
Supply chain management

How companies are securing their supply chain during crisis situations?



Ylemmän ammattikorkeakoulututkinnon opinnäytetyö

Teknologiaosaamisen johtaminen

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Työn nimi Supply chain management
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Teknologiaosaamisen johtamisen koulutusohjelma

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TIIVISTELMÄ

Taloudellinen tilanne on ollut globaaleille yrityksille haastava jo vuosia. Lisäksi on ollut mullistavia luonnon katastrofeja joilla on ollut vaikutusta globaalin teollisuuden toimintaan ja näkynyt muunmuassa materiaalien saatavuus ongelmina. Näin ollen toimitusketjun riskinhallinta on noussut yhä tärkeämpään rooliin jossa tunnistetaan, arvioidaan, hallitaan ja tiedoitetaan toimitusketjussa olevista riskeistä ja niiden vaikutuksista niin aikaisin kuin mahdollista, jotta tuotannon jatkuvuus on taattu.

Työn tarkoituksena on tutkia kuinka eri yritykset varmistavat tuotannon jatkuvuuden ja materiaalin saatavuuden erillaisissa kriisitilanteissa.

Tutkimus perustuu ensisijaisesti toimitusketjun- ja riskienhallinta teoriaan, joka on pohjana haastatteluille, jotka tehtiin globaaleilla markkinoilla toimiville yrityksille. Yrityksiä ei rajattu mihinkään tiettyyn kategoriaan, vaan pyrittiin saamaan mahdollisimman laaja-alainen näkymä.

Tutkimus toteutettiin puolistrukturoituna teemahaastatteluna, jossa aiheet olivat jaettu kahteen kategoriaan, yrityksen oman tuotannon varmistamiseen sekä toimittajien tuotannon varmistamiseen.

Tuotannon varmistamisen ja materiaalin saatavuuden tasoissa on selviä eroja eri yritysten välillä. Mutta kuitenkin vain muutamissa yrityksissä oli selviä haasteita ymmärtää kuinka tätä tulisi tehdä ja mitä se käytännössä tarkoittaa.

Information Technology eli tietotekniikan varmistaminen oli monessa yrityksessä jätetty tyystin alihankkijan vastuulle ja sopimus tasolle. Tämä IT systeemi on aivan liian vähän otettu huomioon keskeytys riskeistä puhuttaessa, sillä näinä epävarmoina aikoina kun taloudelliset paineet ovat kovat ja kaikki toiminta perustuu tietoliikenteeseen ja tietokoneissa olevien tietojen hyödyntämiseen tulisi IT systeemin vaikutukset toimitusketjuun ottaa paremmin huomioon. Tämä on alue johon monen yrityksen tulisi erityisesti keskittyä. Sillä jo muutaman päivän keskeytys tai tärkeän tiedon menetys voi aiheuttaa mittavia vahinkoja ja kustannuksia yritykselle.

Avainsanat Riskienhallinta, Toimitusketjut, Jatkuvuudenhallinta, Vaikutusanalyysi**Sivut** 76 s. + liitteet ovat luottamukselliset.

VISAMÄKI

Teknologiaosaamisen johtamisen koulutusohjelma

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ABSTRACT

The economic environment has been challenging for global companies for many years. In addition to this, there has been large natural disaster such as the tsunami in Japan, flooding in Thailand and Iceland volcanic eruption. All of these things have contributed to the global industry, especially for the availability of raw materials or components. Thus, to identify, assess, manage risks and to inform their effects as early as possible has become increasingly important in risk management.

The aim of this research was to examine how different companies ensure the continuity of production and the availability of the material in case of crisis situations.

The study is primary based on the theory and secondly on interviews that were made to companies which are functioning in a global environment. The interviewed companies are not restricted to any particular category.

The study was conducted with semi-structured theme interviews. Subject of the study was divided into two categories; how to ensure own production, as well as how to ensure supplier's production in supply chain from risk management point of view.

There are clear differences between companies in ensuring of production and availability of the material levels. However, each company chooses its own risk management level. Only, in a few companies there were clear challenges to understand how this should be done and what it means in practice.

In general, companies didn't take enough notice of vulnerability of their IT-systems. In many cases managing the IT-systems was outsourced and the company itself didn't know how IT systems are ensured. However, all the business actions are based on availability of the IT-systems and utilizing of data. Due to a few days of interruption or loss of data can cause substantial losses and costs to company. This would be an area where many companies should particularly focus at.

Keywords Risk management, Supply chain, Business continuity management.**Pages** 76 p. + appendices have confidential.

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DEFINITION

BCM	Business Continuity Management
BIA	Business Impact Analysis
BIS	Business Impact Scoring
COT	Complete On Time
IT	Information Technology
OTD	On Time Delivery
RA	Risk Assessment
RM	Risk Management
RPO	Recovery Point Objective
RTO	Recovery Time Objective
SCM	Supply Chain Management
SCRM	Supply Chain Risk Management

1 INTRODUCTION

All business activity involves a lot of risks. The most common and the most widely spoken corporate risk is the financial risk - how well the business is doing? However, there are plenty of other risks that endanger this economic side, directly or indirectly. Customers have become much more demanding and aware of how they should be served. Production is concentrated in low-cost production countries and close to growing markets. At the same time the costs should be cut. The global supply chain risk levels are growing and risks identification is challenging or even impossible.

The researcher didn't have previous experience in supply chain management, or risk management, before this research. The researcher previous experience is very technology oriented, mostly in research and development department. Because the researcher did not have any prior experience in supply chain risk management, the researcher has been able to openly take all comments. This might have impacted to the work results.

The purpose of the research is to study ways different companies ensure the continuity of their supply chain. How companies are prepared for threats which affect the supply chain in situations of crisis? The research will examine the continuity of production and availability of materials from the supply chain point of view. Although the supply chain risk management has been extensively studied and well known in companies, however aims to bring out the hot topics, perspectives and best practices for companies. The researcher is intended to study the already existing practices and point out the basics of risk management by ensuring supply chain operations in crisis situations. The study tries to find a connection between supply chain risk management theory and company's best practice as well as compare different ways of companies to manage supply chain risk management

The basic idea of supply chain risk management is that in crisis situation company will remain flexible and to be able to react quickly to any event by using its normal. In practice, how the supply chain should act and what should be taken into account in order to ensure continuity of production in crisis situations?

What is a crisis? A crisis can be a sudden unexpected event or chain of events which forces companies to react immediately. On the other hand a crisis can be result of a long process where irreversible damage has already occurred.

Supply chain excellence has been chosen as one of the main strategies in several companies. Companies have recognized the fact that supply chain excellence is one of the key competitive advantages, especially in these difficult economic times. That's why they have invested heavily to supply chain excellence.

Based on the this chapter's views it is still important to examine supply chain risk management in practicality point of view, and to try to bring a new and fresh perspective to this type of research as much as possible. That would be useful to companies as well as workers who work in the field of risk management.

1.1 Background

At the beginning of 2009 manufacturers of electronics components began to reduce production volumes and at the same time announcing end of life to multiple product families due to the economic recession in 2008. KONE became aware of these reduced production plans and EOLs only during the last quarter of 2009, because the component manufacturers are not the first tier suppliers to KONE. According to forecasts, the situation should have been stabilized in the first quarter of 2010, but the rapid economic growth surprised the market. The rapid growth and the slow production ramp-up, 6 - 12 months depending on the product, caused component

shortages and extremely long lead times for all industry sectors. These shortages became a major threat for KONE, because the demand for its products kept increasing.

In March 2010, in Iceland, volcano Eyjafjallajökull began volcanic eruption. Tens of thousands of flights were cancelled because most of airspace of European countries was closed. Almost the whole of the European air traffic was stopped temporarily. This caused delivery problems to elevator components to Europe.

All things seemed to be in order when Sendai earthquake and tsunami took place in March 2011. This caused extensive damage in Japan to Japanese industries. This event had a substantial impact on the global component market because Japan's market share in the manufacturing of silicon wafers and other electronics related raw materials is significant.

Functionality of supply chain is more important due to global disasters and of course it is commercially remarkable also. In addition, a well-functioning supply chain will create competitive advantage and deliver more value to the customer when the goods come in on time. In addition, a well-functioning supply chain will create competitive advantage and deliver more value to the customer when the goods come in on time. Thus, the supply chain must work properly, smoothly and reliable.

This thesis will be done to KONE Supply Operations (KSU) and KONE Corporations Global Risk Management (KCO).

1.2 Objectives and scope of the research

The scope of the research is to investigate the continuity of the supply chain in some global industrial companies. This study looks how these companies are prepared for different threats affecting the supply chain and crisis situations in general. This study aims to deepen supply chain risk

management during crisis and proactive threat detection. The study takes into account also other companies from other industry sectors.

The research will examine the continuity of production and the availability of materials from the perspective of the supply chain.

The research problems are:

1. How continuity of production is ensured during crisis situation?
2. How availability of materials is ensured during crisis situation?

The main objectives are:

1. How production continuity planning should be done, so that it would work through the entire supply chain?
2. How the supply chain should be managed?
 - a. What should be taken into account in order to ensure continuity of production in crisis situations?
3. How other companies are prepared for different supply chain crises or threats?
 - a. How other companies operate when the supply chain is in crisis.

The purpose of examination is to find similarities, best practices and consistent way to manage supply chain risks. The purpose is also to achieve better level of understanding of supply chain risk managing and to find out different ways to manage supply chain risks. In addition to realize how and where different managing methods can be used.

1.3 Framework

This research is limited to include only supply chain risk management. The research is taking into account all different branches. The research doesn't include supply chain management or supply chain theory more than necessary.

The research does not take into account other risk management areas e.g. insurances, environmental and risk analysis.

1.4 Context of the research

All interviewed companies are working in global market. It was aim to get more than one company from each levels of processing step to be able to compare those to each other. Four of twelve interviewees were risk managers and the rests were sourcing managers or equivalent. Figure 1 shows how interviewed companies are located in the levels of processing. The white boxes inside the figure 1 are companies which were interviewed in this survey. One company is working several levels of processing. All other companies are working own special area as you can see in figure 1. Three of the twelve companies are working 2 at the level of processing and also three companies are working at levels of processing 3 and 4. Six of the twelve interviewed companies are working 5 at level of processing.

Figure 1 shows one example of possible levels of processing the formation of elevator industry. First level of processing is raw material (1) in this case it is iron ore enrichment. The next step is to put the iron ore concentrate the blast furnace (2). The iron blanks are result of the blast furnace these can be manufactured by rolling (3) metal plates. Door factory (4) is buying metal plates and produces door panels and frames to elevators. After that the elevator factory (5) is collecting all delivery material to own deliveries and sending those to front line (6). The front line in this example is a contractor, they are installing elevator to the subscriber, which in this example, is the end customer Children's hospital.

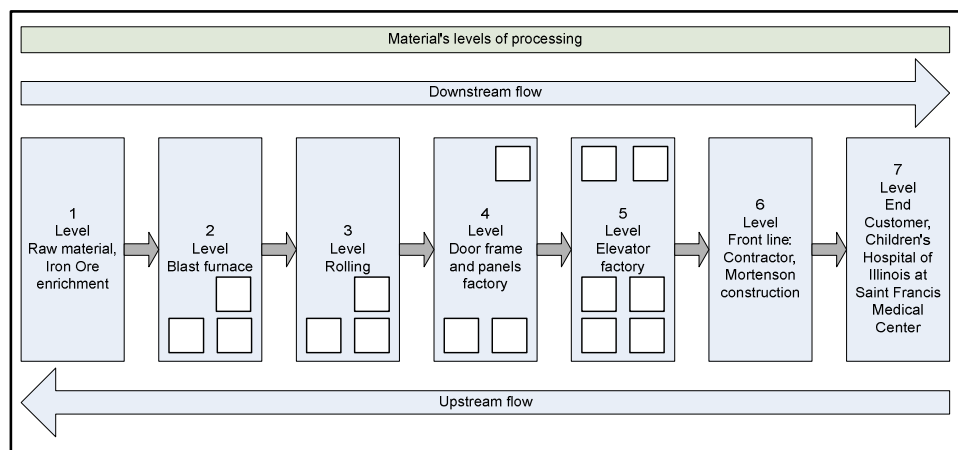


Figure 1. Figure shows different levels of material processing. Each white box describes a company and its position in material levels of processing.

