years back. The companies do not change suppliers often; they keep the current suppliers that they have relation with. They rather seek new suppliers when they develop new products and services. The conclusion is that some level of agility is important to the companies to keep up with the changing market and competition.

Redundancy and Robustness in the Systems. Kapsch has redundant resources in machine stocks and premises and every link in the supply chain use multi-sourcing for their suppliers. In contrast VCE uses mitigation plans for their major suppliers. The companies were able to handle the Fukushima disaster rather well. VCE thanks to the newly learned lesson from the financial crisis, they deployed their contingency plan. Kapsch used their dual-sourcing strategy to reallocates some production. Despite this single-sourcing strategies are more exposed to risks than multi-sourcing strategies. If a suppliers facility for example burn down they have nothing to fall back to and it might take years to come back to the levels of production before the disaster. With a multi-sourcing strategy there would be an option to move the production to other suppliers with less disruption to the supply chain.

Financial crises justified Kapsch philosophy of multi-sourcing, highly flexible suppliers base and redundant resources in crafting supply chain more resilient and robust. The crisis also confuted that being just lean is the only way for supply chains to survive. It requires more than just being lean to even survive and stay ahead. Multi-sourcing (flexibility) and redundant resources in a supply chain increase its shocks absorption capacity and enhance its effectiveness to stay resilient under any eventuality. This also demands good management from the organizations leaders to get prepare for both seen and unseen risks.

Looking at the research question put forward in the beginning of this thesis the following conclusion has been drawn.
How a Firm Assesses Risks in its Supply Chain?

The firms are well aware of the risks that they are exposed to and are present in their mindset. They have frameworks to evaluate the risks and how to tackle and hedge these risks. The frameworks stretch from the tangible risks that the firm has control of to macro factors that they have little possibility to influence but have to be aware of and react to. For example tangible risks can be quality, lead-time (sourcing from Asia) etc. and macro factors can be natural disasters, political tumult, strikes etc. Many supply chains are more fragile today as they source from suppliers far away, mainly due to cost issues and that have forced companies to be more vigilant to the risks that they are exposed to. The risks are ever present and the companies are aware of them and they are taking measure to mitigate them.

Which Robust Strategies a Firm Employs to Design Resilient Supply chain?

There are different strategies used to make the supply chain more robust. On one hand dual- and multi-sourcing is used to ensure supply of components. Having different sources for supply greatly lower the risk level the supply chain is exposed to. On the other hand, in many cases companies do not see multi-sourcing as a viable alternative mainly due to cost and management issues. Single-sourcing is in many cases more risky and a number of strategies are used to manage the risks such as collaboration with the suppliers, using forecasting and stockpiling components. Local-sourcing and agility is also seen as a way to avoid risk of long lead times and secure supply.

How to Ensure Uninterrupted Flow From Suppliers?

There are many strategies to ensure uninterrupted flow from suppliers, dual- and multi-sourcing, more local-sourcing and stockpiling are strategies to make a supply chain more robust. Also it is useful to fostering a more agile supply chain to adapt to changing demand both in product range and volume. The respondents did not use all these strategies but they agreed that there was a need to foster more robust strategies to secure the flow in they supply chain.

This thesis has contributes two major theoretical contributions. Firstly it describes how companies view the challenges that are related to supply and demand in their supply chain. Even if they do not know when disruptions and changes will occur they know that they will be exposed to them at some point. Further it shows how companies are handling these challenges and try to adapt to the changes in the supply chains. They do adapt to the changes but the question is how fast they are able to adapt. The organizations need to be flexible enough and have the resources available to absorb the shocks of the disruptions.

Managers in modern organizations have to be vigilant to changes in supply and demand. As the disruptions are hard to predict they need to act quickly to any problem. Companies need to have processes to forecast problems as soon as possible to minimize the impact of these. There also has to be processes in place to deal with these disruptions in appropriate ways. Managers need to understand that there is a need to allocated resources to handle problems when they occur in order to minimize disruptions in the supply, even as it might not seem as the most efficient choice at the monument. But over optimization can lead to lack of resources when there is a need to deal with disruptions in the future.

