Supply Chain Risks Associated With Relocating a Production System in a Foreign Market

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Abstract

Relocating a production system in a foreign market is the top agendas’ of the global companies in the business market (European Parliament, 1998; Pedersini, 2006). The issue becomes accelerated because of the different benefits that firms can acquire by producing in a foreign market. However, for firms, the decision to relocate abroad involves a complex relocation decision process which demands the management of potentially dangerous risks. The most common risk linked to relocating a production system in a foreign market is supply chain risk (Schoenherr et al., 2008). On the contrary to this global issue, academia gives only little attention in determining and managing supply chain risks (Zsidisin et al., 2004; Tang, 2006).

This research, as part of a master thesis, aims to investigate supply chain risks that need to be considered while relocating a production system in a foreign market. Besides, the study extends to determine the associated risk mitigation strategies that can be used to reduce the effect of the supply chain risks. This study collects all the necessary data to achieve its objective through literature reviews and interviews conducted at three manufacturing companies that relocated recently (i.e., between two to six years). All the three interviewees were key personnel’s of the organizations and members of the relocation project management team.

By analyzing the findings from the literature review and the empirical study, this research results a framework for managing supply chain risks while relocating a production system in a foreign market. The framework lists in detail the potential supply chain risks that need to be considered while relocating a production system in a foreign market. Supply risks, demand risks, process risks, inventory risks, intellectual property risks, disruption risks, procurement risks and forecast risks are found some of the potential supply chain risks that firms need to consider while relocating their production systems in a foreign market. Moreover, the framework specifies the associated risk mitigation strategies that can be applied to reduce the effect of each of the supply chain risks. Strategies that are observed to mitigate the effect of multiple (two or more) supply chain risks includes adopting different form of flexibility, improving supply chain visibility across partners in the supply chain, developing better inventory management system, and dealing with reliable suppliers.

To ensure continuity in their supply chains, firms needs to view the risks in a holistic manner. Besides, there is a need to respond to changes in supply chain accordingly to meet competitive advantages and stay profitable in the global market.
Keywords

Supply chain risks, Risks, Relocation, Relocating a production system, Relocation of production, Foreign market production, Global relocation.
Acknowledgements

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I express my deepest gratitude to my supervisor, Dr. Carin Rösiö, for her guidance, support and attention to detail during this thesis. I also want to use this opportunity to declare my appreciation for all the companies and interviewees who collaborate to this study.

My sincere admiration also extends to my lovely family who have been helping me through the whole years of my study both financially and emotionally. It is a great pleasure, honor and privilege to have you.

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All the best!

Elizabeth Gultie

January, 2013
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1. Introduction

This section introduces the need to consider supply chain risks while relocating a production system in a foreign market. This thesis has a scope of determining supply chain risks and the associated risk mitigation strategies that can be applied to mitigate the effect of supply chain risks while relocating a production system in a foreign market.

1.1 Background

The increased demand of customers for product variety and service efficiency (Rush, 2001; Harland et al., 2000; Harland, 1998) added to the short life span of products in the market (Akkermans et al., 2003; Beesley, 1997; Christopher & Towill, 2006) let firms develop different techniques and methods to handle changes. Relocating a production system in a foreign country could be seen among the common modes firms are following these days to gain different economic, strategic and logistics/supply chain advantages (Walker et al., 2001; van Eenennaam & Brouthers, 1996). Among these benefits includes, lower labor cost, closeness to the market, economies of scale in the long term (Braunerhjelm & Ekholm, 1998, Cho & Kang, 2000), expansion into new market, obsolete facility or business merging (Thanh, Bostel, and Peton, 2008) and knowledge transfer (Rao, 2000). However, the move to gain these competitive advantages is often accompanied by a complex relocation decision process which involves severe risks (Alli et al., 1991; Schoenherr et al., 2008; Zsidisin, 2003).

The most notable risk associated with relocating a production system in a foreign market is supply chain risk (Schoenherr et al., 2008). A supply chain denotes, “a network of entities such as manufacturer, suppliers, and distributors working together to transform goods from raw material to final product while moving them to the end customer” (Blackhurst & Wu, 2009 p. 1). Thus, supply chain risk “refers to risks associated with inbound supply and the subsequent impact on customers” (Schoenherr et al., 2008 p. 101). Relocating a production system allows the movement of capital, information, people, products and services, which implies it encourages global relationships and international trade where supply chain parties (i.e., manufacturers, wholesalers, retailers, and customers) maximize their benefit (Fombrun & Wally, 1992; Harland, 1995). On the contrary, it also turns out to increase supply chain risks by making the supply network more complicated and vulnerable to different problems (Bowersox et al., 2002; Christopher et al., 2002; Harland et al., 1999; Schoenherr et al., 2008; Skjoett-Larsen, 2000). Due to supply chain risks, firms could face poor supply chain performance (Juttner et al., 2003), reduced responsiveness, decrease in shareholder value, and loss of customers (Chris et al., 2008). This has led researchers and practitioners to focus on supply chain risks so as to improve the performance of firms (Danny et al., 2010).

Despite the fact that research associated with supply chain is growing, little attention is given in determining and managing supply chain risks by academia’s (Zsidsin et al., 2004; Tang, 2006). On the contrary, the current trend of firms to relocate a production system abroad, stresses the importance of considering and
managing supply chain risks for firms to stay competitive in the global market (Chris et al., 2008; Schoenherr et al., 2008). According to Schoenherr et al. (2008), when supply chain risks are identified, it assists decision makers to easily understand the risks that cause supply chain disruptions so as to take measures that reduce their supply chain vulnerability. In the same notion, Chopra and Sodhi (2004) states, identifying supply chain risks and developing ways to mitigate them help firms to limit the impact of supply chain disruptions and reduce the extent of loss due to supply chain risks. Thus, there is a need for firms to determine supply chain risks (Chopra & Sodhi, 2004; Sodhi & Tang, 2012), and design effective risk mitigation strategies to reduce the negative consequences or ideally eliminate the adverse effects so as to stay competitive in the global market (Schoenherr et al., 2008; Chopra and Sodhi, 2004).

1.2 Objectives of the research

The objective of this research is to investigate about supply chain risks that need to be considered while relocating a production system in a foreign market and determine ways to manage these supply chain risks. In order to achieve the objective, the following research questions were formulated.

1. What are the supply chain risks that need to be considered while relocating a production system in a foreign market?

2. What kind of risk management strategy can be used in order to lessen or mitigate the supply chain risks linked to relocating a production system in a foreign market?

Research question two is designed to study about risk mitigation strategies that can be applied for each of the supply chain risks mentioned under research question one.

1.3 Delimitations

In order to narrow the topic to the specific objectives, this thesis focuses on potential supply chain risks which are common to all types of supply chains. The supply chain risks included in this thesis are risks due to issues emanating from or affecting the basic enablers or components of a typical supply chain (i.e., from supplier, (e.g., quality problems with a supplier), logistics provider (e.g., transportation problems), producer (e.g., problems in planning), wholesaler, retailer and the customer).

Besides, while considering risk mitigation strategies, methods which are designed to reduce the likelihood of occurrence of supply chain risks by using strategies such as the concept of risk avoidance (e.g., the Poka-Yoke system) or by considering mechanisms such as the use of total quality management (TQM) principles is not considered. However this thesis is merely designed to consider risk mitigation strategies which are designed to reduce the negative implications of the supply chain risks.
1.4 Definitions

In order to create a uniform understanding on the concept of the terms used throughout this research this section states the meaning of the following words in the same way as used in this study.

- **Relocation**
  
The concept of production relocation according to Mucchielli and Saucier (1997) is stated as the move of a manufacturing process from one place to another. More specifically van Eenennaam & Brouthers (1996) explains the transfer of firm production activities to a location outside its home country.

- **Risk**
  
A risk is “a chance of danger, damage, loss, injury or any other undesired consequences” (Harland et al., 2003, p. 52).

1.5 Outline

This paper is organized as follows. Chapter two, states the method used to achieve the purpose of the study. Chapter three, includes the theoretical background linked to the subject matter. It covers chapters on identifying supply chain risks and the associated risk mitigation strategies. Chapter four presents the results of the study. Chapter five states the analysis made to attain the objectives of the study. Chapter six draws conclusions and presents discussions based on the result achieved and chapter seven deals with suggestions for future research on the subject matter.
2. Methodology

This chapter presents the methodology used to achieve the purpose of the research. In this section the research process, the type of the research, the method used, data collection and analysis are introduced.

2.1 The Research process

The research which is related to this master thesis is carried out for a period of eight months. It is done as a compulsory part of Production Development and Management master program in the School of Engineering at Jonkoping University. The research is primarily a theoretical study. However, an interview study at three manufacturing firms is viewed to support the findings from the literature review. Thus, the empirical data and findings from theoretical review are used to answer the research questions and derive conclusions.

The research has been carried out progressively undergoing a different set of activities. At first, an initial plan was initiated followed by choice of topic and setting research objectives. Then after, a set of research questions were designed that need to be addressed in order to achieve the purpose of the research.

This research utilizes an intensive amount of literatures to answer the research questions. The literatures reviewed were mainly in the field of supply chain management and production management. While making the literature review search engines such as Google Scholar, Science Direct, e-Julia, Journal Storage, Google and Google Books were used. The key words that were used to find out the supply chain risks on the stated engines includes “managing supply chain risks”, “supply chain risks”, “risks in relocation of production”, “risks in foreign market production”, “risks in global relocation”, “relocation decisions and supply chain risks”. After reviewing different literatures on supply chain risks, a framework by Chopra and Sodhi (2004) was adopted to determine the list of supply chain risks. Then after, the other task that was done includes merging the template of Chopra and Sodhi (2004) with other frameworks on supply chain risks by Tang & Tomlin (2008) and Kaku & Kamrad (2011) and create a more comprehensive theoretical template that encompasses the different supply chain risks (See table 2). A further literature review was then made by using the name of the category of each of the supply chain risks as key words on the search engines (e.g., “supply risks”, “mitigation strategy for supply risks”, “demand risks”, “mitigation strategy for demand risks” etc). The comprehensive template created thus enables to design the theoretical background of this research.

After the theoretical framework of this thesis is evolved the next step was to design an interview questionnaire to collect primary data. The interview questions were designed based on list of supply chain risks and the associated risk mitigation strategies extracted from the literature review. After the data was collected, the next step was to analyze the data to answer the research questions.

The following Gantt chart below demonstrates further the set of actions taken to achieve the objectives of the thesis work and the time needed for each activity.
The longest activity was reviewing the literature which was done throughout the thesis work and done in parallel with writing the report.