Levels of processing

- Level 1. Raw material, Iron Ore enrichment
- Level 2. Blast furnace, interviewed of three companies working in this level of processing.
- Level 3. Rolling, interviewed of three companies working in this level of processing.
- Level 4. Door frame and panels factory, interviewed of three companies working in this level of processing.
- Level 5. Elevator factory, Electrification assembly, interviewed of six companies working in this level of processing.
- Level 6. Front line: Contractor
- Level 7. End Customer, Children's Hospital

1.5 Source criticism

The literature is in this case the primary source. The supply chain and risk management has been extensively studied from different perspectives and backgrounds of literature so reliability is at a sufficient level. The research is based on as broad as possible samples of the interviews. However, it is noted out that the reliability of the interviewee should be considered critically.

2 SUPPLY CHAIN MANAGEMENT

2.1 Supply chain

The companies are focused on their supply chains because of the fierce competition and heightened expectations of customers in today's global market. Supply chain consists of raw materials, work in process inventory and finished products as well as suppliers, manufacturing factories, warehouses, distributors and retailers. Typically, the supply chain starts when raw materials are produced, then goods are processed at one or more factories before delivered to warehouse for intermediate storage. Finally goods are delivered to retailers or customers. (David Simchi-Levi, Philip Kaminsky and Edith Simchi-Levi. 2003, page 1)

The purpose of the supply chain is creating a competitive advantage and add value to both the customer and the owners. The supply chain must always be understood and treated as a whole which includes all stakeholders within the chain. (Virpi Ritvanen, Aimo Inkiläinen, Anders Von Bell, Jouko Santala. 2011) The supply chain is only as good as its weakest link in chain.

2.2 Supply chain strategies

Supply chain strategy should be based on company's strategy. It is important to long-term success of the company. (Philippe-Pierre Dornier, Ricardo Ernest, Michel Fender, Panos Kouvelis. 1998, page 56) Also KONE has announced its own development program; delivery chain excellence, being part of KONE's strategy. (KONE's development programs) This kind of strategic level decisions have long-term effect to the company. Those decisions consist of product design, supplier selection, what should make internally and what outsource, who are the strategic partners. It also includes locations, warehouses, manufacturing plants and flow of the material through the logistic chain. (David Simchi-Levi, Philip Kaminsky And Edith Simchi-Levi. 2009, page 12) Quality,

speed, dependability, flexibility and cost are defined in general to operations performance objectives of strategy, so these should be monitored actively.

- Quality means that the products or services are done according to requirements and those fit the intended purpose.
- Speed, completing goods on time. Short lead time between customer requesting products or service to the customer receiving them.
- Dependability means that the customer can trust the supplier. So that products or services are delivered as agreed.
- Flexibility means capability to adapt processes during unexpected incidents and introducing new products or services when it is needed.
- Cost means that all processed products and services are done as cheap and cost effectively as possible, however fulfilling requirements. (Nigel Slack, Stuart Chambers, Ropert Johnston, Alan Betts. 2009 , page 40)

The supply chain strategy has an impact on the company's operations and well managed supply chain strategy is give opportunity to taking over new marketplaces and increase corporate profit.

There are four basic supply chain management strategies lean, kanban, agile and hybrid (lean and agile combination). Demand and supply of products are affected by the choice of supply chain management strategy. The hybrid approach is used if the lead time is long and the demand is difficult to predict or unpredictable. The hybrid is the combinations of lean and agile. When lead time is short and demand is unpredictable it is strategy of Agile. Similarly, in the lean principle things will go the other way around because then the demand is predictable and the lead time is long. The fourth principle is the kanban supply chain, where the product lead time is short and demand is predictable. (Virpi Ritvanen, Aimo Inkiläinen, Anders Von Bell, Jouko Santala. 2011)

Supply	Long lead time	LEAN Plan and Optimise	HYBRID De-couple through postponed
	Short lead time	KANBAN Continuous replenishment	AGILE Quick response
		Predictable	Unpredictable
Demand			

Figure 2. Supply chain strategies. (Christopher, Martin. 2011 , page 101)

2.3 Supply chain management

Supply chain management is defined in following way. It is used to working efficiently suppliers, manufacturers, warehouses and stores in order that goods is produced and shipped at the right quantities and to the right locations just on time in order to minimize cost of the chain and achieve satisfied service level. (David Simchi-Levi, Philip Kaminsky and Edith Simchi-Levi. 2003, page 2)

This is better understood than ever before. Supply chain is nowadays broader than earlier. The customer demands and competition with increasingly global pressures are creating huge challenges to succeed in the tough competition. (Gene Tyndall, Christopher Gopal, Wolfgang Partsch, John Kamauff. 1998, page xi)

Supply chain management can be divided into two productive value chains; primary and supporting activities.

Primary activities include inbound logistics, operations, outbound logistics, marketing, sales and service; while procurement, technology development, human resource management and infrastructure are included in supporting activities. (Christopher, Martin. 2011 , page 10)

Primary activities:

- Inbound logistics includes receiving, storing, inbound transportation, material handling, warehousing, inventory control and all kind of activities which give input to the production process.
- Operations are related to machining, assembling, packaging, testing and all process activities in production facilities.
- Outbound logistics includes sending the final product to customer and all related activities such as order processing, scheduling and outbound transportation.
- Marketing and Sales are handling advertising and pricing issues.
- Services activities are including installation, maintenance, parts supply and training.

Supporting activities

- Procurement: The aim of the procurement is supplying supporting products and services for other functions within a company, these are called indirect materials, such as office equipment, lease-cars, laboratory equipment for research and development, infrastructure and etc.
- Technology development: Technology development is typically including all kind of scientific disciplines as well as product design to product life cycle management.
- Human resource management: There is included all types of personnel management issues. Such as recruiting, training, compensation and etc.
- Infrastructure: Aim of the infrastructure is to support all primary activities and in additional it supports facilities management, quality management, legal, finance and accounting.

(Arjan J. van Weele. 2010 , page 6-7)

Typically supply chain logistics simplified as figure 3 shows. There supplier provide raw materials to manufacturer. Manufacturer receives materials which are purchased. Then manufacturer refines the goods and delivers the finished goods to next supply chain level. Distributor or wholesaler combines the products of many manufacturers to stock for sale

retailers. Finally the consumers are buying goods from retailer. (Philippe-Pierre Dornier, Ricardo Ernest, Michel Fender, Panos Kouvelis. 1998, page 216)

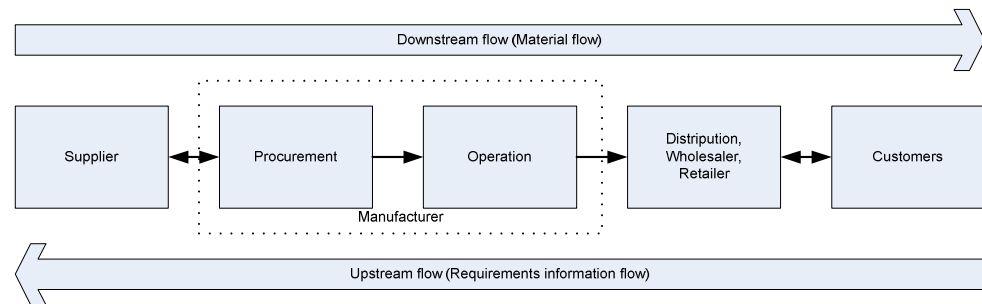


Figure 3. Goods and information flows in a linear supply chain logistics. (Philippe-Pierre Dornier, Ricardo Ernest, Michel Fender, Panos Kouvelis. 1998, page 216)

Figure 4 describes supplier tier layers into supplier supply chain logistics.

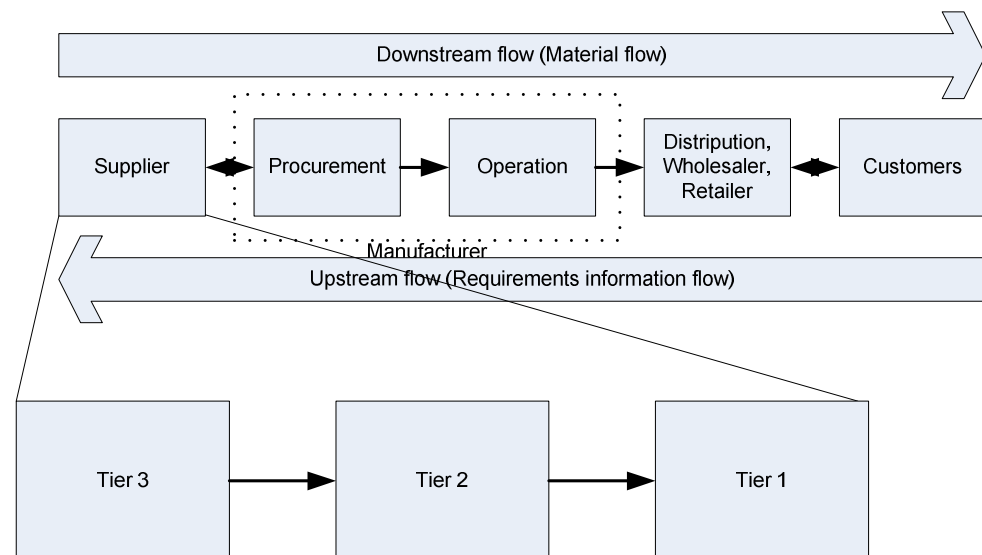


Figure 4. The extended supply chain logistics flow (Christopher, Martin. 2011 , page 143)

As Christopher saying in his book Logistics & supply chain management. *The scope of logistics spans the organization, from the management of raw material through to the delivery of the final product.* (Christopher, Martin. 2011 , page 11)

Speed, cost and services together with channels and products provide the operational excellence in supply chain management. (Gene Tyndall, Christopher Gopal, Wolfgang Partsch, John Kamauff. 1998, page 8)

Speed is meaning minimum throughput time. So doing things fast and minimizing the lead time between customer asking to customer receiving goods or services. (Nigel Slack, Stuart Chambers, Robert Johnston, Alan Betts. 2009 , pages, 40, 141)

The buyer is only interested to know final cost of the products. Total supply chain costs consist of raw material to the customer including products and services. Supply chain cost should be followed careful. There are two different focus areas; external and internal costs. External costs ensure that final product is price-competitive in the marketplace. Internal costs focuses to generate profit within the competitive price. (Fred A. Kuglin. 1998 , page 148)

Only high quality or unique products are not enough to customer, they also expect added value services for their products. Services can be consisting of quality, warranties, packaging, rebates and documentation. In additional there can be also extrinsic services as discounting, credit, delivery reliability, transportation, product assortment and training. Nowadays in many cases services are more important to customer than the product itself. (David Frederick Ross. 1999 , page 49)

In order to achieve operational excellence in supply chain management, companies have to continuously address value drivers. These value drivers are cost minimization, tax minimization, fixed capital efficiency, working capital efficiency and profitable growth. Well managed value drivers are indicating performance of supply chain. (Gene Tyndall, Christopher Gopal, Wolfgang Partsch, John Kamauff. 1998, page 8-12) Next, is considered a little more detail what the value drivers includes.

These value drivers are customer satisfaction, quality, asset utilization, operating cost, cycle time and productivity.

- Customer satisfaction
 - Product availability
 - Order information and process
 - Delivery timeliness and completeness
 - Number of customer complaints
 - Customer rating

-
- Quality
 - Reliability
 - Conformance of standards
 - Durability
 - Serviceability
 - Errors in order contents
 - Incomplete orders
 - Complete on time
 - Poor inventory management
 - Asset utilization
 - Inventory turnover
 - Return on assets employed
 - Working capital employed
 - Operating cost
 - Cost of labor
 - Transportation
 - Maintenance
 - Taxes
 - Insurance
 - Information service
 - Rentals
 - Cycle time
 - Production processing time
 - Order processing
 - Picking
 - Shipping
 - Delivery
 - Productivity
 - Order processed per unit of time
 - Shipments per facility
 - Operating per asset and process unit
 - Network costs per sales unit

(David Frederick Ross. 1999 , page 165)

2.4 Summary

This study focuses on a strong supply chain functionality, resilience and sustainability. Therefore, supply chain theory is one of the most important theories in this work.

Supply chain management is very important activity for global companies and currently prevailing economic situation has placed particular emphasis on the importance of supply chain enterprises. A well-managed supply chain is creating a competitive advantage over the rivals. All the companies who want to succeed in the future have noticed this and have taken action in this regard. However, there are a lot of risks and pitfalls in the supply chain. Those things will go through more detail in the next chapter.