In the end companies are well aware of the risk they are exposed to in day-to-day business. They have strategies to ensure parts for suppliers, even though they are different from
company to company. In order to survive in the competition they agree that they have been alert in order to avoid and mitigate disruptions.
7 Discussion

More and more disasters are being reported (note that it is reported and not an increase actual disasters but rather a indication of a more fragile society) in the world and companies are getting more and more exposed to disruptions.

With this in mind supply chain is more vulnerable today than ever due to fast changes in the environment. Despite this firms to some extent seem to ignore the risks that are present. For example natural disasters cannot be predicted in the short term some areas are more exposed than other. The author believe that that the risk for many disasters can be quantized in the long term as it can be predicted how often these disasters occur in many cases and especially in the resent earthquake and tsunami in Japan.

Companies need better tools and processes to deal with the risks and calculate the financial risk they are exposed to. When a delivery is delayed or faulty for some reason it will cause ripple in the supply chain that will not just hit the focal company but many companies in the chain. The management in many companies is focusing on cutbacks and financial goals that are pushed down in the organization. This will force managers to source components with a main focus on price and that will often expose the supply chain to a higher risk, that are in many cases not apparent and often not even recognized. It is the authors beliefs that the world is becoming ever more complex and it will continue to challenge companies and the risks need to be managed and mitigated in a better way than many companies are doing it today. They should also look carefully when going for sourcing into other parts of the world. There is a need for broader integration and collaboration among all the partners across the supply chain, focal firm, suppliers and sub suppliers. Continuous screening and auditing of suppliers is very important, because even if a supplier fails the whole system would have to bear the burden of that failure. Many firms have launched the supplier development tools and processes to enable and prepared them well for any mishap.

Financial analysis also proved a good opportunity for VCE because it tested the VCE strength and weakness and exposed the weaker area of the organization. VCE also took this challenge as opportunity and crafted a success out of it, by performing major restructuring both inside and outside of the organizational boundaries.
8 Further Research

When starting the thesis process it was hard find enough literature in the field of risks management in supply chain after the financial crises. This crisis put as strain on companies supply chains and forced them to see the strengths and weakness of their supply chain strategy.

The current paradigm of lean and agile supply chains needs to be scrutinized further in order to see the weaknesses of them and how to tackle them. There are inherent challenges that need to be tackled and explored further in these strategies.

In the course of research the author tried to use the current literature, which touched the modern risk management approaches for supply chains. There is big field available to study the supply chain strategy and effective risk management approaches for post crises world of supply chains. Questions interesting to research could be why and how some firms remain more resistant during the crises and why other disappeared. Which new kinds of risk management and mitigation strategy have been proposed and which have become outdated?
List of references


Taleb, N. N. (2010a). Convexity, Robustness and Model Error inside the "Black Swan Domain".


Appendix 1: Interview Guide

1. How do you define risks?

2. How do you measure risks in your supply chain, and how did you respond to the last financial crises, did it cause any damage to your supply chain operations, both in short term and long term perspective?

3. How do you see the global cyber security threats?

4. How vulnerable is your supply chain network, both upstream and downstream?

5. How do analyze risks? Do you have any mechanism for risk management?

6. Do you use any model or framework?

7. How do you characterize your supply chain, is it resilient to major disruptions? Like if key supplier or customer switch? How would you tackle that situation? Do you have any contingency mechanism or personnel responsible for screening up coming crises?

8. What kind of supply chain do you have or that you are a part of? Lean, Agile or Leagile?

9. To what extent you foster flexibility in your operations?

10. Do you have redundant resources in your value stream in terms of financial capital, physical and human resource or you prefer lean philosophy?

11. Which type of supply chain are you aiming at? Just-in-Time or Just-in-Case?

12. How often you switch your network of suppliers, to keep company open to new resources and opportunities?

13. How do you select suppliers? Do you have any supplier selection process or model?

14. Do you see global outsourcing a threat or opportunity? Is it more opportunity than threat or vice versa?

15. Any story you would like to share that is worth to remember in company’s culture, in terms of dealing with crises?

16. Do you see the modern world is ever agile than before? Do you see any upcoming crises? And are you prepared for that?

17. How do you see the over-optimization of business processes or supply chains, hence leaving very little space for any kind error or mistake?

18. Have you ever created a simulated scenario, in which you major customer go bankrupt or stop its production process? What kind of impact it will have on your company’s future?