<table>
<thead>
<tr>
<th>no</th>
<th>Activity</th>
<th>May</th>
<th>June</th>
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<td>Design of interview questions</td>
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<td>Translation of interview questions on word</td>
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<td>Contacting companies to make the interview</td>
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<td>Carry out the interview</td>
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<td>Transcription of the interview</td>
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<td>11</td>
<td>Analysis from the interview</td>
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<td>13</td>
<td>Write discussion and conclusions</td>
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Fig.1 The research process

### 2.2 Exploratory research

According to Saunders et.al (2003), the common type of research constitutes exploratory, descriptive and explanatory research. The objective of an exploratory research is to examine a new or underexploited research purpose and it usually covers research questions of type “What” (Yin, 2003: Saunders et.al, 2003). An exploratory research often relies on secondary data such as literature reviews and perform informal discussions or in depth interviews to collect primary data. In the same notion, descriptive research tries to report “accurate profile of persons, events or situations” (Robson, 2002 p. 59). Research questions of type “who”, “where”, “how much” and “how many“are the common type of research questions to be answered in descriptive research (Yin, 2003: Saunders et.al, 2003). On the contrary explanatory research studies cause and consequences of an event or a phenomenon. “How” and “Why” type of research questions are suitable to be covered in explanatory research.

This research on supply chain risks associated with relocating a production system in a foreign market is conducted to answer a research question of type “what” which makes exploratory research more convenient. Besides, according to (Saunders et.al, 2003), step to conduct an exploratory research involves searching and studying literature and taking the consideration of the opinions of experts by using a group or individual interviews. The procedure conducted in this research involves reviewing literature followed by interviews which aligns with the procedure for exploratory research. Moreover the flexibility present in exploratory research is another measure which makes this study to lean towards exploratory
research. According to Yin (2003) the flexibility in exploratory research allows to undergo a study from a wider to a finer perspective.

### 2.3 Qualitative method

Data for a research can be collected qualitatively or quantitatively. As Williamson (2002) mentions, the choice of either method depends on the nature of the research and its purpose. This research aims to study the supply chain risks that need to be considered while relocating a production system in foreign market and the associated risk mitigation strategies deeply than in more general terms which directs to choose qualitative methods over quantitative methods (Saunders et al., 2007). Besides, the result from this study is expressed in terms of words and involves analysis based on the researcher's frame of reference and interpretation which suits with the chosen qualitative method (Williamson, 2002). It was more meaningful to explain the results verbally than in terms of numbers.

Moreover, this thesis concentrates on a small sample of the population which directs to a qualitative method (Saunders et al., 2007). Furthermore, while using a qualitative method, data can be collected in multiple ways which was important for this study to boost the overall reliability and validity of the research (Saunders et al., 2007, Williamson, 2002). Compared to quantitative methods, qualitative methods use more flexible approach (Saunders et al., 2007, Williamson, 2002). The flexibility present in qualitative methods during data collection and data analysis was also another measure to choose a qualitative method in this thesis.

### 2.4 Data Collection

Data can be collected from two sources namely: primary and secondary sources. Primary sources mean data which are directly collected for the research purpose under study. This includes, observations, interviews and questionnaires, whereas, secondary data denotes data collected for another purpose but can be used in the research to achieve the purpose of the research (Saunders et al., 2009; Kumar, 2005; Williamson, 2002). For this study data collection methods have been both primary and secondary sources. The use of more than a single data collection method enables methodological triangulation and increases the validity and reliability of the data (Saunders et al., 2009; Williamson, 2002).

#### 2.4.1 Primary Data: Interviews

In order to accomplish this study primary data was used. Primary data according to Jacobsen (2002) lay foundation for the research and used for the purpose of achieving the research questions. The different methods for collecting a primary data include interviews, questionnaires and observation (Saunders et al., 2009). According to Williamson (2002), interviews allow unlimited possibility to the choice of questions and can be suitably used if an author wants to undergo through interview about a particular question. For this study the choice of an interview was due to this measure.
Methodology

The type of the interview adopted was a semi structured interview allowing flexibility for new questions brought up during the interview (Williamson, 2002). However, to keep the meeting on track the interview template at the appendix E was used. The interview questions were sent one week in advance in order to increase the accuracy of data from the respondents.

The interview was conducted with the vice president, material planning and logistics personnel and with the supply chain managers and company representative of the respective companies. Their knowledge and job status of the respondents made them suitable targets for the study. The types of the interviews conducted are indicated in the table below.

<table>
<thead>
<tr>
<th>Company No</th>
<th>Type of company</th>
<th>Job title of the interviewee</th>
<th>Type of the interview</th>
<th>Duration (min)</th>
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<tbody>
<tr>
<td>1</td>
<td>Automobile manufacturing company</td>
<td>Vice President, Material Planning &amp; Logistics</td>
<td>Face to face interview</td>
<td>140</td>
</tr>
<tr>
<td>2</td>
<td>Textile manufacturing company</td>
<td>Supply chain manager and company representative</td>
<td>Phone interview</td>
<td>110</td>
</tr>
<tr>
<td>3</td>
<td>Manufacturing company of motorcycle and automobiles</td>
<td>Supply chain manager and company representative</td>
<td>Phone interview</td>
<td>110</td>
</tr>
</tbody>
</table>

Table 1. Types of interviews conducted

Face to face and phone interviews

The semi structured interview conducted had taken the form of face to face and phone interviews. Saunders et al. (2009) note that several factors such as ease to contact the interviewee, distance between the interviewee and the interviewer, time available to collect the data and the cost involved in conducting interviews lead researchers to choose the type of interview.

According to Williamson (2002), face to face interviews are great ways to collect information. The benefits that can be acquired from face to face interviews includes more flexibility (repeat questions, chance to inquire for more specific answers etc.), possibility to watch nonverbal behavior, control over the physical environment and to exactly know who is answering (Saunders et al., 2009; Williamson, 2002). Besides, the use of face to face interviews enables the interviewer to get a lot of extra information and thus facilitates further understanding (Jacobsen, 2002). In this research, the choice of face to face interview was motivated by the need to get these advantages. Regarding phone interviews, as relocating a production system is a rare phenomenon of firms and persons involved in such decisions are in high level positions in the organization these issues facilitates the difficulty to contact respondents. Thus, phone interviews were used as an alternative way to collect data. Besides, the distance
present between the interviewer and the interviewee was another factor for the choice of phone interviews.

**Selection of interview questions**

The selection of the interview questions was based on what data have to be collected in order to achieve the objectives of the research. According to Williamson (2002) data collection depends on the research questions and the purpose of the research. Regarding the author’s objective is to conduct a research through literature review and interview study, interview questions were prepared. The types of interview questions designed were both open ended and closed ended. Open ended questions were used to find out more about particular information and to gather extensive responses whereas closed ended questions were used to gather short and quick responses (Saunders et al., 2009).

The interview questions had two parts. Part one questions were designed to find out general information about the company including its size, field of production, relocation areas, and the major reasons of relocating the production activities. Part two questions are intended to determine the supply chain risks the company faced while relocating its production activities and also to understand the supply chain risks the company considered in relocating its production activities. Moreover, part two questions answer the different risk mitigation strategies used by the company to overcome the effect of the different risks. The interviews conducted at all the three companies were fully recorded and transcribed.

**Selecting respondents**

While making a research it is necessary to select respondents. In qualitative research it is necessary to make a selection due to the great time and resource required while collecting an empirical data (Williamson, 2002). The selection of respondents in qualitative research is mainly done based on the measure that comes from the author’s knowledge of the subject (Saunders et al., 2007).

In choosing a respondent for this thesis the basic requirement was to select a manufacturing firm that relocated its production system in a foreign market. In order to select respondents that match with this requirement, list of companies in Sweden, United Kingdom and Ethiopia was extracted. The choice of Sweden companies was motivated by the possibility to make face to face interviews whereas the later choices were due to the author’s ease of understanding the languages. The list of the companies was extracted by using different sources of information including internet, magazines, and newspapers. Once the lists of the companies are known, each company was further investigated to find out if the company has relocated further in a foreign market. The primary source to get this information was each company’s web page. Through this way it was possible to collect the names and the exact contact email addresses of twelve manufacturing companies in Sweden, seventeen manufacturing companies in the United Kingdom and eight manufacturing firms in Ethiopia.
Methodology

After the email addresses are collected the next phase was to send an email to the companies to find out if it was possible to make an interview with the managers in the field of production or logistics. Through this way it was possible to get responses from most companies. However, due to the fact that relocation decisions are taken on a very high level position in the organization, it was not easy to find those people to make the interview as expected. The three respondents were all the companies that were found quite early. Once it’s confirmed to make the interview at the companies the contact letter presented in the appendix D and the interview questions exhibited in Appendix E are sent to the respondents whereby an interview is made.

2.4.2 Secondary Data: Literature review

In order to accomplish its objective, this research widely used secondary data. According to Williamson (2002) secondary data are an important source of information and can be widely used in a research. Government publications, prior researches, historical data, written and non-written materials include the different sources for secondary data (Kumar, 2005; Saunders et al., 2009).

For this study, an extensive amount of documents in the form of, books, scientific- journals, electronic documents, conference papers, publications etc. are used in order to collect data and achieve the objective of the research. These documents have been extracted from academic databases such as Google Scholar, Science Direct, and Google Books in order to depend on the reliability. As it is stated earlier, the literature review mainly includes journal of supply chain management and logistics management which have direct connection with the research questions under study. During this study Jonkoping university library was used as a main provider for secondary data. The details of the key words used while reviewing literatures are stated in section 2.1.

2.5 Data Analysis

Gathered data for this study was categorized and analyzed in related areas in a flexible manner as Miles & Huberman (1994) states. Primarily the recorded interviews at each of the three companies were transcribed. An analysis was then performed on each of the empirical texts against the developed frame of reference. The main objective of doing this was to understand how each company’s actions and performances matched the theories. Then after a framework is developed by the author of this thesis to analyze the findings of this research and derive conclusions. The design of the framework for the analysis of the research has been inspired by Chopra and Sodhi (2004) template. However the framework constitutes the idea of many other researchers including Tang & Tomlin (2008), Kaku & Kamrad (2011) and Speckman & Davis (2004). According to Saunders et al. (2009), in case where one made research questions from existing theories; the existing theoretical frameworks can be used as a guide to create an initial framework for analyzing the data. This was what was exactly applied in this research while analyzing the data and designing the framework for managing
supply chain risks while relocating a production system in a foreign market indicated in Fig 2. Then after, major findings of the study are drawn followed by conclusions and final discussion in the last chapter.
3. Theoretical Background

This chapter states the core theoretical aspects that are linked to this master thesis report. It covers chapters on identifying supply chain risks and the associated risk mitigation strategies that can be used to reduce the negative effect of the supply chain risks.