3 RISK MANAGEMENT

3.1 Risk definition

First of all some definitions should be good to clarify:

- **Hazard or threat:** These mean anything that can go or wrong or cause harm or there is a possibility that some threats are realized.
- **Risk:** This means the possibility that hazard or threat will cause a problem.
- **Risk assessment:** Aim is to define what can go wrong.
- **Risk management:** Scope of risk management is taking steps to control risks. So this is a proactive work to assessing potential threats or hazards and finding the best ways to avoid those threats or hazards. (Kid Sadgrove. 1997 , page 4)
- **Crisis management:** Objective of crisis management is to deal with threats or hazards before, during, and after those have occurred. (Michael Regester, Judy Larkin. 2005)

Risk management brings up some questions when discussing about risks and especially business risks.

What are the worst hazards or threats that could happen to us?

How probably those are to happen?

Do we have correct process to prevent the event?

What are the right steps to do it? (Kid Sadgrove. 1997 , page IX)

3.2 Different types of Risks

There are many different types of risks. Here is to focus on the risks associated with business. However, here are a few examples of the risks:

- **Financing risk:** There is probability of loss that increases as the repayment period of a credit or loan increases.

-
- **Technology risk:** This can be old and outdated technology, lack of knowledge of system or inappropriate systems for business. So this risk is related to the use of technology in company.
 - **Personnel risk:** The major personnel risk is the loss of key personnel. But it can be also poor recruitment, uncompetitive remuneration and so on.
 - **Operation risk:** The operational risk is failed systems, processes or people which is stopping the operation in anywhere within chain.
 - **Market risk:** Customers or users won't want your product and typically related to price, liquidity, legal or competition. (David Loader. 2007 , pages 76 – 87)
 - **System failure risk:** This is related to IT and other system risks. There could be problems such as viruses, bugs, incorrect codes, too old technology and so on.
 - **Outsource risk:** Here is risk that it is difficult to control and it increase reliance to partner. In additional it does not work as well as expected (Donald Waters. 2007, page 71).

3.3 Risk management process

Companies should be committed to thoroughly do risk management, because they have to set the policies and processes then assess the risks, implement plans, take actions and control, finally monitor the risks and threats. Risk management is a continuous process which should be developed continuously. (Kid Sadgrove. 1997 , pages 12-14) The risk management process is defined in following ways in ISO IEC 31010 standard. See figure 6. First communication and consultation, this is base for successful risk managing. Context of establishing is specified scope and criteria of risk management process. There is taken into account internal and external parameters and of course it is assessed that particular risk. Next step is risk assessment. This includes risk identification, risk analysis and risk evaluation. After that is risk treatment where basically

implemented one or more possible options for changing the probability of occurrence. Finally monitoring and reviewing are done continuously during each process steps. See figure 5. (IEC/ISO 31010, pages 8 - 12) Companies without risk management are likely to suffer more from the cost of problems and crises than companies who are managing risks properly and systematically. Systematic risk management process helps companies to assess its strength and weaknesses. (Kid Sadgrove. 1997 , pages 12-14)

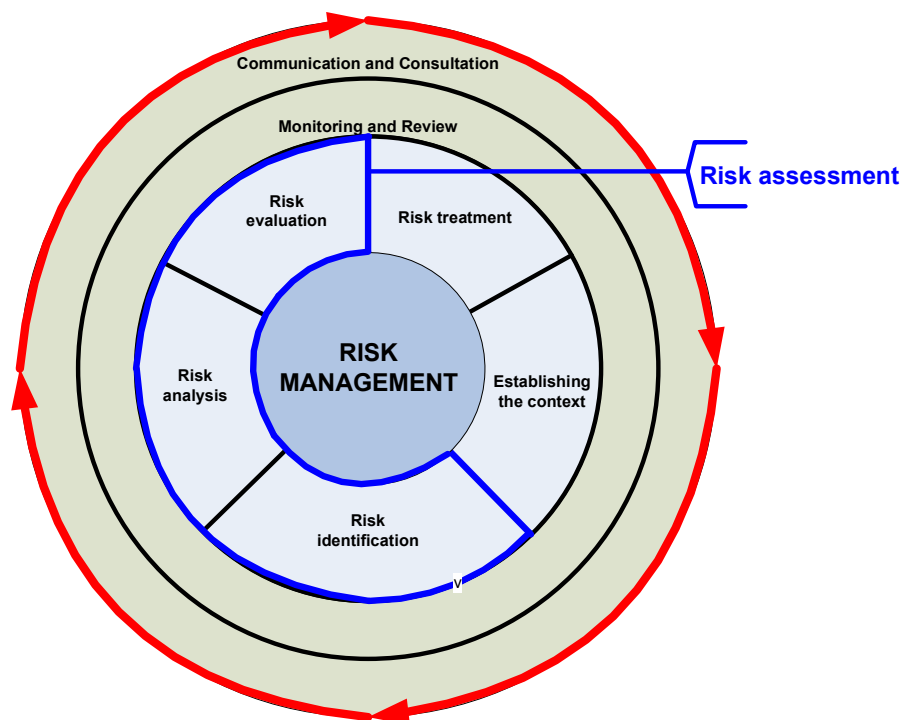


Figure 5. Risk management process wheel. (ISO/DIS 31000, page 8)

3.4 Business continuity management

Business continuity management is part of the wider context of risk management, so it is needed to be integrated as part of risk management process. Business continuity management plan is a way of making sure that unexpected events have as little effect as possible on the day to day running of your company. (Business Continuity Management Guidelines, pages 3-5)



Figure 6. Risk management and business continuity management interface. All other management processes are based on the company's business management. (Business Continuity Management Guidelines, pages 3-5)

How to establish this kind of business continuity management (BCM) and what is needed? Business continuity management is needed to establish five basic steps.

1. Establishing BCM team. Team is responsible for BCM process and budget. They also specify requirements and strategy of BCM. Finally, fit BCM strategy with other business strategies and develop the way to achieve them.
2. Make risk assessment. This includes business impact analysis and following steps: a: identify, b: analyze and c: response.
 - a. Identify risks, treats and vulnerable functions.
 - b. Make business impact analysis, to find realistic probabilities for expected events and how much spend money for event.

-
- c. How to deal with emergency. For example, transfer, avoidance, acceptance and ect. (Donald Waters. 2007, 224-226)
 3. Identify response options. Make business continuity management plan. The plan shows how an organization should respond to unexpected events and how the organization will restore normal operation of business.
 4. Develop response plan. Implement the business continuity management plan. This means that BCM plan is communicated to all relevant stakeholders.
 5. Exercise and maintain BCM plan. This means that BCM plan is trained to all relevant stakeholders.

The aim is to ensure BCM process is used in daily work. (Donald Waters. 2007, 224-226)



Figure 7. BCM process includes program management, business impact analysis, risk assessment, response options, response plan, exercise and maintain. (Business Continuity Management Guidelines, page 33)

3.4.1 Business continuity management plan

The fundamental aim of BCM is to help an organization survive and recover from an emergency (Donald Waters. 2007, 223).

The general term 'business continuity management' describes the methods that ensure the essential business functions continue to work through an emergency (Donald Waters. 2007, s.216).

Business continuity management is obtained permission commitment to relevant resources and stakeholders. Key tasks of BCM program management are defining BCM policy, develop a schedule and to budget related activities. As well as establishing responsibilities, roles and giving support to resources. (Business Continuity Management Guidelines, pages 8-10)

3.4.2 Risk assessment

The scope of risk assessment is providing information for decision makers. Defining what are the options and assess seriousness of threats. So its assignment is identified the important contributors to risks and weak links in systems and organizations, as well as risk prioritization. The risk identification, risk analysis and risk assessment are included in to the risk assessment. (Business Continuity Management Guidelines, pages 7-10)

The organization should keep information related to its threat, risk and criticality assessments up-to-date and confidential, as is appropriate. Threat, risk and criticality assessments should be re-evaluated within the context of changes within the organization or made to the organization's operating environment, procedures, functions, and services. (ISO/PAS 22399, page 12)

3.4.3 Business Impact Analysis

Business impact analysis is one of the many tools and techniques when making a risk assessment. Purpose of the business impact analysis is to

analyse how key disruption risk might be affect organization's operations and how many resources are needed to manage it. (IEC/ISO 31010. 2009 , page 42)

An organization should analyze impacts of disruptions to its operations and identify critical business operations that are given high priority for restoration, in order to set up recovery time objectives (RTO).

The organization should consider the amount of time, cost, and resources required to restore critical functionality and clear backlogs resulting from the disruption including workarounds and continuity arrangements with other organizations. (ISO/PAS 22399, pages 12 - 13)

3.4.4 Identify response options

The aim of identify response options is to find out recovery options which meet the requirements for business continuity and to present recommendations to the management. There are many different ways to respond to threats or risks. One response option is transferring the activity to alternative organization. Then other option can be relocating the activity to an alternative location. There is also option of temporarily suspending the activity. However basic principle is that the cost compared to benefit of each option needs to be assessed against the requirements for business continuity. The response options should take into account several things before it can be properly managed. Those are e.g. people, IT systems, network, premises, facilities, off-site storage and data backup. Then viability of response options needs to be evaluate from technical, operational and financial point of view. (Business Continuity Management Guidelines, pages 15 - 18)

Detailed treatments for IT continuity and recovery are a key aspect of BCM. Ensure the IT plans integrate with the overall plan. (Business Continuity Management Guidelines, page 24)

3.4.5 Develop response plan

The purposes of this process step is to invite and inform all relevant resources and organizations how to react if some incident occurred. The BCM response plan developing is included three main assignments. Firstly crisis management and business continuity teams need to be established. Then secondly it is necessary to document the BCM plan, because it helps people to act in similar way in similar incident. Finally it is important to developing the BCM plan whenever needed and then it is up to date all the time. (Business Continuity Management Guidelines, pages 19 - 23)

3.4.6 Maintain BCM plan

All relevant resources and organizations are trained in order for them to know when and how plan should be used and to ensure that resources and organizations are indeed able to execute the plan. Of course BCM plan needs to be maintained so it is relevant and up to date. (Business Continuity Management Guidelines, page 25)

3.5 RTO and RPO definition

This chapter explains what RPO and RTO definitions means.

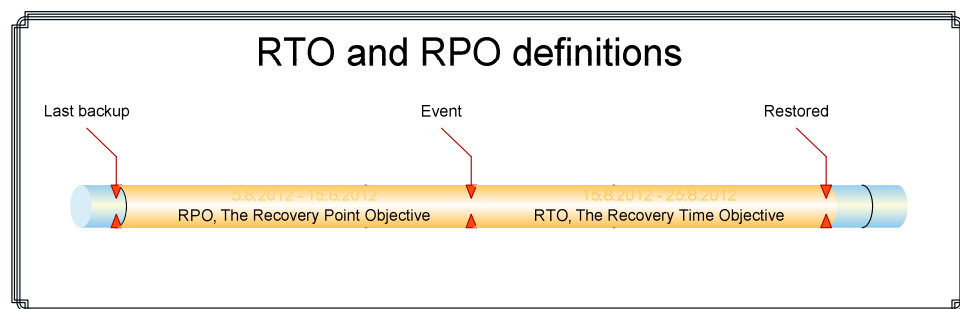


Figure 8. Figure shows RTO and RPO principles.

The definition of the Recovery Time Objective (RTO) is the time how quickly you need to have that function back available after interruption. (RTO & RPO) Additionally, ISO standard is defined RTO to following

way. The RTO is specified that time period which within special equipment or IT capability is recovered to normal level. (IEC/ISO 31010, page 43)

The definition of the Recovery Point Objective (RPO) is the point in time where backup was made last time, the last good data backup. It could be minutes, hours or days back. (RTO & RPO) Alternatively, what is the maximum time period where the companies can afford to lose data? (Auditing Business Continuity)

The RTO and RPO objectives are achieved when technologies, products, processes and procedures are defined.

The business impact should be taken into account when setting RTO and RPO objectives. How much does it impact the business if application, process or data becomes unavailable?

RTO should not be fixed as a specific time. It should be an assumption about per cent of the time that the RTO will be achieved. (RTO & RPO).

3.6 Summary

Risk management is a broad field where there are lots of things that could be raised. However, this was intended to focus on issues that are essential to this work, such as business continuity plan and risk assessment.

When the risk management functions have been part of the company's daily work, then it is easy and fast for the company or individual to respond to any of the company's unit challenges or potential threat in the same way. Risk management is often done in companies with limited resources. If the basics of the risk management are in order to the company. The limited resources are not the problem because good co-operation with other departments is possible to obtain the necessary functions to have been made at a sufficient level.