3.1 Identifying supply chain risks

Identifying, defining and classifying ideas are often needed for a research in order to create better understanding (Oke & Gopalakrishnan, 2009). Researchers have used different ways to explain and classify the concept of supply chain risks. (For example, see Chopra & Sodhi, 2004; Kaku & Kamrad, 2011; Norrman & Jansson, 2004; Svensson, 2002; Zsidisin and Ellram, 1999; Zsidisin et al., 2004; Tang & Tomlin, 2009) and consequently many frameworks have been developed by the researchers. However, there is no clear agreement on which type of the framework best captures the supply chain risks (Oke & Gopalakrishnan, 2009). The tables in the appendix A, B, and C summarize prior researches in determining supply chain risks and clearly show the diversity of supply chain risks identification and categorization ways used by the researchers. According to Sodhi and Tang (2012), the supply chain risk categorization methods employed by researchers are suitable to address a set of different supply chain issues. For example, Tang and Tomlin (2008) discuss the major type of supply chain risks that occur regularly, Chopra and Sodhi (2004) classify and lists supply chain risks based on the drivers of the risks, Kaku and Kamrad (2011) presents a supply chain matrix classifying supply chain risks based on two major dimensions (Internal vs. external events and high-frequency, low-impact events vs. low-frequency, high-impact events).

After reviewing the framework by different researchers, this thesis adopts the template of Chopra & Sodhi (2004) to follow in this study. While adopting this model, this thesis considers that the model by Chopra & Sodhi (2004) best enables to answer the research questions raised in this paper as it deals the supply chain risks more specifically by considering the drivers of the supply chain risks. Besides, the categorization by Chopra & Sodhi (2004) empowers to position the associated mitigation strategies for each category of supply chain risks (to answer research question two) as compared to for example the categorization of supply chain risks by Kaku and Kamrad (2011). However, in order to make it more comprehensive a modification is made to it by considering the work of other researchers including Kaku and Kamrad (2011), Speckman and Davis (2004) and Tang and Tomlin (2008). The following table is the adopted model and will be used throughout this research while identifying, supply chain risks and reviewing risk mitigation strategies that can be used in order to lessen the effect of the risks while relocating a production system in a foreign market.
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Table 2. Identifying supply chain risks

<table>
<thead>
<tr>
<th>Category of supply chain risk</th>
<th>Drivers of the risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply risks</td>
<td>Supply cost, Supply quality, Supply commitment</td>
</tr>
<tr>
<td>Demand risks</td>
<td>Demand uncertainty</td>
</tr>
<tr>
<td>Process risks</td>
<td>Quality, Time, Capacity</td>
</tr>
<tr>
<td>Intellectual property risk</td>
<td>Global outsourcing, Vertical integration of supply chain</td>
</tr>
<tr>
<td>Behavioral risks</td>
<td>Lack of supply chain visibility</td>
</tr>
<tr>
<td>Disruption risks</td>
<td>Natural disaster, Labor dispute, Political risks, Source of supply, Supplier bankruptcy, Transportation risks</td>
</tr>
<tr>
<td>IT system risks</td>
<td>Information infrastructure breakdown, System integration, E-commerce</td>
</tr>
<tr>
<td>Forecast risk</td>
<td>Inaccurate forecast, Bullwhip effect</td>
</tr>
<tr>
<td>Procurement risk</td>
<td>Exchange rate risk, Single or multiple source supply, Industry wide capacity utilization, Type of supplier contract</td>
</tr>
<tr>
<td>Receivables risk</td>
<td>Number and financial strength of customers</td>
</tr>
<tr>
<td>Inventory risk</td>
<td>Rate of product obsolescence, Product value, Inventory holding cost, Demand and supply uncertainty</td>
</tr>
<tr>
<td>Risk linked with competitor actions and environmental legislations</td>
<td>Competitor actions, Environmental legislations</td>
</tr>
</tbody>
</table>

Table 2. Identifying supply chain risks (Adopted from Chopra & Sodhi (2004), Kaku and Kamrad (2011), Speckman and Davis (2004) and Tang and Tomlin (2009)).

3.1.1 Supply Risks

Supply risk refers to the happening of occurrences linked with inbound supply (Zsidisin, 2006). Due to various reasons suppliers can be unable to deliver the material or service on time leaving the firm to serious procurement problems (Zsidisin, 2002). This difficulty in purchasing will disturb the other manufacturing operations of the firm consequently affecting the end customer. Different factors amplify the existence of the supply risks. For example, the location of the firm (how far it is from the suppliers?), buyer demographics (statistics on customers'
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availability) (Mitchell, 1995), availability of raw materials, type of supplier (Steele & Court, 1996), supply conditions (monopoly or oligopoly), and complexity of the supply chain (Kraljic, 1983).

Moreover, the rise of the supply risk is also linked with the difficulty of finding an adequate reliable supplier in the new market. As Kralji (1983) and Steele and Court (1996) uncover the amount and the availability of supplier will determine the features of the supply risk. Traditionally it was common that companies had many suppliers for a product to insure that the best price is discounted and the procurement risk distributed across the many suppliers. However, the cost of dealing with many suppliers allow firms to depend on one (single sourcing) or two (double sourcing) suppliers which make firms to rely on these sources only consequently increase the supply risk (Tang & Tomlin, 2008).

Risk linked with the supply can also increase in a foreign market due to the globalization of the supply chain which creates complexity of the supply chain by allowing increased participants and diminish response to changes favoring supply disruptions and amplified uncertainties (Hallikas et al., 2005; Wagner and Bode, 2006).

According to Tang and Tomllin (2008), supply risk embraces risks linked with supply cost, supply quality, and supply commitment.

Supply cost
Every organization depends on its supplier for goods and services. The cost of material from a supplier is more than 50% of the total sales of a firm, thus supply costs are very determinable for the success of a company (Tang, 1999). In order to keep the supply cost as minimum as possible, buyers force their suppliers through bargaining and switch to another, when the supplier cost does not match their need (Tang, 1999). To keep this bargaining power Porter (1980) considers the importance of sourcing from many suppliers, undergoing short term contracts with suppliers, and keeping the information of other suppliers (e.g., in terms of cost, sales, product type etc.). Firms can also get a considerable amount of cost saving by appropriately selecting a supplier (Degraeve & Roodhooft, 2006). Thus, it’s important for firms to view the risks associated with the cost of a supply while relocating a production system in order to reduce costs and stay competitive in the global market.

Supply quality
It’s not only enough to consider a supplier with reasonable cost, besides quality aspects of a supplier is very fundamental for the success of an organization (Okes & Westcott, 2011). A supplier with low cost but ignoring quality aspects will cause serious problems in manufacturing including delays, interruption in production, and allowing production of substandard products where by affecting the overall performance of the supply chain (Okes & Westcott, 2011). In today’s global market, there is a severe competition which indicates the need of maintaining quality for firms to stay profitable (Persson & Olhager, 2002). Thus, firms require to consider the availability of a supply quality while relocating. As Okes &
Westcott (2011) reveals there is always an inherent risk to the firms through procuring goods from suppliers in terms of quality.

**Supply commitment**

Commitment is very crucial in any type of business relationships. It is defined as “An implicit or explicit pledge of relational continuity between exchange partners” (Dwyer et al., 1987, p. 19). It encompasses the willingness of business partners to scarify their short term business benefits for the sake of maintaining long-term business relationships, developing trust and partnership arrangements (Anderson & Weitz, 1989; Morgan & Hunt, 1994). A supply commitment is a fundamental aspect for firms to improve the quality of their outputs by reducing the variations in inputs (Okes & Westcott, 2011; Batt and Wilson, 2000). Moreover, it renders other advantages such as better information flow (Batt and Wilson, 2000), and improved performance of the supply chain (Gyau & Spiller, 2008; Kalwani & Narayandas, 1995). The need to consider the availability of a reliable supplier is undeniable for the success of an organization (Steele & court, 1996).

### 3.1.2 Demand Risks

Demand risks are risks due to the undetermined nature of consumer demand in the market (Tang & Tomlin, 2008). It relates to variations in the flow of information and products between the company and the market. (The Decision Makers’ Direct, 2011). Demand risk is one of the supply chain risks companies are facing by relocating their production in a foreign market (Liu & Nagurney, 2011). According to the report by The Economist Intelligence Unit (2009), 500 executives of global companies listed demand risk as a top risk factor which needs to be considered when relocating.

Firms will incur loss if the demand is higher or lower than the actual consumer demand. In case if the demand is higher than the actual consumer demand it’s unnecessary cost to the firm (e.g., excess inventory) and when the demand forecast is lower than the actual consumer demand it’s again a cost to the firm in terms of lost sales (Sodhi, 2005; Kopczak & Lee, 1993). Thus an appropriate demand management strategy is required by firms to handle risk associated with demand.

Tang and Tomllin (2008) explain the main source of demand risk as demand uncertainty.

**Demand uncertainty**

Demand is always uncertain (Blackhurst & Wu, 2009). This unpredictable nature of demand is considered affecting manufacturing firms (cf. Wilding, 1998). When there is uncertainty, there will be an inherent risk which affects firm’s decisions. Van der Vorst & Beulens (2002) explains the existence of uncertainties with questions like, what will be the actual customer demand? Will the supplier deliver the goods? And will the supplier deliver with the required quality? Decisions made through these uncertainties will affect the performance of the firms. “The more uncertainty related to a process, the more waste there will be in the process”
Persson (1995 p. 14). Firms need to consider the existence of demand uncertainties and develop strategies to cope with to reduce wastes and make better decisions which improve their performance (Mason-Jones & Towill, 1998).

### 3.1.3 Process Risks

Process risks are risks of loss due to a manufacturing process or internal operations of a firm (Tang & Tomlin, 2008). For example, schedule instability/revising the production plan, is the common instability of firms in their internal operation which happens mainly due to external issues with buyer and supplier interrelationships (Pujawan & Smart, 2011). It has been viewed that companies have had been implementing different strategies and philosophies to reduce inventory (for example, Just in time inventory and total quality management) (Celley et al., 1986; Norris et al., 1994), to eliminate waste, bring continuous improvement and improved efficiency (Lummus and Duclos-Wilson, 1992; Orth et al., 1990; Suzaki, 1987). Yet, firms are seen unstable in their internal operations (Svensson, 2003; Tang & Tomlin, 2008). Disturbance in the internal operation of firms will disrupt the supply chain leading to failure to conform customer requirements (Sodhi & Tang, 2012).

According to Tang and Tomlin (2008), process risks include risks associated with quality, time and capacity risks associated with inbound and outbound logistics and internal operations of an organization.

#### Quality

Quality can be defined as meeting or exceeding customers’ expectations (Grönroos, 1983; Parasuraman et al., 1985), conformance to requirements (Crosby, 1979) and fitness for use (Juran & Gryna, 1988). Thus, quality risk is the risk of loss due to defective products. Different operations of a firm such as problems in designs, wrong operations/processes, machine breakdowns, can affect the quality of a product (Kaku & Kamrad, 2011), consequently, disturbing the supply chain and the end customer (Sodhi & Tang, 2012). Quality is “the single most important force leading to the economic growth of companies in international markets” (Feigenbaum, 1982 p. 22). Therefore the need to consider and manage risks associated with quality is very fundamental for firms who relocate their production in a foreign market.

#### Time

In the global market meeting order time is very fundamental to meet the need of customers (Lederer & Li, 1997). Answering orders in the minimum time enable firms to stay competitive. Many authors have explained the negative effect of delays in a supply chain causing disruption and inefficiency (e.g., see Spekman & Davis, 2004; Chopra & Sodhi, 2004; Mason-Jones&Towill, 1999; Yeo & Ning, 2002). By Offshoring a manufacturing, firms could face delay risk (Schoenherr et al., 2008; Chopra & Sodhi, 2004). The main source of delays in a supply chain often includes lack of supplier flexibility, quality problems of materials, logistics failures and time spent for checking while border crossing (Chopra & Sodhi, 2004).
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2004). Spekman & Davis (2004) demonstrate the effect of delays of bulk chemicals due to flooding in the Midwest causing the factory to cease operation.

Capacity

Capacity risk is risk of loss due to less supply than demand (Chopra & Sodhi, 2004). When firms have lower capacity and are unable to meet a demand there is an opportunity cost (Pindyck, 1986). At the same time, building excess capacity and underutilizing it is also a huge financial loss for the firm (Pindyck, 1986; Chopra & Sodhi, 2004). “A firm’s capacity choice is optimal when the value of the marginal unit of capacity is just equal to the total cost of that unit” (Pindyck, 1986 p. 2). In times of bankruptcy, firms will usually focus on reducing inventory which heightens the capacity risk (Cable, 2010). Recession also makes suppliers highly vulnerable and unable to deliver their promises to different firms (Szuster, 2010). This consequently makes firms to not produce the required goods and services as required by the end customers, leaving the supply chain disturbed. Assessing the financial situation of suppliers is very important for firms who relocate their production system as their business operations are highly dependent on the capacity of their suppliers (Offshoring Research and Consulting, 2012).

3.1.4 Intellectual Property Risks

Intellectual property is one of the determinable factors that contributes to the success or the failure of any business (Thurow, 1997). Following the outsourcing and offshoring of firms in a foreign market, added to the globalization and the complexity of the supply chain has led to the growth of intellectual property risks (Chopra & Sodhi, 2004; Tang & Tomlin, 2008). It’s seen that different countries entertain the protection of intellectual property at different levels. Developed countries have a regulated market and a high policy of intellectual property right as compared to low developed countries which restrict free market completion and have a low policy of intellectual property right (Reichman, 1989).

Despite the low policy of intellectual property right, developing countries are still becoming a place where firms want to invest their property to get different competitive advantages such as lower labor cost, closeness to the market and economies of scale in the long term (Braunerhjelm & Ekholm, 1998, Cho & Kang, 2000).

The move to gain these advantages heightens the risks associated with intellectual property. Chopra and Sodhi (2004) explain the main drivers of intellectual property risk as global outsourcing and less vertical integration of supply chain, which are described below.

Global outsourcing

Outsourcing refers to the process of giving business activities to outside vendors (Pedersen & Jenster, 2000; Richardson, 1996). These days it has become so broad that it sometimes involves the outsourcing of core business activities (Jennings, 1997; Quelin & Duhamel, 2003). When the fundamental functions of a firm are subcontracted, it creates an opportunity of imitating its vital business functions by
competitors (Chopra & Sodhi, 2004; Richardson, 1996). The extent of intellectual property theft is viewed as more in developing countries as compared to the developed countries. In the same notion, Reichman (1989) and Richardson (1996) state developing countries have less protection for intellectual property that aggravates the loss for the firm. Thus, through relocating a production system, there is a need to consider the risk of loss due to theft of intellectual property and devise a means to deal with it.

Vertical integration of supply chain
Vertical integration of a supply chain denotes a business strategy, (Richardson, 1996) that integrates separate business processes of the supply chain for the purpose of achieving “quick response” over the market (Blackburn, 1991 p. 77). By”quick response” it means that retailers and manufacturers are integrated to achieve the flexibility and develop higher capability to respond to customer orders (Richardson, 1996; Hammond, 1990). Different benefits can be acquired from vertical integration of supply chain including improved control (e.g., on supply quality, quantity, costs), better communication across parties in the supply chain and improved cost structure (by creating economies of scale, integration) (Ellram, 1991). Besides, vertical integration of supply chain reduces the intellectual property risks as it allows the business under direct company control (Chopra & Sodhi, 2004; Richardson, 1996). However, disadvantages of vertical integration exist such as, decrease the strength of competitors, create low awareness to market issues and heightened risk of exit barriers (Richardson, 1996).

3.1.5 Behavioral Risks
Manufacturing in a foreign market imply the development of complex supply chains and an increased number of participants in the supply network (Christopher et al., 2002; Harland et al., 1999). When parties across the supply chain extend there will be a slow flow of information across the chain, reduced visibility and control among the members which lets the development of increased uncertainties named behavioral risks (Sodhi & Tang, 2012; Tang & Tomlin, 2008). Tang & Tomlin (2008) states supply chain visibility as the main driver for behavioral risks.

Lack of Supply chain visibility
The absence of transparency and collaboration among supply chain parties will facilitate a lack of trust and use of mislead information resulting increased disturbance and reduced efficiency of the supply chain (Childerhouse et al., 2003). The common phenomena in a supply chain which is called “bullwhip effect”(Lee et al., 1997 p. 408), is the result of distorted information across the supply chain where order variation is magnified up the supply chain (Croson & Donohue, 2006). Getting the maximum benefit from the supply chain requires clear and fast sharing of information across members of the supply chain and other concerned parties (Horvath, 2001). Moreover, supply chain visibility reduces the loss linked with behavioral risks (Tang & Tomlin, 2008).
3.1.6 Disruption Risks

Disruptions are unpredictable events that have a low tendency to happen but are capable to cause severe damages (Chopra & Sodhi, 2004). The source of disruption includes fire accidents, earthquake, blackouts, theft and damage, floods and labor disputes (Chopra & Sodhi, 2004; Knemeyer et al., 2009). Besides, production in a foreign market also facilitates supply chain disruptions by creating a complex supply network which is vulnerable to different kind of problems (Christopher et al., 2002; Harland et al., 1999). When supply chains face disruptions, the usual movement of materials and goods will be disturbed affecting each member of the supply chain consequently (Hendricks & Singhal, 2003; Kleindorfer & Saad, 2005). The outcome from supply chain disruptions include delays, reduced customer satisfaction, increased inventory, and financial loss (Riddalls et al., 2002; Stauffer, 2003). Moreover, Hendricks & Singhal (2008) highlights that disruptions in the supply chain could also be a reason to lose firm’s reputation and reveals the company to huge operational and financial risks (Stauffer, 2003; Gumbel, 2006; Martha and Subbakrishna, 2002). Therefore, the need to consider external factors that cause supply chain disruptions is undeniable for firms in order to succeed in the competitive market (Henisz & Zelner, 2003).

Chopra and Sodhi (2004) list the main source of supply chain disruptions as natural disaster, labor disputes, war and terrorism (explained here as political risk), source of supply, and supplier bankruptcy. Besides, this thesis adds transportation risks in this as risks associated with transportation could also happen due to disruptions such as natural disaster and weather and road condition (Husdal, 2010).

**Natural disaster**

A natural disaster is an extreme event which occurs as a result of the natural process of the earth (Bankoff, et al., 2003). It can be experienced in many forms such as floods, earthquakes, volcanic eruptions, and cyclones. When natural disaster occurs in addition to the major human loss it causes disruption to supply chains, (Kleindorfer & Saad, 2005) whereby magnifying disruption risks. An instance can be acquired from the recent Japan earthquake and tsunami affecting manufacturers all over the world by disrupting their supply chains (SupplyChainStandard., 2011).

**Labor dispute**

Foreign manufacturing usually involves a reduction of labor in a place where the firm activities were previously undertaken (Pedersini, 2006). When employments are transferred into another location, and labors are reduced from their prior jobs, then it becomes a sensitive issue for the employees and for those who concern about the employment levels of a country. According to a study by European Foundation for the Improvement of Living and Working Conditions (2006), employees with lower qualification are highly vulnerable to lose their jobs due to relocation. This creates excessive pressure on the employees and unpleasant work
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environment (Pedersini, 2006). Moreover, a group of workers in the organization could react negatively and the relocation could become a serious industrial relation issue (Belcourt, 2006; Pedersini, 2006). Labor disputes could happen rarely, but if they occur, they have a tendency to disturb the supply chain severely consequently affecting the end customer (Chopra & Sodhi, 2004; Tang & Tomlin, 2008). Therefore, through relocating, firms need to consider the effect of industrial relations and work together with the concerned parties in order to make the condition of industrial relation in the destination country free from problems (Pedersini, 2006).

Political risks
Different researchers affirm there is no clear stated definition of political risks (for e.g., see Formica, 1996; Kobrin, 1979; Sethi and Luther, 1986). However in the context of political risks for firms, Kennedy (1988 p. 27) mentions, political risk as “the risk of a strategic, financial, or personal loss for a firm because of such non market factors as macroeconomic and social policies (fiscal, monetary, trade, investment, industrial, income, labor and developmental) or events related to political instability (terrorism, riots, coups, civil war and insurrection)”. The World Trade Center terrorist attack on September 11, 2001 can be mentioned here as an example of political risk causing serious disruption in the supply chain (Kleindorfer & Saad, 2005).

By allowing internationalization, relocating a production system in a foreign market lets the involvement of multiple countries in the supply network. When many countries involve in the supply network; uncertainties could be developed due to political (social) issues (Tang & Tomlin, 2008; Chopra & Sodhi, 2004). One’s country governmental laws and its affair with other countries is viewed impacting the concerned trading partners and supply chain parties causing supply chain disruption (Rao & Goldsby, 2009), consequently affecting the end customers. There exists a clear link between political risk and investment decision in a country (Heil, 2012; Hong et al., 1999), therefore the need to consider political issues are necessary for meeting competitive advantage of firms (Heil, 2012).