4 SUPPLY CHAIN RISK MANAGEMENT

4.1 What is a crisis?

Dictionary.com website defines a crisis as follows:

1. *A stage in a sequence of events at which the trend of all future events, especially for better or for worse, is determined; turning point.*
2. *A condition of instability or danger, as in social, economic, political, or international affairs, leading to a decisive change.*
3. *A dramatic emotional or circumstantial upheaval in a person's life.*

(Crisis)

Crisis can become evolving or suddenly, but in general it is change. (Harvard Business Essentials. 2004 , page XVI)

Crisis may be sudden unexpected event or events which forces reacting immediately. On the other hand, the crisis may be a result of a long course of development; the revolutionary nature appears after irreversible damage has happened. The crisis is often unique. It involves fear and confusion. People have unusually high interest for knowledge about crisis, and that must be responded. The lack of the information should not be possible. (Kriisiviestintäsuunnitelma, page 2)

As against ISO standard 22399 (guideline for incident preparedness and operational continuity management) is defined crisis to following way: *any incident(s), human-caused or natural, that require(s) urgent attention and action to protect life, property, or environment (ISO/PAS 22399, page 2)*

4.2 Supply chain risk management

The supply chain risk management is consisting of supply chain and risk management and that is taking into account all important issues from each side. This supply chain risk management is described in the figure 9. It is a systematic process that has been implemented with owners. (Supply Chain

Risk 2011) Supply chain risk management is based on three main activities, which are identifying, analyzing and responding to risk (Donald Waters. 2007, 215). The supply chain risk management should be one part of the whole risk management process. So it is following same process and rules what risk management is approved.

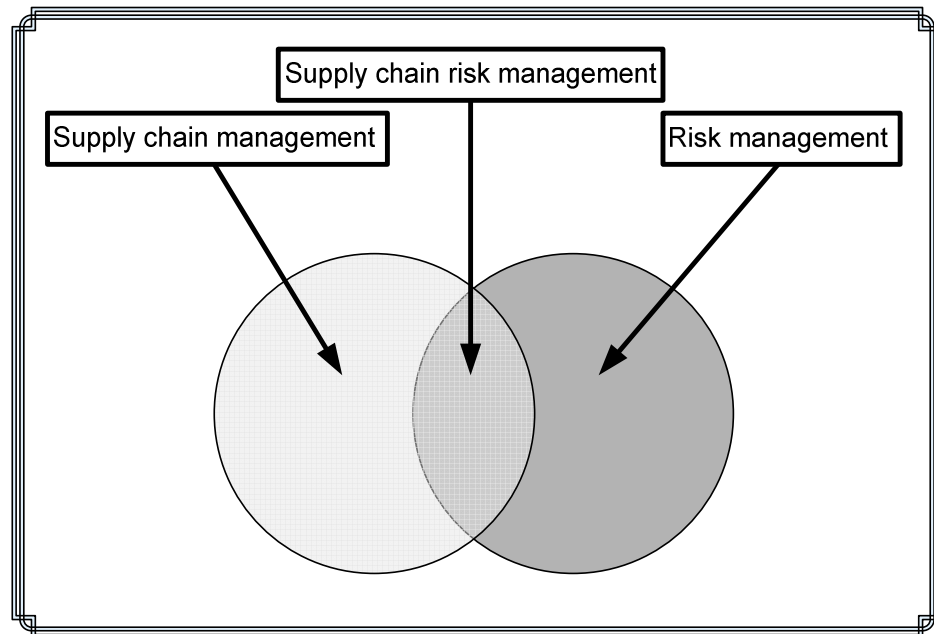


Figure 9. Supply chain risk management (Supply Chain Risk 2011)

The supply chain risk management strategy must be designed to reach the objectives. Choosing, what approach is taken to the supply chain risk management strategy? Strategies can be divided into three main categories: product, supply and demand.

Product strategy:

- The modular design of the product can be easily modified to meet the demand.

Delivery strategy:

- Availability of products is ensured by buffer stocks.

Demand strategy:

- The customer's purchasing decision can be affected by changing product price.

Business continuity management focuses typically on a BCM plan. That plan gives opportunity for the organization to continue working or recover

quickly after an event. Flow of materials is not disturbed by disaster or it able to return to normal operation as quickly as possible. Those are the basic requirements of BCM from supply chain point of view. This means that there has to be enough people to manage the BCM process. Key functions needs to be kept working in the organization. IT, facilities, resources infrastructure and communication system needs to be taken into account to allow business process to continue. Then there is need for capability to produce, move and manage material flows. This means for example that there is a possibility to change supplier in case of interruption. Then the most important issue is communication. The communication channel is needed between different organizations as well as public sector, media, police, etc. (Donald Waters. 2007, pages 218 - 221)

4.3 Summary

How companies are securing their supply chain during crisis situations? The answer is supply chain risk management which consists of both supply chain management and risk management and in addition to the strong co-operation where processes are integrated together. Co-operation and information sharing is the core of supply chain risk management issues. If the company has to invest as well as supply chain management and risk management as a balanced level than necessary. Such as without a real investment to risk management, it is not possible to identify the weakest link in the supply chain.

5 RESEARCH METHODOLOGY

Primary source was theme interviews consisting of various representatives of companies, from risk management or sourcing departments. Secondary data sources were multiple sources (i.e. books, journals, reports, etc.).

The hermeneutic interpretive phenomenological methodology has been used in this research and the theoretical approach is qualitative. The methodology choice is unstructured interview which is implemented by theme interview methods.

The research was conducted by using the theme interview questions. The most of the interviews were realized face to face meeting, but three of the twelve interviews were held by phone.

The interview material is transcribed question by question. Then it was easy to compare to question answers of different interviewees. Then those themes answers are connected to categories which are coming up from answers. Then all categories are analyzed separately.

Inductive inference method was due to the research on the subject. The inductive reasoning based on the material.

6 HOW COMPANIES ARE SECURING THEIR SUPPLY CHAIN DURING CRISIS

The aim of this chapter is to go through objective, plan, implementation and results of research. The primary data is collected by using unstructured interview and secondary data sources were multiple sources (e.g. books, journals, reports, etc.). This chapter looks at the development of research from the planning to analyzing of the results. This chapter aims to achieve strong vision of the research problems and get new fresh perspective to research.

6.1 Background of the interview survey

When the subject of this thesis was agreed, it became clear that it was going to be realized by interview survey. The study would have to be made qualitative because the research theme is difficult and challenging. In addition, it was important to achieve the objectives of the study, and to answer the research questions sufficiently, comprehensively and reliably.

Interviews were held during spring 2012, between April and May.

6.2 The objective of the interview study

The objective of study was to realize how companies are managing supply chain risk management, and what would be the best practices to do that. How to make sure that companies' supply chain is resilient enough against vulnerability. What would be the right actions to avoid vulnerability, and to achieve resilient and flexible supply chain which stands up to hard use?

This study aims to bring out present state of supply chain risk management in companies. Aim is also to create new perspective to companies, how to manage supply chain risk in practice and hand over robust base for success

in challenges of supply chain. However, without limiting this study to any particular sector or part of the supply chain, rather than to look at it extensively throughout the supply chain.

6.3 The interview survey plan

The interview survey plan start to familiarizing to all relevant literature which related to unstructured interview or in-depth interview. When objective of study was clear, research problem questions were defined. Next step was to put together interview questions that were divided to two main themes. First theme was supplier risk and second one was company's own production and process risk.

Interview questions have chosen way that would be possible to get the answers also. However those would not be too sensitive for participants and make questions only as much as necessary.

Separate research plan was made which is approved by the thesis supervisor. The actual interviews began after approval.

6.4 Participants selections

Because of the scope of the topic, it was important to get right persons to answer to interview questions. It was very clear at the beginning of study that it might be very difficult to find the right persons to be interviewed. That's why we focused to people whose responsibility is the supply chain risk management, or people who know very well this area, for example sourcing managers. Of course, the researcher took advantage of all the possible personal contacts, both internal and external, to find the right people to interview

Interview Survey sampling was planned from 15 to 19 participants. Twelve participants accepted to participate to interview. Ten of twelve were successful interviews.

One of the rejected interviews was due to the inexperience of the interviewer to carry out the interview and second was related to unawareness of participant. But result was same in both cases. The data wasn't reliable enough.

6.5 Implementation

First contact to the participants was made by e-mail asking whether the interviewee would be willing to participate to the interview. The e-mail was sent to nineteen participants. Twelve participants accepted, three of them rejected immediately and four of them didn't react to e-mail at all. If participants didn't react at all, then the participant has been contacted by phone.

Next step was to agree time schedule of meeting, and other practicalities related to the interviews. Also interview questions were sent to participants in beforehand.

Primary aim was to have face to face meeting and if that wasn't possible, then interview was held by phone. Face to face meeting were planned to be held in a place that is familiar to the participant, so these interviews took place in their familiar working environment. The phone meetings were much easier and faster to arrange with participants than face to face meetings. On the other hand contact to participants in phone meeting was incomplete. Three of the twelve interviews were carried out in English, and the rest of the interviews in Finnish.

The duration of the interviews were designed to be about one hour, but in several cases time limit was exceeded, however it wasn't so big deal.

The interviews were intended to be recorded by a smartphone and dictator. This decision proved to be good for interviewer because two times one or the other stopped working just before interview and alternative device gave backup to interviewer. Additional notes were made to notebook. In all cases interviewer was researcher.

The questions were presented as clearly as possible and the interviewee was given the freedom to tell as much as they wanted about the subject. Therefore, the interviewer had difficulties to keep the subject matter within the scope of the interviewee.

Some of the questions caused problems for both the interviewees and the interviewer, because the interviewer did not have enough competence to explain the issue. This was due to the fact that the researcher hadn't studied widely enough subject area, and was not prepared for the questions that the interviewees might have. Towards the end of the interviews they went better all the time, and so also better results were reached.

6.5.1 The Letter of invitation to interview

In the invitation it was told to the interviewees what is the purpose of the interview, and why it is done. As the interviewees had different backgrounds all invitations were unique to this was to take into account the sending invitations. Here's one example of an interview invitation.

Dear recipient

I am studying supply chain risk management and scope is to study how companies are securing their supply chain during crisis situations.

I got your contact details from xx xx, Global Electronics Supply Chain Director.

I would appreciate an opportunity to interview a person / persons within your company that are responsible for supply chain risk management or risk management in general.

Interview agenda:

- *Scope of thesis (5 min)*
- *Interview questions (55 min)*

** I would appreciate your approval to record the interview session.*

Your interview will be held strictly confidential and the results reported anonymously in my thesis.

Before publishing the thesis, all participants shall have an opportunity to review and give approval for the work.

All results will be published in a way that no single answer can be identified.

*I am a Strategic Leadership of Technology-based Business student at Hämeenlinna University of applied sciences (HAMK) in Finland
Master thesis is done for KONE Corporations Supply Chain organization.*

The master thesis results will be shared with all persons interviewed.

If you have any question or need for additional information contact me via e-mail xx or phone +358 xx

Sincerely Yours

6.5.2 Interview questions

1. Supplier risks
 - a. How do you follow your supplier operational risks and capability?
 - b. Do you follow your suppliers' financial results?
 - c. Have you made a business impact analysis?

-
- d. If Yes: what was the scope of the BIA?
 - e. Do you have a BCM plan for your critical suppliers?
 - f. How does purchase department follow how much you spend money with your supplier compared to how big business impact the supplier can have in case of suppliers business interruption?
 - g. Have you defined RTO and RPO for critical suppliers?
 - h. What are your capabilities to replace critical suppliers e.g. can you shift production from one production line to another smoothly and quickly?
 - i. Have you identified single source suppliers and do you monitor them regularly?
 - j. Do you require and review BCM plans from your 1st/2nd/3rd tier suppliers?
2. Own premises / production /assembly lines
- a. Have you identified your critical production resources (assets, personnel, data)?
 - b. Do you have business continuity management plans for critical resources?
 - c. Have you defined RTO and RPO for critical resources?
 - d. Have you tested the BCM plans?
 - e. What are your capabilities to replace critical resources e.g. can you shift production from one production line to another smoothly and quickly?

6.5.3 Interview Analysis

The research methodology chapter 5 is describing how interview results were analyzed. Interview material was put together question by question, in order to review results at level that is detailed enough. Interview results are analyzed in chapter 6.7 Analysis of the results. But however those were taken into account so that reader could see this study as a whole. All Original material is stored in the researcher's own archives for possible later review. Summary paragraph 6.8 summarizes the results tightly

together, and finally chapter 7 looks at the results and their reliability and durability of the theory.

6.6 Interview results

Quotations are taken directly from the answers but the translation might impact on the answers. However answers have been strived to keep as original as possible. All questions have been inspected through one by one.

Some of questions can be answered shortly but part of the questions got very long answers.

6.6.1 Supplier risk

The target in this chapter is:

- Find out supplier risk in general
- How supplier risk has been identified in different companies?
- What kinds of things companies have experienced important?
- Are there differences or similarities between different companies?
- What are the activities companies have experienced important?

QUESTION:

How do you follow your supplier operational risks and capability?

The aim of the first question is to clarify how companies follow suppliers capability and operational risks or are they paying attention to those at all

Comment:

All companies are follow own suppliers one way or another way.

ANSWERS:

- Case 9: “We do audits for critical suppliers and it is depended on the turnover/spend? of the supplier. Category 1 means audit once per

month , category 2; audit once per two month or once per three month and etc. Audit includes items such as operational capability, quality, sales activities and etc.”

- Case 5: “OTD, On Time Delivery report.”
- Case 3: “Lead times are important to us, then compete on time (COT) and we also follow supplier’s quality as well as customer’s quality of data.
- Case 7: “Spend, 80/20 critical supplier selection rule. The purchase department makes risk assessment in every time when agreement is updated or risk manager makes supplier audit. Other than the major suppliers, then purchasing is following own instructions.”
- Case 4: “Spend, 60/40 rule, critical supplier selection rule. Every month we are collecting all supplier data. This includes finance, capability, operative activity, quality, ISO standard, OTD and etc.”
- Case 1: “Close relationship with supplier and investigation with supplier. Quality group auditing the supplier formulate relationship and action plan. In case of a sole source, then capability and reliability study plan. Of course try to find out second course otherwise increase inventory.”
- Case 12: Lead time list, real time lead time info. If lead time going down constantly can be an indication that supplier is not doing well. Then starting investigation. What is behind that (root cause). If lead time is more than 12 weeks then need more attention than normally. Inventory model works perfectly lead time up to 12 weeks, also strong 12-12 weeks and over 20 weeks something is wrong. We do several things to mitigate that as long as possible, as long inventory buffer as customer needs. Pipeline as long as customer can forecast. If lead time goes above that and customer wants change lead time. All didn’t go well.
- Case 2: “Limited number of key suppliers and meeting key suppliers regulars. The key figures are monitored as lead time, COT, capability, quality. Also supplier risk specification runs through every year.”

-
- Case 8: “We are audited by the suppliers of the procurement department, and it includes three main things of quality, delivery and price. We should have a business continuity plan for all of our main suppliers. The risk management department will audit the most critical suppliers with insurance companies.”
 - Case 10: “It depends in supplier, but in general if turnover is large enough then we have regular supplier audit which includes capability, quality and cooperation.
 - Case 11: “Spend, 80/20 critical supplier selection rule. This is about 55 units which we will be covered by 80% sales and smaller units are included to their subcontractor chain. 10 units per year so about every 5 year we will cover all subcontractors and suppliers and their capability and operational risks.
 - Case 6: “When purchase will make supplier audit.”

QUESTION:

Do you follow your suppliers’ financial results?

When asked about following suppliers financial results, following answers were given.

Comment:

Nine of twelve companies are followed suppliers financial results actively way. Two companies are followed suppliers financial result sometimes and one company not at all.

ANSWERS:

- Case 4: “Yes, we will follow our supplier and customer financial results. Every month we are collecting all supplier data. This includes finance, capability, operative activity, quality, ISO standard, OTD and etc.
- Case 1: “Only when choosing new supplier, but not regularly.”
- Case 10: “Individual units do not monitor, all monitoring takes place in central administration. They are using a portal which automatically

collects information about suppliers and send an automatic warning message if it is needed.”

- Case 7: “It is part of basic info, at least when the contract is renewed or when choosing a new supplier.”
- Case 11: “It is a point in supplier risk assessment. The same way as the units should be monitored for the customer even if it is a big customer.”
- Case 3: “Yes, we are monitoring the supplier and the customer and they monitor us in the same way.”
- Case 12: Headquarters, They follow those and tell that info to others. If there is any delay to get money, they will get red flag and start the first level investigation. In general, suppliers look us more than we look at them, we don’t audit our suppliers they audit us very carefully. Customers audit us and we audit customer credit awareness on a regular base, every month.
- Case 9: “Sourcing manager is following key suppliers and in addition to the capacity and future investments in long term. This is usually done in price negotiations.”
- Case 2: “Not regular, not every time. Sometimes when sourcing meet supplier.”
- Case 5: “We don't have any process for supplier financial follow-up. No any indicators. It is more on the basis of the feeling of a supplier financial monitoring. This is the area what we want to develop it will bring up more visibility to the suppliers financial risks. Recently it has occurred to us that your supplier without any warnings is fully disappeared from map because of economic problem.”
- Case 6: “We are monitoring all figures and this includes own suppliers and public companies. We know how to interpret them. The supplier for economic monitoring did not switch back easily if the volume is low.”
- Case 8: “60 supplier's financial condition will be monitored although all are not public companies.”

QUESTION:

Have you made a business impact analysis?

Comment:

Seven of twelve companies are working with BIA in some level but four companies does not working at all and one company is working more with risk assessment.

ANSWERS:

- Case 9: “For key suppliers and updated once per year.”
- Case 7: “Yes we will do it, if supplier is important and critical. Then if this supplier is important but not critical we expected that they have to do own BIA and if it isn’t so critical then we don’t expect it.”
- Case 10: “Yes, we have done own BIA for suppliers and one part of this BIA is that supplier impact scoring.”
- Case 11: “Yes, but only those biggest units have to do that.” (80/20 rule)
- Case 5: “No, we don’t do that in regularly only ad hoc.”
- Case 8: “We have own BIA for our suppliers and there is own process for supply chain.”
- Case 12: “We don’t do that analysis. We do other monitoring normal event, cost, how the global economy effect to lead time? How rebound at financial crisis impacts to the lead times and we do assess the suppliers on that, so we look at changes of lead time and numbers of fines suppliers de compensation every month. This is all the time a balancing act between the lead-time and inventory. BIA is not significant because we have a lot of customers and suppliers.”
- Case 2: Yes, Risk specification includes risk assessment and impact scoring.
- Case 3: They don’t do that or the interviewee doesn’t know that.
- Case 6: “In a few of our factories the BIA has been made and there were few suppliers which can interrupt deliveries.”

- Case 1: “We are doing risk assessment. We know our suppliers and we continuously improve those.” They don’t have official way to do BIA, but they are doing risk assessment.
- Case 4: Didn’t know what BIA is or what it is mean. ”Always we should have second source supplier. It is most sensitive area mechanics and printed circuit boards.”

QUESTION:

If yes: what was the scope of the BIA

The aim of this question is to find out purpose of the business impact analysis.

Comment:

Fifth companies are focused on impact scoring when they are doing BIA.

ANSWERS:

- Case 9: “Impact scoring (risk assessment, impact,) Sole source, single source, second source”
- Case 11: “It is based on spend (80/20 rule), we are expected to do it only at a plant level so that the risks are understood. Biggest units will do this in workshop level and then they will do it in more detail.”
- Case 7: “How much supplier impact to profit margin (impact scoring)”
- Case 10: “Impact scoring, how much supplier impact to products and how much product impact to profit margin (supplier’s plant level).”
- Case 8: “Our BIA is focused on the money. How much we can lose money if we will lose our supplier and what could be the impact to our business. Although the euro is not an exact level, still everyone will understand it. For example, if we invest 5M€ and it will save 25M€. Then it is easy to make decisions.”
- Case2: We do first risk assessment where we are scoring 10 % of interruption. For example, sole, single or multiple component sources. Then impact scoring: no impact, minimum delay, some delay, sufficient 10% stop, plant shut down 50 % stop. Third step is

monitor supplier levels: 31-50% Acceptable level, take actions. 51-70% strategy plan, take actions. 71-100% immediate actions required and urgent strategies planned with purchase and operational managers.”

- Case 6: “Criticality is estimated to number from 0 to 3 (0-3). The number itself does not matter but that which is more important than the other, and thus can focus resources in the right places.” *Do you have action point list how you must be reacting to findings?* “The action points are not for everyone, but we are moving in that direction.”
- Case 12: Didn’t do this analysis.
- Case 5: “No, we don’t do that in regularly only ad hoc.”
- Case 1: They didn’t do BIA, but they are doing risk assessment.
- Case 3: They don’t do that or the interviewee doesn’t know that.
- Case 4: Didn’t know what BIA is or what it is mean. “We are focused on to that area where we have single source supplier.”

QUESTION:

Do you have a BCM plan for your critical suppliers?

This question tries to find out how many companies will require business continuity management plan from suppliers.

Comment:

Seven of twelve companies have BCM plan for some suppliers.

ANSWERS:

- Case 6: “We don’t have official BCM plan. This BCM plan is most difficult to us. We don’t have time to do it because operative work is more important. BCM plan is more difficult to make than BIA. The fact that we have a folder of paper does not warm us if people do not know how to react. People have to understand what you need to do, and that folder of paper is only one way to get to a better level of understanding.”

- Case 7: “We have dual vendor policy for critical supplier. (spend 80/20)”
- Case 10: “We will do own, but during audit we expect it also from suppliers. Then we have a second source supplier principle in use. Mitigation issues are based on the assumption that minimizes damage if the supplier cannot deliver. We have BCM plan already in R&D phase. Especially if don’t have second source supplier.”
- Case 11: “BCM plan is part of the BIA and it is required at the general level. We do not believe in a folder that has some in stock, and when it is finished, it is already old. But we believe in BIA. The BIA meeting will hold twice a year and there is checked if they have changed supplier and have they selected new supplier to replace the old one. Action plan gives guide lines how to react when critical issue is recognized. We do not want to use all the time to do the BCM plan for everyone. But when they found there the most important things that are enough. First identified and then made in order to make the right things.”
- Case 5: “Yes, BCM plan then cause and effect matrix and last action point list. The purpose of this is to prevent and prepare for possible problems. If groundwork has skipped and something would happen, we would be already late.”
- Case 9: “This is one of the basic requirements when we will do supplier audits. If the supplier does not have BCM plan then we will require the supplier to make it. The BCM plan must be valid and that has been a challenge for many suppliers. For large global companies, this is easier to implement than for the small local companies.”
- Case 2: “Yes, just starting to do with key suppliers.”
- Case 1: “I believe we do”
- Case 8: “We should have a business continuity plan for all of our main suppliers (critical suppliers), some suppliers have a BCM plan, but not everyone has the BCM plan.”
- Case 12: See the first and second question answers.
- Case 3: “I think so I am not sure”
- Case 4: “Yes, we have BCM plan.”

QUESTION:

How does purchase department follow how much you spend money to your supplier, compared to how big business impact the supplier can have in case of supplier's business interruption?

The meaning of this question is to clarify if they have realized supplier criticality to own business in case of interruption.

Comment:

Seven of twelve companies kept this issue important to follow.

ANSWERS:

- Case 4: “No, we have not gone so far yet. But this is important, however we don't have that kind of unique supplier whom we would not have second source. Another thing would be obsolete component.”
- Case 9: “Yes, our sourcing follows this. There are couple reasons for this: cost efficiency and if something happen we will know the impact to our business. If it is sole source that is also critical or do we have second source supplier.”
- Case 5: “Purchase value is very small but instead of that it is very important component. We have this cause and effect matrix where we identify several things: What kind of component? (Sole source, there are two sources or several sources.) Then how easily we can replace this technology? (Before replacing there are three possibilities: component will need special test or we can find easily second source but it will need approving from customer or component is very easy to replace.) After that we check lead time. (Over 20 weeks, 4-20 weeks or 4 weeks) and final rule is lead time and flexibility expectations for the next six months. (Worsens, stable or improves).”
- Case 11: “Yes, our ERP system will support this, how much cash flow accumulated. In future we will follow this via insurance companies. Because there might be that kind of supplier with who

spend is not so much, but it is a supplier for many different units. In addition we have to double check this because of corporate ERP is different than ERP in different segments. If we would have one ERP system this would be very easy. Then we have system which collects financial data from different ERP systems but this data doesn't include detailed information."