Source of supply
In order to be effective, firms need to select their sourcing strategy. Basically there are two types of source of supply which are single sourcing, and multiple sourcing (Ramsay & Wilson, 1990; Seshadri et al., 1991). Singles sourcing which denotes dependency on a single source of supply is feasible in a highly stable environment, develops long term supplier commitment, and initiates a lower purchase price (Costantino & Pellegrino, 2010; Treleven & Schweikhart, 1988). However, it has the disadvantage of dependency on a single supplier, and increased risk of supply interruption whereby causing supply chain disruptions (Ford et al., 2011; Treleven & Schweikhart, 1988; Chopra & Sodhi, 2004). On the other hand, multiple sourcing has the benefits of having alternative suppliers for the firm, supplies better product and creates a more flexible environment in times of uncertainty (Costantino & Pellegrino, 2010; Treleven & Schweikhart, 1988). However, multiple sourcing has the limitation of creating a high cost to the organization
through managing multiple suppliers (Ford et al., 2011; Treleven & Schweikhart, 1988).

Supply disruptions are deemed to affect the performance of the organization at a greater level (Xiaoqiang, 2009), thus firms need to select the appropriate purchasing strategy in order to reduce disruptions and increase the efficiency of their organization (Costantino & Pellegrino, 2010; Xiaoqiang, 2009).

**Supplier bankruptcy**

Visibly, supplier bankruptcy is one of the major reasons which cause disruption to supply chains (Chopra & Sodhi, 2004). Depending on how extent a firm depends on its supplier, the supplier failure can cause minor disruption to complete shutdown of the plant (Wagner et al., 2009). As an illustration of the effect of supplier bankruptcy, Jung et al. (2011) demonstrates the case of Korea supplier bankruptcy in 2002 that had monopolized the market for more than twenty-five years causing stoppage of the assembly line of a global car maker. Pursuing a multiple sourcing strategy is viewed to manage disruptions linked to supplier bankruptcy (Anupindi & Akella, 1993; Horowitz, 1986).

**Transportation risks**

Risk associated with transport is one of the other factors which affect the supply chain performance (Yam & Tang, 1996; Husdal, 2010). Linked with the transportation of goods and services, many factors affect the flow including weather and road conditions, accidents and engine vehicle breakdowns, errors in loading (e.g. Mixing hazardous and non-hazardous goods), theft, distorted information from and to parties in the supply chain, strikes and other work related issues (Husdal, 2010). Besides, logistical failures and time wasted during border crossing are the contributory factors (Chopra & Sodhi, 2004). When either of these factors happens, it will cause supply chain disruption consequently affecting the end customer. On such occasions good delivered to the customer will be late or in damaged condition (Chopra & Sodhi, 2004; Husdal, 2010).

**3.1.7 Information Technology (IT) Systems Risk**

IT systems risk refers to the risk which is inherent due to instability of the systems in the information system (Chopra & Sodhi, 2004). Firms achieve their objectives and stay competitive in the market by using modern technologies. For example, in order to enable end customers to make orders directly, Dell computer used premier web page technology resulting in an increased amount of online sales. As Kraemer & Dedrick (2001) explains, the use of the new system enables Dell to increase its online sales from $ 1 million per day to $ 3 million per day in one year. However, when a failure or an expected event happens on the integrated information system, this can be a reason for inefficiency for organizations. For example the “Love bug” virus, affecting emails leads to a bankruptcy of billions of dollars at the Pentagon, NASA and Ford (Maney & Zuckerman, 2000).
As relocating a production system allows globalization of firms and their supply chains, firms need to use integrated information technology systems to facilitate collaboration with others and extend their communication channel across the globe, so as to increase their profits and efficiency (Tafti, 2005; Spekman & Davis, 2004). Therefore, firms couldn’t escape from IT system risks and thus they need to consider and develop ways to reduce their effects (Chopra & Sodhi, 2004). Chopra and Sodhi (2004) explain the sources of IT system risks as information infrastructure breakdown, system integration (extensive system networking), and e-commerce. Follow on these drivers for IT system risks will be explained in the following sections.

Information infrastructure breakdown

The use of information technology assists firms to increase the efficiency of supply chains and organizations. Some of the benefits include improving the flexibility of a supply chain, reduce cycle time, attain greater efficiency and faster rate of meeting customer orders (Rajou, 2003). Powell and Dent-Micallef (1997) explains when IT systems are introduced in supply chains better knowledge about suppliers, customers, and market conditions can be acquired that assists to improve the efficiency of the organization. A breakdown of this IT system means losing all these advantages and thus affecting the performance of supply chains and organizations.

System integration

The integration of the information system is very important for the success of an organization. Motiwalla and Thompson (2009 p. 54) define system integration as “allowing a heterogeneous (hodgepodge) information system to communicate or integrate and share information or data seamlessly with one another”. System integration offers different advantages including improved communication, better flow of information, and information sharing in real time between stakeholders of an organization (Powell & Dent-Micallef, 1997; Motiwalla & Thompson, 2009). However, this thesis agrees with (Chopra & Sodhi, 2004, p. 56) that by integrating IT systems extensively in an organization, there is a high risk that “failure anywhere can cause failure everywhere”.

E-commerce

E-commerce which denotes the buying and selling of goods via the internet, (Dolber et al., and 1998) is a great way to reduce costs, facilitate information flow, grow markets and increase efficiency (Palmer, 2002). However, the use of e-commerce has a built in risk (Golicic et al., 2002). Explaining this Golicic et al. (2002) states, e-commerce creates a very high transparency of information allowing a greater flow of information in terms both volume and speed across the supply chain. The volume and immediacy flow of information can create confusion across the members and leads to decisions involving risks. Moreover, the complex and dynamic nature of the e-commerce environment, makes managing supply chain a challenging task (Chopra & Sodhi, 2004).
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3.1.8 Forecast Risk

A forecast is a qualified guess (Berry, 2004). It’s a prediction of the future events, usually of about demands and supply (KinaXis, 2012). Firms use different kind of forecasting methods such as, sales forecast estimates, executive opinion, market research, and Delphi method in order to make an advance planning of their business and operations (Levi & Kaminsky, 2007). A forecast risk thus, is uncertainty that the forecast made will be wrong (KinaXis, 2012) and it results from misfit between a demand forecast that need to be met with the actual consumer demand (Chopra & Sodhi, 2004; Sodhi, 2005).

Generally forecasts are inaccurate (Levi & Kaminsky, 2007; KinaXis, 2012). Thus, firms that also relocate their production in a foreign market cannot escape from risks associated with the forecast. In order to cope risks linked with forecast, firms use different kind of approaches such as “selectively holding inventory and/or building responsive production and delivery capacity”(Chopra & Sodhi, 2004 p. 56), collaboration between customers or suppliers and fast response to demand changes (KinaXis, 2012). However, issues such as, long lead time (Walker, 1999, Sen2008), information distortion in the supply chain, seasonal demands, high product variety and smaller product life cycles tend to heighten forecast risk (Chopra & Sodhi, 2004; Sodhi, 2005). Chopra and Sodhi (2004 p. 54) lists the main source of forecast risk as inaccurate forecasts and Bullwhip effect or information distortion across the supply chain.

Inaccurate forecast

In order to be profitable in the increased global competitive market, manufacturers are building flexible manufacturing systems to deal with the increased need of customers (Kaighobadi & Venkatesh, 1994; Attaran, 1992). However, in the manufacturer side, this flexibility allows an increased forecast risk. By production of a variety of multiple products, inaccurate forecasts are aggregated which lets the firm to make a marked down price, or even sell with a loss if the product is unwanted (Fisher et al., 1994). Though, a forecast cannot be 100% accurate (Levi & Kaminsky, 2007), firms need to be aware and consider the risks associated with the forecast and devise means to reduce the impact of inaccurate forecasts (KinaXis, 2012; Fisher et al., 1994).

Bullwhip effect

The bull whip effect is an observed phenomenon of increased demand variability up the supply chain due to small changes in consumer demand (Chen et al., 2000; Baganha & Cohen, 1995). The increased demand variability results in fluctuation of order quantities up the supply chain, allowing manufacturers to receive an exaggerated order which is far from actual demand. By introducing this distorted information in their operations firms face inefficiency which is reflected in the form of “excessive inventory investment, poor customer service, lost revenues, misguided capacity plans, inactive transportation, and missed production schedules”(Lee et al., 1997 p. 93). Therefore, companies need to understand and
Theoretical background

devise a means to manage demand variability in order to stay profitable in the highly competitive global market (Chopra & Sodhi, 2004; KinaXis, 2012).

3.1.9 Procurement Risk

Procurement is a contract or agreement between a buyer and seller to perform a purchasing activity (Seshadri et al., 1991). According to Chopra & Sodhi (2004 p. 57) procurement risk refers to a sudden increase in purchasing costs of items due to “fluctuating exchange rates or supplier price hikes”. Procurement becomes a challenging task when relocating a production system in a foreign market. This is connected to the difficulty of managing suppliers overseas (Burke et al., 2007), added to supplier capacity to respond demand (Lee & Tang, 1997) and variations in exchange rate (Chopra & Sodhi, 2004). Chopra & Sodhi (2004) categorize the main drivers of procurement risk as exchange rate risk, single or multiple source supply, industry wide capacity utilization and type of supplier contracts.

Exchange rate risk

Exchange rate risk refers to a country’s currency price relative to the currency of a foreign country (Liu & Nagurney, 2011; Offshoring Research and Consulting, 2012). When the value of one country's currency depreciates there will be a corresponding appreciation of another country’s currency and through conducting business overseas firms will face exchange rate risks (Evans, 2012). Relocating a production system in a foreign market is also known to reveal a firm’s supply chain to exchange rate risks as it usually involves buying goods and services from outside suppliers and lets global trade which involves converting currencies (Liu & Nagurney, 2011).

While deciding to relocate production systems, there is a need for firms to examine the currency of their destination country. Zinnov Offshoring Research and Consulting (2012) states that fluctuating currencies can aggravate the loss of firms.