- Case 10: "We don't follow this. This would be good improvement to us. In general those are so large suppliers and they deliver big volume when they have big impact to profit."
- Case 7: "Yes, those critical suppliers they are those, they also have biggest spend."
- Case 6: "This spend is clear. We are following it all the time."
- Case 8: "Yes we will follow our critical suppliers. For example, how much we spend money with supplier1 (5M€) per year and how about supplier2 per year (25M€), but this supplier1 is more critical to us. Then we will check how much supplier1 and supplier2 impact to our profit. So the supplier1 can impact more to our profit than supplier2."
- Case 12: The interviewer did not get answer directly, but understood what was said the following way: "Spend is not significant because we have a lot of customers and suppliers."
- Case 2: Inadvertently left unanswered.
- Case 3: "This is very difficult question, purchase cannot do that analysis."
- Case 1: "Yes, purchase department follow this. There are four key suppliers and 50 % is too much but 33% is okay. We have one part of the component where we have only two supplier and then the spend ratio is 60/40 between those suppliers."

QUESTION:

Have you defined RTO and RPO for critical suppliers?

Comment:

Only four companies are defined RTO and or RPO for critical supplier.

Three companies are defined those to IT side.

ANSWERS:

- Case 5: “Yes, the RTO is defined. So what is done immediately, within 24 h, from 24 h to 48h, from 48 h to a week and from week to month after event is defined in BCM plan. The BCM plan includes suppliers network as well as internal. Such as corporate BCM plan, there are detailed BCM plan in each unit. “
- Case 6: “If we look those terms without IT-system then we didn't defined it but in IT-system side those are recognized and defined.”
- Case 7: “We don't define those to our supplier. “
- Case 12: “Headquarters is managing all things which related to IT systems. Only 2 hours of down time in the last 10 years. IT is totally in our own hands.”
- Case 10: “Recovery time objective coming from (BIA) business impact analysis. I don't know anything about IT systems. “
- Case 8: “We didn't use resources for investigate IT-systems from this side. Couple day's interruptions in IT-system don't mean anything to us.”
- Case 9: “There is one check point in business continuity management plan related to RTO. How quickly production can be recovered after a disaster in some other production plant. This defines the RTO and it depends on product. “
- Case 2: “Not calculated, multiple sources and minimum two sources for materials. Test data backup is available.”
- Case 11: “Yes, absolutely for supplier. That time coming directly from BIA when that supplier is found from BIA. After that we will do the recovery plan. When we reviewing it we will find out that we have to do back up plan for supplier. If we talking about IT-system that is corporate level discussion and we have separate risk manager who is charge of risk of IT system. We are doing business impact analysis for whole IT system. This is so important issue that we had to establish own management for IT risk. We can easily loose one of our manufacturing plant compared to losing one of our crucial IT system. We don't look at IT systems only technical point of view.

Then recovery time will be different level if we would lose whole IT system. I believe this issue isn't fully understood. Generally discussion is on a technical level but never in disaster level which is really possible. This issue cannot be managed from bottom up. The corporate top management has to understand this because of business unit doesn't understand that how the IT system is working. The business unit just try to make sure that information is copied, mirrored and confirmed. They take water from the river and they think that the water is always flowing. They don't think about that why the flow is interrupted.”

- Case 1: “It depends on what is the impact? Only one company, they have some process issue. In IT and RPO we do have capacity to protect own shelf but supplier is managing servers. They have risk, responsible and security issues in order.”
- Case 3 and 4: The answer was unclear or did not answer the question

QUESTION:

What are your capabilities to replace critical suppliers e.g. can you shift production from one production line to another smoothly and quickly? This question investigates the supply chain flexibility and structure.

Comment:

Four companies can shift production from one production line to another and they can replace supplier also. Six of twelve companies have some challenges with this but in principle they can do this.

ANSWERS:

- Case 11: “We don't have so much extra capacity that this would go without any problem. This has not been made therefore that we would have a crisis, but because we have had the need for additional production capacity. Then we have moved staff to another place living in a hotel and to make things ready. We didn't yet find that kind of production what we cannot replace if needed. That doesn't mean that it could be. That another production line could be our

competitor and it has been tried. But the upstream production is the most challenging to manage.”

- Case 4: “Yes we can and sometimes we used. For example when customer demand is increasing then we can split volume to different locations or another supplier’s manufacturing quality is worsening. “
- Case 2: “We can manage material flow from subcontractor into second source.”
- Case 3: “We have so many suppliers that this is not our focus area.”
- Case 9: “This issue is depending a lot on which kind of component we are going to be buying? Is it sole source or common? Of course it also depends on suppliers’ structure of supply chain. Part of the key suppliers has got capability to deliver product from other locations, but some key suppliers, for example single source components which doesn’t have second source, we cannot shift production. Only way to manage this issue is to keep enough stock (buffering). In these cases it is very important that we have a good communication channel with suppliers, because in case of allocation you can get components. We try to build up our supplier structure to that way that they have production plant in different location so they can deliver goods also from another production plant. “
- Case 6: “In general we have very little experience with good BCM plans or capability to replace our supplier or shift production to another location and at the worst case that is single source supplier. But one of our key supplier have excellent BCM plan. I can say that it really works in practice. When we had some suggestions for our point of view they immediately took it into account. So in less than half a year they had implemented and taken it to use for daily work. Then we ask from them, can you deliver part of our demand from alternative factory. A few months later they delivered part of our demand from another location and rest from another. If something happens in another location then in reality we have some kind of capacity to get products from alternative factory. But in general we have very little experience with good BCM plans.”

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- Case 7: “Yes, but the way to do this shift depends on segments, for example the basic industry we can rent production capacity from our competitors. But the engineering or construction industry we have opportunity buy more production capacity from our subcontractors.”
 - Case 10: “We always have two suppliers for all materials. That means you are sharing manufacturing volume to two different locations. If we will buy whole manufacturing volume from one supplier. This might cause a quality problem when second source supplier ramping up own production lines.”
 - Case 8: “Yes we have the capability to share it, but how quickly our purchase can be buying from second source. It is about one to four weeks. In addition when you have very big or special component or both so competitor also buy from same supplier and if something happens who is the first in place and get capacity for own use?”
 - Case 1: “It depends on the components and the supplier's own structure. Some of the key suppliers are having the capability to make the same product in another place. Unfortunately, there are also those components that cannot be moved and then you have to depend on the buffers and that's when relationships with suppliers must be in order. But we are trying to build the structure of the supplier for critical components so that they can produce the product in another factory in case of problem. “
 - Case 5: “If it is not our core process then we outsource, we identify all suppliers in our cause and effect matrix.”
 - Case 12: “This question is not relevant for us”.

QUESTION:

Have you identified single source suppliers and do you monitor them regularly?

Comment:

Ten of twelve companies have identified single source suppliers. Two companies did not keep this question relevant for them.

ANSWERS:

- Case 12: “This question is not relevant for us. We have several suppliers in our database where we can buy components and it might be single source to us but not to our customer. “
- Case 8: “When we started this continuity program it was a surprise how many single source suppliers we had then, but today we have only couple single source suppliers.”
- Case 10: “Yes, we can identify that in BIA already product developments phase in first time. We will try to avoid them as far as possible.”
- Case 7: “Yes we will monitoring those and these are critical. What do you do for those then? How will you manage buffer and inventory? We have a plan for single sources which describes how to act in case of interruption. “
- Case 6: “Yes we have identified all single sources suppliers in case of internal and external.”
- Case 9: “Sole and single sources are identified and delivery capabilities are monitored daily, weekly and or coordinator meetings. In addition buffer levels and inventory alarm levels are agreed with suppliers. Four to six weeks forecast in weekly and where visibility is poor there we have more challenges.”
- Case 2: “Yes we do, it is one of the key thing in supply chain risk management. We don’t have many of these we look to see it if we can change that situation from single source to multi source or dual source, we do have them and we do monitor them on regular basis.”
- Case 4: “Single source suppliers are identified and recovery plan is done if something happens. “
- Case 3: “This is not our requirement.” So they do not identify single source suppliers.
- Case 11: “Yes we do, Every time when we noticed single source supplier in BIA we will respond to those until we have some realistic way to manage them. Single source supplier (risk) is not so common for us than the customer risk. We are encountered more frequently customer risk than supplier risk. Therefore it is greater risk for us. It

is important look at the customer risk and the supplier risk together because that customer risk is quite easily to forgotten. Everybody understands that if supplier risk is greater than customer risk. But if that is opposite it will be difficult to understand. This is very important to understand if you have a customer risk you have to expand your clientele or if you have a supplier risk you have to increase your quantity of suppliers or if you have an energy risk you have to expand your energy reserve. When you are comparing those risks at the same time then you can understand importance of each risk more easily. But that does not guarantee continuity of supply chain if you are only look at supplier risk. In future we will do this investigation in twice in year. This way we will ensure that everything is still okay.”

- Case 5: “Single source is being monitored together with the main suppliers such as distributors and some component suppliers. This applies to those cases where we have sometimes bought it.”
- Case 1: “Yes, we do. We know where we have risk e.g. sole source. If I have sole source and then developing quality issues, it is much more serious to me than I have impurity source like east way shift.”

QUESTION:

Do you require and review BCM plans from your 1st/2nd/3rd tier suppliers?
The aim was to find out how far the structures of the supply chain companies are willing to go.

Comment:

Eight companies are followed somehow to 1st tier supplier but 2nd and 3rd tier supplier did not keep important to follow in general.

ANSWERS:

- Case 4: “We will see 1st tier but 2nd and 3rd tier don’t interest. Only if supplier manufacturing performance is going to wrong way then we can audit also 2nd and 3rd tier suppliers. “
- Case 2: “We don’t do that to 2nd and 3rd tier suppliers.”

- Case 9: “In general BCM plan is for 1st and 2nd tier suppliers. The 3rd tier supplier isn’t critical but of course it depends on turnover and criticality.”
- Case 6: “In some cases we are following the 2nd tier suppliers but it does not official look for them systematically. We don't want to look at 2nd or 3rd tier supplier because we have enough work with 1st tier suppliers.”
- Case 7: “The 1st tier yes, and only the most important. For the others we don’t require it. We don’t see them and we don’t want to see them.”
- Case 10: “It is part of the supplier evaluation process that they have BCM plan. We don’t review it regularly. The critical 2nd and 3rd tier suppliers are within the scope of our audit. Typically those are printed circuit board suppliers. We will manage those critical (2nd and 3rd) suppliers and we make sure that it comes to supplier contract even if we only buy the finished product”
- Case 8: “Currently we don’t require 2nd and 3rd tier suppliers. But we have been discussing internally that should we require our suppliers to tell us their top fifth critical supplier information. Now, this is not possible.”
- Case 5: “We don't required BCM in our 2nd or 3rd tier suppliers. ISO 14001 and ISO 9001 is our main requirement to our suppliers. We don't have process or regular audits to our suppliers.”
- Case 11, 3 and 12: The answer was unclear or did not answer the question.
Case 1: “I think we do. Look for risk assessment if we have risk we try to mitigate it.”

6.6.2 Own premises, production or assembly lines

The aim of this chapter is:

- How companies identify their own risk and supply chain vulnerability?

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- How companies identify critical resources from own organization?
 - How flexible organization is in case of interruption?
 - What companies consider as important when we talk about own premises, production and assembly lines?
 - Are there differences or similarities between companies?
 - What kind of activities companies have experienced important?

QUESTION:

Have you identified your critical production resources (assets, personnel, data)?

The purpose of the question is to find out how they identify those things and what method is used.

Comment:

Almost all companies are identified critical production resources.

ANSWERS:

- Case 5: “The risk management approach is that those things are identified. How we are doing BCM plan? Firstly you have to identify and note down the production resource assets, personnel and data. Then BCM plan is based on these findings. ”
- Case 6: “Identified, what happens after identification? That is another story. Asset, what are you doing for what is important? We have successor story for key persons and key group. “
- Case 11: “All information can be found in BIA. Two days audit is done every fifth year. We have external audit for data and logistic. In addition we will go through assets. Also insurance company is making twenty audits per year related to fire insurance and they required to see BIA.”
- Case 10: “Critical resources and alternative locations for functions are defined in BIA. I don’t know how often this updated.”
- Case 8: “The BIA has been made to three of our own factories. When insurance company makes an audit it gives only two scenarios. Then you cannot make continuity plan for that. That's why we do the BIA

because there is the loss of money for each item. E.g. building, equipment, manufacturing function. The BIA is basis where we want BCM plan to do. So each item (building, equipment, manufacturing function) which has loss of money more than alarm level then we will do the BCM plan. So we don't do that for all."