Single or multiple source supply

The type of supply strategy (single sourcing or multiple sourcing) is viewed as a major source of procurement risk (Seshadri et al., 1991; Chopra & Sodhi, 2004). As opposed to single sourcing supply strategy, multiple sourcing supply strategy is viewed as a main contributory factor which heightens procurement risk (Seshadri et al., 1991; Chopra & Sodhi, 2004; Tang & Tomlin, 2008). Single sourcing strategy allows a closer relationship between buyers and sellers in order to achieve shared benefits, however, increases the risk in case of supply interruption (Ford et al., 2011; Treleven & Schweikhart, 1988). On the other hand, multiple sourcing involves managing many suppliers, which is tedious and involves many uncertainties (Burke et al., 2007). In order to reduce risks and improve their efficiency, firms need to select a suitable supply strategy (Costantino & Pellegrino, 2010; Xiaoqiang, 2009).
Industry wide capacity utilization
When capacity utilization of a firm increases the total cost of a firm increases (Corrado & Mattey, 1997; Saini, 2012). This is linked with the extra cost of material, machinery, labor required to meet the excess capacity or demand in the market (Saini, 2012). In other words this means that there will be an enhanced procurement activity inside the firms which uses the exchange of currency. It’s clear that when there is inflation or deflation of the currency it affects the procurement activity of the firm whereby fostering the risk associated with procurement.

Type of supplier contract
Supplier contracts are binding agreements by which an organization minimizes its risk associated with supplier relationships (Harrison et al., 2005). Supplier contracts are helpful to lock the benefit package that the supplier is willing to offer to the customer for the determined period of time (Maurer et al., 2004). Basically there are two types of supply contracts, long term and short term type contracts. In long term contracts the buyer commits itself to source from single supplier where short term contracts leaves the option of change over to another supplier (Maurer et al., 2004; Harrison et al., 2005). Though signing long term purchasing contract will hurt profits if the price of the good fall, it helps to reduce procurement risks associated with increases in supply price hikes (Chopra & Sodhi, 2004).

3.1.10 Receivables Risk
In the business market customers and suppliers likely will have different objectives. A customer always wants to get the product/service in the shortest time possible but want to delay the payment as long as possible, whereas a supplier want to collect the payment as soon as possible. The uncertainty to receive a payment for the goods and services rendered is referred as receivables risk (Chopra & Sodhi, 2004). Illustrating the effect of receivables risk, Chopra & Sodhi (2004) states the unexpected losses in Sears’s stock as the stock was dropped by more than 30% per day by customers using delinquent cards. Managing receivables is very important for the success of a firm. If receivables are collected on time and faster, they can be used for meeting different other purposes of a firm (e.g., for payrolls or future expansion) where by ensuring the continuity of a business (Chopra & Sodhi, 2004). When firms relocate their production system overseas, the supply network becomes more internationalized, allowing an increased number of participants and customers (Tang & Tomlin, 2008), consequently increasing the receivables risk (Chopra & Sodhi, 2004). Chopra & Sodhi (2004) states the main sources of receivables risk as the number and financial strength of customers.

Number and financial strength of customers
In conducting business selling credits is a common phenomenon (Greer, 1967; Lieber & Orgler, 1975). In order to get benefits, firms who sell credits needs to have a proper administration of their receivables (Lieber & Orgler, 1975). Else,
there is a risk of not collecting the payments from debtors which is referred as receivables risk (Chopra & Sodhi, 2004; SunGard press release, 2011). When the number of debtors increases the risk associated with receiving the payment from them also increases. It is often easy and manageable to control few debtors (Loeser, 1988). On the contrary, selling credits to few competent customers will heighten receivables risk (Chopra & Sodhi, 2004). Organizations often use different kind of strategies to collect payments from debtors including cash discount, credit period and charges for late payments (Lieber & Orgler, 1975).

3.1.11 Inventory Risk

Firms hold inventories in order to satisfy demand. An inventory risk is a kind of risk which is created due to excess supply than demand that results in an increased carrying cost, marked down price, and tied up of capital (Cachon, 2004; Chopra & Sodhi, 2004).

Manufacturing in a foreign market magnifies the risk associated with inventory. As the Association for Operation Management (APICS, 2012) notes it is very challenging to manage inventory abroad as almost usually the actual demand needed to be satisfied for overseas sources are always greater than the estimated demand. Besides factors such as uncertain demand, delays in supply, and disruptions can occur which need an additional stock to be kept as inventory (APICS, 2012; Chopra & Sodhi, 2004). By carrying excess inventories firms obtain huge financial loss. For example in 2001, Cisco investors incur a $2.5 billion inventory charge (Barrett, 2001). In order to reduce losses linked with inventory, implementing the appropriate inventory management technique is crucial for the stability of any organization (Chopra & Sodhi, 2004). Chopra & Sodhi (2004) state rate of product obsolescence, product value, inventory holding cost, and demand and supply uncertainty are the main source of inventory risk. An explanation for these drivers will follow.

Rate of product obsolescence

Some products have a higher rate of obsolescence than the others. By product obsolescence it means that products with falling demand sometime in the future (e.g., computers and pharmaceuticals), or products with fast change of customer taste (for example, fashion clothes, some food items, books, and perfumes) (Song & Zipkin, 1996). Traditional inventory control methods consider demand uncertainty to make possible forecasts to carry inventory. However, the rate of product obsolescence should also be considered while developing an inventory control method in order to find an economic benefit from holding inventory (Schonberger, 1982; Song & Zipkin, 1996).

Product value

The amount of money and investment spend in an inventory need to depend on the value of the product. Cohen & Ernst (1988) note about ABC classification that categorize inventory items as A (Very important), B (Moderately important), or C (Least important) items. The control of the inventory then is as per the
categorization. I.e. tight control should be given for A class items, Medium control for B class items and least control for category C items (Cohen & Ernst, 1988; Silver et al., 1988). In an organization managing different kinds of inventories, it becomes very important to know where an inventory to focus in order to reduce losses due to stock outs and reduce the total cost of the inventory (Partovi & Anandarajan, 2002).

**Inventory holding cost**

Firms hold inventories in order to meet uncertainties (Lai et al., 2009; Sodhi, 2005). However, carrying inventory has a cost. The total cost of inventory holds both capital and non capital cost for inventory investment. Capital cost denotes the actual cost of investing on the inventory and the opportunity cost that could be acquired if the money were invested in something else, whereas the non capital cost includes the cost of physical handling, obsolescence, deterioration, insurance, tax, damage and theft, and cost of administrating the inventory (Lord, 2009; Timme & Williams-Timme, 2003). Developing an effective inventory management includes understanding the total inventory holding cost and develops ways to reduce such costs (Chopra & Sodhi, 2004).

Better management of inventory is crucial for the success of any firm. An organization deploying an effective management of inventory will get an economic advantage which enables to sell its products at lower prices, develops possibility to enter into new market and release cash which can be spend for future expansion of the firm, and meeting other competitive advantages (Timme & Williams-Timme, 2003).

**Demand and supply uncertainty**

Supply chains face problems due to uncertainties in supply and demand (Davis, 1993; Kleindorfer & Saad, 2005). In order to absorb these challenges and meet customer expectations, firms hold inventories (Chiadamrong, 2010). However, holding inventory is associated with cost. When there is a shortage of supply firms face cost in terms of lost sales (Sodhi, 2005; Kopezak & Lee, 1993). On the contrary, a firm can also face a risk by holding inventories (Lai et al., 2009). Adopting the appropriate inventory management method assist firms in reducing the risk associated with inventory (Chopra & Sodhi, 2004).

**3.1.12 Risks linked with competitor actions and environmental legislations**

Risks affecting a firm’s supply chain could happen due to other events such as competitor actions (e.g., discounts and promotion) and environmental legislations of a country (Kaku & Kamrad, 2011). An explanation for each is given below.

**Competitor actions**

When firms relocate their production in a foreign market, they face a new market with new competitors. Porter (1980) expresses a move by one competitor have a
consequence on its competitors. Competitor actions such as discounts, promotions, introducing new technology and new products are known to affect the market share of its competitors (Karakaya and Yannopoulos, 2011; Scherer, 1980). Thus firms need to know and stand the acts of competitors around the industry to stay competitive in the new market (Yannopoulos, 2011).

**Environmental legislations**

Through relocating a production in a foreign market, environmental and other similar legislations of the destination country need to be considered for meeting competitive advantages. For example, developed countries have strict regulations which prohibit the relocation of polluting industries than developing countries (Dey, 2004). Thus, relocation of a polluting industry is impossible in developed countries. Risk associated with environmental or other legislations of a country could be a barrier in meeting the relocation objectives thus need to be considered in order to maximize opportunities and minimize costs (Heil, 2012). Moreover, a firm is expected to be socially responsible and consider its impact on the environment and community while making any decision (Doane, 2005).

### 3.2 Supply chain risk mitigation strategies

The section describes the supply chain risk mitigation strategies that can be applied to mitigate the effect of the different supply chain risks. The associated risk mitigation strategies for supply risks, demand risks, process risks, intellectual property risks, behavioral risks, disruption risks, IT System risks, forecast risks, procurement risks, receivables risks, inventory risks and risks linked to competitor actions and environmental legislations are discussed below.

#### 3.2.1 Mitigation strategies for supply Risks

**Sourcing Strategy**

Firms need to define a sourcing strategy which is consistent with their internal policy and quality strategies to mitigate risks associated and stay competitive in the market (Treleven & Schweikhart, 1988). The two basic kinds of sourcing strategies (single and multiple sourcing) have their own benefits and limitations (Chopra & Sodhi, 2004; Ford et al., 2011). In order to stay safe from heightened risks which arise from dependency on a single source (Ford et al., 2011; Treleven & Schweikhart, 1988), multiple sourcing strategies are selected over single sourcing supply (Buffa, 1985; Juran & Gryna, 1993; Porter, 1998). Besides, multiple sourcing strategies reduce the risk associated with supply quality (Costantino & Pellegrino, 2010; Treleven & Schweikhart, 1988). However, single sourcing strategy is also important to reduce supply risks due to supply commitment and supply cost (Deming, 1982; Robert, 1983; Treleven & Schweikhart, 1988). Hahn et al. (1986) claims that the best strategy is a combination of single and multiple sourcing strategies. This thesis agrees with Hahn et al. (1986) that in order to optimize benefits and reduce risks a mixed strategy of single sourcing and multiple sourcing is viable for firms.
Dealing with certified suppliers

A supplier who meets performance characteristics such as, quality, cost and delivery are given an award or certification namely called, Supplier Certification (Cox and Blackstone, 1998). The certification process provides the needed information about the performance of the supplier to the customers whereby, assisting customers to better know their suppliers (Zsidisin & Ellram, 2003).