- Case 12: "Yes we have BCM program and our resources can do their jobs from home or anywhere where there is Internet connection, because they have remote access to our central point. In addition we have global system and process so they can help each other."
- Case 9: "Yes we have own BCM plan where the critical resources, assets and etc are verified. We have BCM plan for all factories and business impact is taken into account."
- Case 2: "Yes, those are taken into account for all process steps and factories. Recovery plan, the purpose of plan is preventive risk mitigation, got knowledge supplier to the customer and protection any business application any software or data that we need. "
- Case 3: "Yes, those critical storage places. Those are safety and security protected."
- Case 1: "We don't have too large inventory and purchase create false demand."
- Case 7: "Risk and business continuity, comprehensive risk management: managing, insured, monitoring action, developed, made contingency plans, action verification and update. These are things that are made previous to harm. Then what happens after incident? First Crisis management, second business recovery, third rescue work, fourth harm prevention, fifth crisis barrier, sixth crisis leadership, seventh regional authorities and insurance company relationship and last eighth project leadership related to business recovery. The comprehensive risk management toolkits are business continuity management, crisis management, crisis management executive group, liability distribution, communication and who can say and what. It is practiced in front of the camera. If we have a foreseeable risk then we have prepared paths how to react. It is so-called action plan card, but it depends on the subject or matter. This

action card gives guide lines how to react in that situation. Actually, it is anticipated contingency plans for this situation. Accuracy level of continuity planning is always based on risk and risk scenario. It is proportional to the event execution probability. Moreover descriptions of interruption time (RTO) and the necessary instructions for coordinating crisis management and business functions.”

Classes of the accuracy level: A, B and C

- “A level means that complete business continuity has been tested. It is trained and informed to relevant staff, line organization and they are working according to process. The risk scenarios have already been considered. This will affect staff, customers and production. Then it is a balancing act with these issues.”
- “B level means that partial continuity has been tested in a simulation. We don’t simulate all things.
- “C level means that minimum continuity level has been guaranteed. This is a rough level continuity planning which the risks, causes, consequences and necessary measures to restore the situation have been taken into account. Thus, responsible business leader has moderate certainty of continuity.”
- Case 7: “But prioritizing goes according to the situation and there is not a static condition. You will need good data system that you can make the decisions as soon as possible in order to prioritize the events.”
- Case 7: Summary:

“Before incident we have comprehensive risk management and business continuity management. After incident we have crisis management and business recovery. Continuity plan includes the following items:

 - Risks, probability, seriousness
 - E.g. 5M€ minor risk and 200M€ remarkable risk.
 - A, B and C classes

-
- Immediate actions
 - Preventative actions
 - Time schedule and status
 - Person in charge
 - Participants
 - Initialization, only high level not too accurate.
 - Example of risk: device, machine or important customer. A detailed description of the measures to be replaced or the activity card how it will be managed. “
- Case 4: The answer was unclear or did not answer the question.

QUESTION:

Do you have business continuity management plans for critical resources?

The aim was to enquire do they have plan for critical resources.

Comment:

Nine companies have BCM plan for critical resources.

ANSWERS:

- Case 7: See the answer to the question under have you identified your critical production resources (assets, personnel, data)?
- Case 2: “Back up makes sure, we have secured in place and we follow our business management system, always have back up.”
- Case 9: “Human resources management in terms of identifying the critical resources and talent people. In addition to explaining who is the replacement person.”
- Case 12: “Yes, they have in BCM plan. It is four years old BCM plan, now they know what to do if something happens. Then we established core team in case of crisis situation. It holds meetings and makes decisions on how to minimize the interruption. In addition, we have BCM safety and security plan for our main HUBs centers.”
- Case 8: “Yes, there where BCM plans done. Now would be intended to make the BIA itself. Thus we could make also BCM plan itself. If you can estimate price of risks then it helps to make decision.”

- Case 10: “The backup method is made for critical recourses, factories and equipment, but not to persons. The idea based on alternatives production sites.”
- Case11: “It is part of BIA process. We have separate process for IT system (large service providers there).”
- Case 5: “We have corporate level BCM plan and in additional unit level BCM plan. This unit level plan includes more detailed information. For example devices in production, we have listed all devices what we have and we have checked those to following way:
 1. what is the capacity.
 2. what are the capabilities within the organization to service and maintain those devices.
 3. what is the risk? Here we have scoring.
 4. what is the availability of spare part?
 4. what is the action point? And last 6. what is due to date. This is the normal maintenance during the production. How we will follow up and provide for events. What are the biggest risk issues (devices supplier etc.)? Now we see this is critical so we are going to make plan how we mitigate level of risk. “
- Case 6: “The management team tell us how they will do however because we don’t have official BCM plan (no document) they can explain away why they do something this way. The document itself isn’t important but it gives opportunity to estimate if it is even possible to make. The value of official BCM plan is that it can be evaluated how good it is, and we can improve it. When it has been written, we can see can it work even in theory.”
- Case 3: “Continuity planning is forecast and pipeline visibility to customer needs and to anticipate the range of different tools. Annual contracts and buffering. What is critical? Staff is critical, although there is a lot of information technology. Quality standard heavily influenced the activities and to impose level of requirement”
- Case 1: “Do we have fully protected? No we don’t. It depends the problem. How bad it is.”
- Case 4: The answer was unclear or did not answer the question.

QUESTION:

Have you defined RTO and RPO for critical resources?

This question aims to clarify and focus the previous question.

Comment:

Only three companies have defined RTO and or RPO for critical resources.

ANSWERS:

- Case 7: See the answer to the question under have you identified your critical production resources (assets, personnel, data)?
- Case 11: “This is also part of BIA process.”
- Case 5: “Yes, the RTO is defined. So what is done immediately, within 24 h, from 24 h to 48h, from 48 h to a week and from week to month after event is defined in BCM plan. The BCM plan includes suppliers network as well as internal. Such as corporate BCM plan, there are detailed BCM plan in each unit. “
- Case 12: “Headquarters managing all things which related to IT systems. Only 2 hours of down time in the last 10 years. IT is totally own hands.”
- Case 9: “RTO and RPO are difficult to define in resource point of view.”
- Case 7: “We are defined recovery time objective to our mega risk. How long time we can survive if someone our supplier cannot deliver to products?”
- Case 6: “We didn't defined those”
- Case 2: “Back up always in two places.”
- Cases 10, 3, 1, 4 and 8: The answer was unclear or did not answer the question.

QUESTION:

Have you tested the BCM plans?

This question looks at a practical example of how to test or to use BCM plan.

Comment:

Seven of twelve companies have tested BCM one way or another.

ANSWERS:

- Case 7: See the answer to the question under have you identified your critical production resources (assets, personnel, data)?
- Case 5: "I don't know."
- Case 11: "No not 100% and will not be tested. One test is done in IT environment. For example, Server transfers operation. It was a good possibility to try how BCM plan is performed." *Do you simulate BCM plan?* "When you are doing the BIA it is one way to simulate events. You can take out the item what you want to check and look at what is the impact to the business. We've put together a summary of all BIA and we looked at where consist of the largest flow in the supply chain. It is important to look at supply chain relative to wholeness. Thus, where had the longest chains we made the decision to break up them? We didn't allow their existence."
- Case 6: "No we don't test it (no document). We have had a few near-miss situations. For example, the eruption in Eyjafjallajökull. Some minor capital goods which coming by airplane caused concern after a few weeks."
- Case 10: "We have had cases together with other companies but fortunately we don't have any worst case. The supplier side we can see those too many times unfortunately." *Do you simulate BCM plan?* No, we don't.
- Case 3: "I don't know."
- Case 12: "Yes once. We learn one think don't react too quickly. Nowadays they know what to do if something happens. (tsunami and etc.)"
- Case 9: "Yes we have tested it. Insurance companies are auditing our BCM plan also. *Do you simulate BCM plan?* The BCM plan is part of the simulation."
- Case 8: "Yes we have a case with one important supplier. Luckily, we were already audited by the supplier and they had upgraded their

BCM plan. This BCM plan was controlled operation during the suspension period and deliveries came just a few days delay. This did not affect us.”

- Case 2: “Yes we have tested it.”
- Case 4: “I don’t know.”
- Case 1: Did not answer to this question.

QUESTION:

What are your capabilities to replace critical resources e.g. can you shift production from one production line to another smoothly and quickly?

This question investigates own production and assembly lines flexibility and structure.

Comment:

Nine of twelve companies have capabilities to replace critical resources and shift production in general level. This does not mean that they can shift or replace all production.

ANSWERS:

- Case 7: See the answer to the question under have you identified your critical production resources (assets, personnel, data)?
- Case 5: “Each production process is in duplicate. All devices are replicate. The key processes are identified and those are copied within organization, but if not then it is outsourced.”
- Case 11: “Yes we can in general. You might have normal basic activities and that you can get capacity easily. But then we have areas such where production is stretched to the extreme. This is very important question and answer is known only too well. So if you are doing everything that you can do however you cannot get it because it is just not. Do you get workers or experts who can do it? Some of things, it just is exceedingly difficult to obtain workers or capacities although how much makes a great effort.”
- Case 10: “Generally yes. Our strength is the global components and products of consistent.”

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- Case 1: “In all places we have same product, same process and equipment, mirrored”
 - Case 9: “Yes, we have certain capabilities. We already do same product in different locations to one customer.”
 - Case 2: “Yes, we can. We have to make sure that we have same equipment both at the primary and at the back up site.”
 - Case 4: “Yes we can. For example last Thailand floods: we can help our customer and we got competitor capacity to us. In addition we have that kind of multi business sites where we have very strong relationship together and we can e.g. transfer our resources as well as our production to another production site.”
 - Case 12: “Word wide computer platform. Every one of those hubs can see live information on inventory purchase orders coming in and coming out. Word wide engineering management system.”
 - Case 3: “Yes we can. For example, the eruption in Eyjafjallajökull. Then we have to change material logistic rout from place 1 to place 2 and change that from airplane to transportation.”
 - Case 6: “In a few of our factory has been made BIA and the findings were that there are group of machines which can be interrupting deliveries. We run through our internal operation places which are very difficult to replace or outsourced any way. But whole factory is one streamline and there were not any redundancies. When whole factory is critical. Then it is quite unnecessary assess what is the most critical inside the factory. There are lots of machines inside the factory and it does not matter which of equipment is out of operation in the factory then it cannot produce the product for you.”
 - Case 8: The answer was unclear or did not answer the question

6.7 Analysis of interview results

The previous chapter went through the answers to the questions one by one. From these responses can be observed that the field of action is very broad, and in some cases the companies operate in different ways, and in

other cases a lot of similarities can be found. It was discovered that inside the themes own categories can be found, and they were linked to the themes. On the other hand, there was difference between different categories in spite of themes that connect those to each other. The connection of themes is very noticeable to categories, because if the SCRM had the suppliers under control, as it was at the same level as our own factories also.

The supply chain management and related issues are not in scope of this work to study. However a few times during the interviews ERP and demand planning things come to the fore because of these are highlighted and they are also briefly examined.

Some companies consider particularly important the IT system, and how the IT system affects the business continuity management.

The next survey categorized theme interview data. This will begin with a presentation of the categories. Then each category is analyzed separately.

6.7.1 Categorizing data

Category 1: Business continuity Management plan

The companies are divided to few separate categories very clearly. There were companies where supply chain risk management is one of the key strategies to succeed in competition. In this kind of companies it was also understood how important it is to manage supply chain quickly and flexible way. It should be noted that in these companies risk management starts from the upper levels, and flows downward to a sufficient level. After this, companies learn about BIA and other specific points that can be converted into cash. It can be said that this is a higher level of supply chain risk management. These types of companies are characterized so that they resort to Business Continuity Management plan primarily.