Firms engage in supply risks through their procurement activities with their suppliers (Zsidisin et al., 2003). According to a study by Murphy (1992) 50% of the costs of failure of a material to meet the standard is due to problems with suppliers. In order to mitigate the risks through their inbound supply, Larson and Kulchitsky (1998) notes the importance of dealing with certified suppliers to get high quality products at a lower price to the buyers. Carter & Narasimhan (2006) and Lockhart & Ettkin (1993) also mean that verifying if a supplier is certified or not has the advantage of checking the financial health of suppliers, and identifying the supplier capability to check if the supplier meet the requirements such as quality, cost and deliverability which is highly needed by the buyers.

Flexible supply strategy

Tang & Tomlin (2008) underlines, the importance of developing flexible supply strategy in order to reduce risk associated with supply. Firms can mitigate supply risks for example supply cost by developing a flexible supply strategy (Li & Fung, 1998). It is clear that when a firm develops multiple suppliers, order quantities are transferred across many suppliers where by reducing the risk associated with supply cost (Tang & Tomlin, 2008). Moreover, by developing flexible supply strategy, firms can mitigate supply risks linked to supply commitment. Tsay and Lovejoy (1999) claims the importance of a flexible supply strategy via flexible supply contracts to mitigate risks linked with supply cost and supply commitment. Flexible supply contracts, such as quantity flexible contracts set an obligation to be filled, and bind a commitment between the customer and supplier so that a shared objective is achieved (Gottardi et al., 2010). However it should not be underestimated that there is a need to know the suppliers well before signing any contracts to maximize profits and reduce risks (Cremer & Khalil, 1992; Crosby et al., 1990).

Inventory Management

Inventories are often used as a buffer to mitigate risks associated with demand and supply in a supply chain (Lee and Billington, 1993; Zsidisin & Ellram, 2003). The inventories can be placed at any point in the supply chain designed to meet different objectives. For example, Zsidisin & Ellram (2003) notes inventories at the supplier side help to mitigate risks linked to supply, whereas inventories at the manufacturer side can be used to meet uncertainties in demand. However, holding inventories have costs linked to different issues including capital tied up, obsolescence and marked down price (Lee & Billington, 1993; Cachon, 2004). Therefore, firms need to determine the amount of safety stock for each item in the store to reduce costs, improve performance, and mitigate risks linked with handling inventories (Newman et al., 1993; Willems & Graves, 1998).
3.2.2 Mitigation strategies for demand risks

Flexibility is the common approach used by firms in order to mitigate demand risks (Lee, 2004; Liu & Nagurney, 2011). Flexibility is a broad concept which encompasses flexibility in product, process, production and market (Sethi & Sethi, 1990). Tang and Tomlin (2008) reveal two flexibility strategies (product flexibility and pricing flexibility) that can be used to mitigate demand risks. Besides Zsidisin & Ellram (2003) suggests the importance of holding inventories to reduce risks linked with demand uncertainty. Follow on, each of these strategies to mitigate demand risk will be explained.

**Developing a flexible product**

Lee and Tang (1997) demonstrate the importance of a flexible product in order to mitigate demand risks. Supporting this Tang and Tomlin (2008) mean that, a demand risk can be mitigated by developing a flexible product to enable product differentiation. Flexibility in product is explained as the ability of easily adding or substituting components to make it a unique product (Yi et al., 2011; Sethi and Sethi, 1990). By developing a flexible product a product can be differentiated which enables to mitigate the effect of demand risks. Illustrating this Tang and Tomlin (2009) mentions the case of HP DeskJet mitigating demand risk by delaying the point of product differentiation until the actual demand is known.

**Pricing flexibility**

Pricing flexibility is another strategy which can be applied in order to mitigate demand risks (Tang & Tomlin, 2008; Tang & Tomlin, 2009; Lee & Tang, 1997). By enabling a flexible pricing in the market, firms can initiate the taste of their customers. Gregson (2008) and Tang and Tomlin (2008) mean that adopting a flexible pricing strategy influences the customer demand. The illustration given by Tang and Tomlin (2009) on the case of Dell computer also demonstrates on how Dell computer mitigates demand risk by adopting a flexible pricing strategy. It is stated as, when there was a disruption of supply of certain components from Taiwan due to an earthquake, lowering the price of certain products was done to shift the customers accordingly (Tang & Tomlin, 2008). By studying the behavior of the market and the need of customers Dell was able to mitigate demand risks by adopting a flexible pricing strategy.

**Inventory Management**

The increased product variety and the short life span of products have contributed to the heightening of demand risks (Blackhurst & Wu, 2009). When the actual demand in the market exceeds the expected, firms fail to meet the alarming need of their customers. On such occasions, inventories have a basic importance of mitigating demand risks (Lee & Billington, 1993; Zsidisin & Ellram, 2003). At times when the actual demand in the market is higher than the forecast demand, inventories can be used to meet customer expectations and improve the service level of firms (Kopczak & Lee, 1993).
3.2.3 Mitigation strategies for process risks

Flexibility in the context of a manufacturing process is explained as “being able to reconfigure manufacturing resources so as to produce efficiently different products of acceptable quality” (Sethi & Sethi, 1990, p. 295). In alignment to mitigate supply and demand risks, flexibility is implied as one way to mitigate process risks (Tang & Tomlin, 2008; Sethi & Sethi, 1990). Tang and Tomlin (2008) suggest manufacturing flexibility as one strategy to reduce the effect of process risks which will be described below.

Flexibility in manufacturing process

Flexible manufacturing processes enhance efficiency and effectiveness of firms (Stalk & Hout, 1990; Tang & Tomlin, 2008). By flexible manufacturing processes, firms will be enabled to produce multiple variant products where by meeting customer needs on time, with better quality and with the required capacity (Tang & Tomlin, 2008). Adding to this, Stalk and Hout (1990) claims, by increasing flexibility and responsiveness firms are able to increase their competitive advantage, efficiency and responsiveness in the market. Thus, adopting a flexible manufacturing process helps to mitigate the process risks linked with capacity, quality and time (Tang & Tomlin, 2008).

The common issue raised linked to adopting flexibility is the challenge to make the trade off between the benefits of flexibility and the cost associated with implementing a flexible manufacturing process (Stalk & Hout, 1990; Meyer et al., 1989). According to Tang & Tomlin (2008), the firms' interest need to be to understand how much flexibility is required to mitigate such risks, and keep the firm’s cost as minimum as possible. Tang (2006) also mentions, when flexibility is kept as minimum most of the possible advantages to mitigate supply chain risks can be acquired.

3.2.4 Mitigation strategies for intellectual property risks

In order to mitigate the risk linked with intellectual property Chopra and Sodhi (2004) suggests keeping the outsourcing of core business or products in house and limiting the flow of intellectual property to countries that have inefficient legal protection. Moreover, Kim et al. (2009) mean that registration of patents is also helpful to mitigate intellectual property risk. Follow on these issues will be described.

Keeping core business activities in house

As compared to in house production, firms who outsource their business activities and products are able to reduce the cost of operation and capital costs and increase their return on investment and flexibility (Rimmer, 1991; Hendry, 1995; Uttley, 1993). However, the expected benefits from outsourcing may not be achieved for major reasons including strategic outsourcing, (Alexander & Young, 1996), over outsourcing, (Hood, 1997; Boston, 1996; Patterson & Pinch, 1995) and of losing their intellectual property (Chopra & Sodhi, 2004; Kim et al., 2009).
Keeping production in house, at least the core business activities, is considered as a major way to mitigate intellectual property risks (Chopra & Sodhi, 2004; Kim et al., 2009). By in-house production firms can also attain controlled quality and reputation. Yet, the different advantages of outsourcing could not be denied. In order to optimize the benefits of outsourcing and mitigate risks, deciding to outsource need also be a strategic choice (Zhu et al., 2001; Jennings, 1998; Quinn et al., 1990).

**Limiting the flow of intellectual property and registration of patents**

Despite the fact that outsourcing business processes and activities to labor cheap countries favors benefits, intellectual property right is becoming a challenge to most economies (Economist Intelligence Unit, 2004). Maskus (2000) also noted, by performing business activities in counties with inefficient legal protection there is often a discouragement and under utilization of human capital due to the theft of intellectual property. Though the challenge is there, developing a method to deal with it is not rather easy for firms (Zhao, 2006). However, if firms become highly dependent on their internal resources they can mitigate the risk of intellectual property (Chopra & Sodhi, 2004; Zhao, 2006). Furthermore, registrations of patents have got a great value in order to protect the leakage of intellectual property by competitors or other parties (Kim et al., 2009; Shavell & van Ypersele, 2001). These patents include right for specific inventions and entitle a right for the owner so as the owner enables to claim when intellectual properties are taken by competitors or other parties (Shavell & van Ypersele, 2001; Chopra & Sodhi, 2004).

**3.2.5 Mitigation strategies for behavioral Risks**

The main driver of behavioral risk is lack of supply chain visibility (Faisal et al., 2006, Tang & Tomlin, 2008). Supply chain visibility helps to make optimal decisions and reduce the cost of managing risks which is created due to lack of supply chain visibility (Robert et al., 2005). In order to mitigate such risks Faisal et al. (2006) and Moberg et al. (2002) stresses the importance of information sharing to achieve visibility and effectiveness in the supply chain.

**Information sharing**

The main issue in supply chain management is the coordination of supply chain parties to stay competitive in the market and achieve the satisfaction of customers (Faisal et al., 2006; Simatupang et al., 2002). To enable coordination, clear flow of information across members of the supply chain is the basic concern (Faisal et al., 2006; Simchi-Levi et al., 1999). Information across a supply chain can be better shared through technology (e.g Electronic data interchange: EDI, Barrat & Oke, 2007), and communication and collaboration of supply chain parties (Sudy, 2007; Simatupang et al., 2002). By coordination and information flow across supply chain parties, effectiveness and efficiency of a supply chain is achieved (Moberg et al., 2002; Lee et al., 1997). However, Mason et al (2003) and Lee (2000) argues that
it’s not only enough to find a reliable information but also supply chain members should cooperate and use the information to make better decisions and improve the efficiency of the supply chain.

When information is shared across members of the supply chain it increases the visibility in the supply chain where by reducing the risks (Christopher & Lee, 2004; Chopra & Sodhi, 2004). Mason-Jones and Towill (1997, 1998) also states a supply chain with shared information have better responsiveness providing an opportunity to reduce costs, improved service to customers, and exhibit better overall performance.