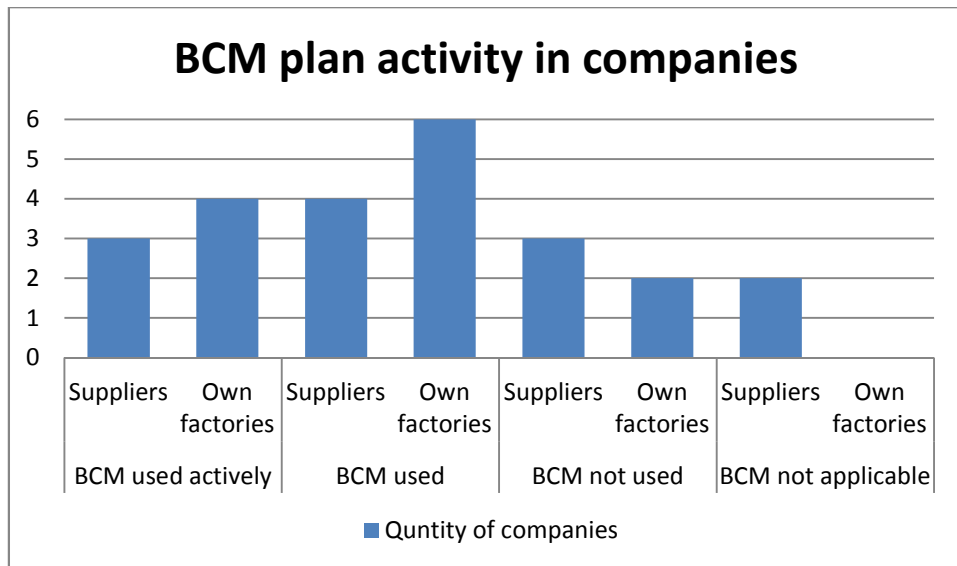


Figure 10 Figure shows how many companies doing BCM plan and how many companies required BCM plan from supplier.

Category 2: Business Impact Analysis

Companies which do not have either the opportunity (resources), need (industry, construction), or have not yet reached a desired level of supply chain risk management, resort to Business Impact Analysis. These companies generally aim to achieve a better level of supply chain risk management. However, these companies have difficulties in implementing a higher level of supply chain risk management, for one reason or another.

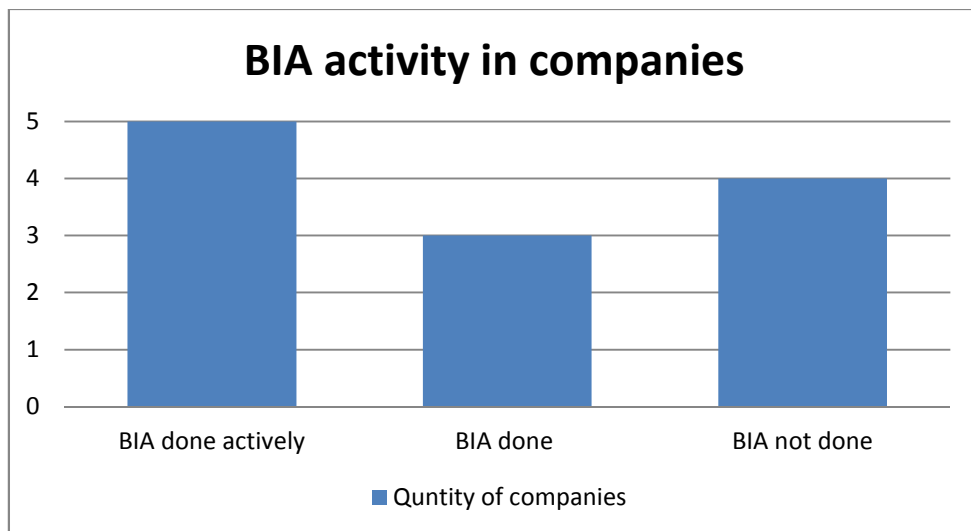


Figure 11. Figure shows how many copanies activity doing BIA.

Category 3: Exceptions

These companies are in area, or they work in an industry that is somehow special. This is not to say that these companies would not take into account the supply chain risk management. But due to this very special field in these companies the supply chain risk management is not a significant factor when you talk about the risks and threats in general. This means that threats and risks of these companies are coming from outside the supply chain.

Category 4: Does not belong to any category

Then there are companies on the basis of the interview data that does not belong to any category. These companies do not have the supply chain risk management at all or it has not been identified. Supply chain management is not based on systematic planning or predicting.

6.7.2 Business continuity management plan

As Donalt Waters has said in his book Supply chain risk management. *“That risk management and business continuity management are clearly very closely related and at best different aspects of the same function. Some people say that risk management is really a part of broader business continuity management. Others argue that business continuity management is really a part of broader risk management. Other people say that the two are distinct functions.”* (Donald Waters. 2007, 216). When going through interview results, it looks that there is no one correct way to do supply chain risk management. Also in this survey there are companies which think that business continuity management is part of risk management, and others think vice versa.

For example, when asked about *have you identified your critical production resources?* Then one of the companies (Case 7) replied that *“they have a business of holistic risk management, controlled, insured, monitored, and measures are being developed.”* They are thinking that BCM plan was one tool among many other risk management things. So, this is one part of the process or way of working what will be done before

the injury. Then if something happens, they have eight-step process how the business is returned to operation.

For companies in this category it is common that basis of risk management is in order. Starting point for SCRM is identifying vulnerability of supply chain; to identify risk, to recognize dependencies and to make business impact analysis. In Addition typically they have global process for risk management, all process steps and activities reviewed or checked in regular basis. Roles and responsibilities have been identified and are communicated properly to stakeholder. In all cases where the BCM was well under control, it was obvious that the BIA is one small part of this process, but that does not reduce its value. Evidence of this is the fact that the BIA's result can be converted into cash. So how much money will be lost if something happens?

6.7.3 Business impact analysis

As the previous chapter shows business impact analysis is part of broader business continuity management plan. In business continuity management plan risks are managed through organization, and roles are clear for all.

For this category it is characteristic that BIA is led by activities. In spite of this there are difficulties to change BIA to money or other relevant losses. These kinds of companies don't have official business continuity management process.

6.7.4 Exceptions

This category does not mean that companies do not have experts in supply chain risk management. Vice versa they really know own supply chain risks, and other threats, and they just do sufficiently what they need to do. Typically they apply risk management rules to own branch. For example they might have BCM plan but focus is more to security than supply chain

vulnerability, because it is not important to them. Then they don't do BIA at all and they have good reason for that.

It's very important to understand that when you know well your risks and threats, you can focus to right things, and not run from pillar to post.

6.7.5 Does not belong to any category

Based on the interview results, this group is characterized so that their risk management is not based on any coherent plan, or they have an integrated process how to proceed. The operation is more reactive than proactive.

6.8 Summary of interview results

There are risks in the supply chain when unexpected events might disrupt the flow of materials on their journey from initial suppliers through to final customers (Donald Waters. 2007 s,7.).

6.8.1 In general

If a company wants to succeed and grow in a highly competitive situation, the supply chain has to function effectively. Almost all companies have noticed this. But how it is done? There is no right answer. Literature and other sources can give some theoretical models and ideas, but unfortunately, it is not enough. You have to identify your supply chains weaknesses and bottlenecks. It is challenging to implement supply chain risk management to different organization levels because the process, resources and organization structure might not support this kind of activities. In addition operative work might take all time so that there isn't enough time or resources to make it. But the supply chain risk management is in order where there is risk of losing customers, trades, or supply related to the liquidated damages.

Researcher was surprised that companies didn't follow their suppliers' financial results in regular basis. In addition in these companies there were problem with suppliers and those were economic problems. *“We don't have any process for supplier financial follow-up. No any indicators. It is more on the basis of the feeling this supplier financial monitoring. This is the area what we want to develop is bring up more visibility to the supplier financial risk. Recently it has occurred to us that your supplier without any warnings is fully disappeared from map because of economic problem.”* (Case 5)

6.8.2 Supplier risk

Supplier audit was the way how companies are following supplier's operational risk, capability or financial results. Key or critical suppliers were regular monitoring circuit. There were also companies who did not consider this matter very seriously.

Scope of the BIA was without exception impact scoring where is given to the impacts of score. Then those scores can be converted into cash. But BIA is made to suppliers that have been identified as critical suppliers.

BCM plan is made to 1st tier critical suppliers or suppliers are required to do that. When asked *‘What are your capabilities to replace critical resources e.g. can you shift production from one production line to another smoothly and quickly?’* there were three kinds of responses; second source, competitors and buffering. The most common answer was second source policy. Then second common answer was buffering. But then there was identified that there is possibility to use competitor's equipment's. *“...the basic industry we can rent production capacity from our competitors.”* (Case 7)

Only one company has fully understood question which related to RTO and RPO issues. That's why, the validity of RTO and RPO issue is very difficult to define.

6.8.3 Own premises, production or assembly lines

If company is done business continuity management plan then these questions were very clear for them, with the exception of RTO and RPO question.

One of the interviewees answered as follows when asked: *Have you defined RTO and RPO for critical resources?* Case 9 answer this way “*RTO and RPO are difficult to define in resource point of view.*” This is a way to ignore the question of when the subject is unknown.

If company only makes business impact analysis then they cannot respond to all interview questions. This is quite clear because BIA is not destined to extend so wide subjects. In addition, if company doesn't practice to BCM then they cannot know answers to the questions which related to BCM.

7 REFLECTION

In the current situation of the world the economic pressure on companies has increased, and the global markets have intensified through competition. For companies there is all the time the need to improve efficiency in order to keep costs down. This has contributed to such endeavor that they have become brittle that is not at all wanted. This is forgotten in all this rush of supply chain resilience and avoidance of vulnerability. In recent years, the companies make more and more work to developing forward to sustainable and flexible supply chain.

7.1 In conclusion

The research examines how companies ensure functioning of supply chain during crisis situation.

The research problems were:

1. How continuity of production is ensured during crisis situation?
2. How availability of materials is ensured during crisis situation?

The main objectives were:

1. How production continuity planning should be done, that it would work through the entire supply chain?
2. How the supply chain should be managed?
 - a. What should be taken into account in order to ensure continuity of production in crisis situations?
3. How other companies are prepared for different supply chain crises or threats?
 - a. How other companies operate when the supply chain is in crisis.

Company where supply chain is recognized to be important, supply chain risk management is part of the daily work.

7.1.1 How continuity of production is ensured during crisis situation?

Ensured supply chain performance during crisis situation doesn't need any miracles. It is the own motivation that is most important, ambition to succeed. Furthermore structure of own supply chain and logistics flows are needed to be understood. Then just work together with stakeholder, and monitor continuously. *'If we don't regularly review our risk assessment then we have all the time some problem'* (Case 6). The official process and rules are needed through whole organization, so everyone will know how to proceed if something happens. *'That you have permission to use 10 000€ because prevents 100 000€ damages, so everyone know that decision can be done'* (Case 6). In general there is not one right or wrong way to do the supply chain risk management, but there are lots of good practices to manage those threats. Business continuity management is one good tool for systematically manage the supply chain. As this research is shown, there is lot of different ways to work with business continuity management. The basis of supply chain continuity is to identify own supply chain weaknesses. *'Keep it straight and simple'* (Case 8).

7.1.2 How availability of materials is ensured during crisis situation?

It is the same if manufacturing interrupted in own factories, or suppliers factories, the results are same: final products cannot be delivered to customer. So if you want ensure production continuity during crisis, first you have to ensure availability of materials. The business impact analysis was the most common way to ensure availability of materials. This BIA is simple and systematic way to identify, analyze and respond to risk.

7.2 Gaps in research

This study is not committed to any particular company or industry, and that gave a good and comprehensive approach to the research problem.

The steps of the study are presented in detail so as to ensure validity of the study. This also affects the reproducibility of the study, affect the reproducibility of the researcher's ability and experience at the time. One of this kind of things was in the interaction between interviewer and interviewee. There were certain challenges throughout all the interviews. Of course, if the interviewer had more experience in this matter, much deeper results would have been achieved during the interviews. Vice versa, the researcher did not have the old ballast; he remained with an open mind to listen to and to evaluate the answers of the interviewees, of their own vision. He could also purely examine and compare the responses to literature. The interviewer's lack of experience came up when the interviewee challenged the interviewer's questions or topics.

7.3 The further investigation

Today, companies cannot operate without IT system but how many companies have noticed this? Many companies trusted all IT systems to supplier and they believe that all data is secured. They don't make sure how long time IT system can be down before it will affect to deliveries in supply chain.

'The business unit just to make sure that information is copied, mirrored and confirmed. They take water from the river and they think that the water is always flowing. They don't think about that why the flow is interrupted.' (Case 11)

How long time a company really can be without IT systems in case of server hotel has destroyed totally?

7.4 Recommendations for the management of the crisis in the supply chain

If you don't already have business continuity management team, it is recommended to set that up. Good way to work concerning supply chain

risk management has been found to work systematically and consistently. In addition, do not try to do everything at once but accept the fact that the supply chain risk management requires a long-term activity, together with stakeholders. Focus onto things that affect mostly to profit. Investigate what are the weaknesses of your company and improve those. Create a simple and easy process that is easy to monitor, update and implement it so that it can be understood at every level of the organization.

It would be useful to examine whether the company has actually implemented the risk management within the company at the right level, as it is easily too general level and then there is no real benefit to the company once a threat is realized.

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