### 3.2.6 Mitigation strategies for disruption Risks

In a world of globalization, supply chains are becoming more vulnerable to disruptions (Chopra & Sodhi, 2004; Christopher et al., 2002; Christopher & Lee, 2004). Though the source of disruption risk is many, firms need to devise effective means to mitigate disruption risks in order to meet competitive advantages and stay profitable in the market (Chopra & Sodhi, 2004; Henisz & Zelner, 2003). Chopra and Sodhi, and Kleindorfer & Saad (2004, 2005) notes adding inventory and having redundant suppliers can be used as a strategy to mitigate disruption risks.

#### Add Inventory

Inventories are used as a strategy to mitigate different kind of supply chain risks such as supply, demand, and disruption risks (APICS, 2012; Chopra & Sodhi, 2004; Sodhi, 2005; Tang, 2006). However, in order to use inventory as a strategy to mitigate disruption risks, firms need to be aware the associated cost of handling inventory (Chopra & Sodhi, 2004; Sodhi, 2005; Tang, 2006). An inventory stocking policy which can continually change to adapt to current circumstances in the supply chain is used as a strategy to mitigate the cost of inventories (Lee & Billington, 1992). Moreover, Tang (2006 p. 38) suggests the importance of carrying inventories at “certain strategic locations” which can be used by multiple parties in the supply chain to reduce the cost of carrying inventory and mitigate the effect of supply chain disruptions. Elaborating this Tang (2006 p. 38) states the case of the Center for Disease Control (CDC), keeping inventories of medicines, (Which are called “Strategic National Stockpile” (SNS)) at certain strategic locations of USA aimed at keeping the public of the USA from health crisis due to natural disaster, earth quake, flu, etc.

#### Redundant Suppliers

Despite the fact that managing multiple suppliers is costly, having redundant (multiple) suppliers is used as a strategy to mitigate disruption risks (Chopra & Sodhi, 2004; Juran & Gryna, 1993; Porter, 1998). Chopra & Sodhi and Treleven & Schweikhart (2004, 1988) also mean that, firms that practice single sourcing are highly susceptible to disruption risks than organizations that use multiple sourcing.
**Theoretical background**

By having redundant suppliers, firms can also mitigate risk linked with the sudden price increase by sole suppliers (Chopra & Sodhi, 2004; Treleven & Schweikhart, 1988). However, there is a dilemma on which type of sourcing strategy would avoid fears of a sudden price increase by suppliers as single sourcing also can lead to price discount by suppliers (Treleven & Schweikhart, 1988).

**Flexible Transportation**

Supply chain disruptions could also happen due to problems in transportation (Chopra & Sodhi, 2004; Husdal, 2010). When either of transportation risks such as delays, theft, and engine vehicle breakdown happens, the supply chain will be disrupted reducing its performance to meet customer requirements (Yam & Tang, 1996; Husdal, 2010). On such occasions adopting a flexible logistics strategy is known to mitigate supply chain disruptions (Christopher & Peck, 2004; Tang, 2006). Zhang et al. (2005, p.71.) defines logistics flexibility as “the ability of the firm to respond quickly and efficiently to changing customer needs in inbound and outbound delivery, support and services”.

Firms can achieve flexibility in transportation by adopting “multimodal transportation“ (multiple mode transportation for example trucks, ships, helicopters etc.), ”Multi-carrier transportation” (use of many alternate carriers), and use of “Multiple routes” (Tang, 2006, p. 41). By deploying a flexible logistics strategy firms are becoming more efficient and can better meet their competitive advantages (Barad & Even Sapir, 2003; Zhang et al., 2005).

**3.2.7 Mitigation strategies for IT systems Risks**

Information is considered as one of the most valuable asset of an organization (Faisal et al., 2006; Wu et al., 2006). By integrating information systems into supply chains, benefits such as improved supply chain flexibility, reduced cycle time, higher efficiency and deliverability can be acquired by firms (Radjou, 2003). However, in times of system instability firms need to devise a method to deal with the associated risk. Faisal et al (2006) and Kolluru and Meredith (2001) stress the importance of developing an information security system in order to mitigate an organization's risk associated with using information.

**Information Security**

Enterprises have been attempting to make their information system as secure as possible to reduce the risks associated. Anderson (2003) states large financial firms are investing above 2% of their total IT budget to deal with information security. Information security refers to “computer security attempts to ensure the confidentiality, integrity and availability of computing systems components” (Pfleeger & Pfleeger, 2003 p. 29). The information security system is designed at mitigating an organizational loss caused by “intrusion, system misuse, privilege abuse, tampering, fraud, etc.” (Faisal et al., 2006 p. 538). For example developing an access privilege to a user in the supply chain can be considered as one type of information security (Shaw, 2000). Moreover, Chopra and Sodhi (2004) suggest the use of robust backup systems and developing a recovery process that duplicate
all data and processes in order to reduce risk linked with information technology system.

3.2.8 Mitigation strategies for forecast Risk

A forecast risk can be mitigated by keeping inventories and increasing the responsiveness of the supply chain (Chopra and Sodhi, 2004). Developing collaborative relationships among supply chain partners is also suggested to diminish the effect of forecast risks (Faisal et al., 2006; KinaXis, 2012). Follow on these approaches will be explained.

Keep an inventory

Inventories become expensive for firms when they are in excess (Chopra & Sodhi, 2004; Kopczak & Lee, 1993; Lai et al., 2009; Sodhi, 2005). But, there are reasons when an organization needs to keep inventories in order to stay profitable and meet competitive advantages. The major reason to keep inventory is to meet variations. Variation can be in the form of supply (Zsidisin, 2002), demand (Liu & Nagurney, 2011; Tang & Tomlin, 2008), production process or lead times (Schoenherr et al., 2008) etc. For such occasions firms need to keep inventory to reduce inefficiencies (Chopra & Sodhi, 2004; Tang, 2006). Similarly, when variation in actual demand and forecast demand exists, inventories can be used to mitigate the effect of inaccurate forecast (Chopra & Sodhi, 2004; Sodhi, 2005). However the difficult questions lie on how much inventory should be kept to meet uncertainties? For how long will the inventories be kept? And where in the supply chain system should inventories be kept? These questions are challenging and need analytical techniques in order to make optimal decisions (Davis, 1993; Moon et al., 1998).

Increase responsiveness

Keeping inventories as a strategy to mitigate the effect forecast risk may not be suitable for firms if the item has high holding costs (Chopra & Sodhi, 2004). In such occasions firms can mitigate the effect of forecast risks by developing a responsive production process and or delivery capacity (Chopra & Sodhi, 2004). Responsive production refers to “the ability of a production system to achieve its operational goal in the presence of supplier, internal and customer disturbances, where disturbances are those sources of change which occur independently of the system’s intentions”( Matson & McFarlane, 1999 p. 765). By increasing responsiveness firms can better achieve their company goals such as quality, delivery, cost, safety, etc. (Matson & McFarlane, 1999; Barclay et al., 1996). Moreover, by being responsive firms can better understand the cause of disturbances whereby they get a chance to take an appropriate action (Chopra & Sodhi, 2004; Matson & McFarlane, 1999). The increased competition in the global market necessitates the need to develop a responsive production system in order to meet competitive advantages and stay profitable (Barclay et al., 1996; Suri, 1998).
Theoretical background

Collaborative relationship among supply chain partners
Collaborative relationship is a complex form of supply chain partnering (Barratt, 2004; Faisal et al., 2006). To reach to collaboration relationship supply chain partners pass a series of stages namely cooperation, coordination and then to collaboration (Tyndall et al., 1998; Faisal et al., 2006). Developing a collaborative relationship in a supply chain is claimed as challenging to implement (Sabath & Fontanella, 2002), needs technology (McCarthy & Golocic, 2002), and is difficult to develop trust along supply chain partners (Ireland & Bruce, 2003; Barratt, 2002).

When supply chain partners are able to collaborate, the efficiency and the effectiveness of the supply chain is improved (McCarthy & Golocic, 2002; Tyndall et al., 1998). By collaborating among supply chain partners, firms can get the required information which enables them to make a better forecast where by improving the accuracy of forecasts (Moon et al., 1998; KinaXis, 2012). Moreover, visibility in the supply chain is improved which diminishes the effect of bullwhip effect consequently mitigating the effect of forecast risks (Chopra and Sodhi, 2004) other than this, collaborative relationship assists the development of agile supply chains consequently reducing supply chain risks (Hoyt and Huq, 2000).

3.2.9 Mitigation strategies for procurement risk
In order to mitigate the effect of procurement risk it is suggested to create financial hedges (Chopra & Sodhi, 2004), signing long term contracts and having redundant suppliers (Peleg et al., 2009; Weissman, 1992). These strategies will be explained below.

Creating financial hedges
By global trading, there is an exchange of currency from one country to another where it involves an exchange rate risk. In order to mitigate the effect of foreign exchange risk organizations use a strategy called hedge (A transaction that reduces the risk of an investment) (Allayannis & Ofek, 2001; financial web, 2012). By hedging, business owners protect themselves from sudden change of foreign exchange currency. In order to mitigate the effect of foreign exchange risk, form of hedging strategy includes different form of contracts (Allayannis & Ofek, 2001; Pirrong, 1993). Among them includes, spot contracts, forward contracts, foreign currency options, interest rate options, foreign currency swaps, and interest rate swaps (Financial web, 2012). By using these contracts business partners are making arrangements so that they mitigate the effect of foreign exchange risk (Allayannis & Ofek, 2001; Pirrong, 1993; Financial web, 2012). When foreign exchange rate risks are reduced this supports to the mitigation of procurement risks (Chopra & Sodhi, 2004).
Long term contracts and redundant suppliers

By signing a long term contract firms can mitigate the effect of sudden price hikes by suppliers which consequently mitigates procurement risks (Chopra & Sodhi, 2004). Long term contracts favors the benefits of long term certainty of supply, provides opportunity to take advantage of economies of scale and facilitates less procurement activities where by reducing procurement risk (Peleg et al., 2009; Weissman, 1992). However, it should not be underestimated that by signing long term contracts if the price of the contracted item fall organizations will lose profits (Chopra & Sodhi, 2004; Rey & Salanie, 1990).

Similarly having redundant suppliers reduces procurement risk by limiting the effect of unexpected price increment by suppliers (Chopra & Sodhi, 2004; Treleven & Schweikhart, 1988). However, to reduce the effect of procurement risk by having redundant suppliers firms should be able to take the advantage of economies of scale (Chopra & Sodhi, 2004).

3.2.10 Mitigation strategies for receivables risk

Dividing the sales across many customers is suggested as a strategy to deal with receivables risk.

Distributing products across many customers

In order to diminish receivables risk, distributing the products across many customers is very important (Chopra & Sodhi, 2004; SunGard press release, 2011). When receivables are distributed across many customers, the risks associated with collecting the payment will diminish. Depending on a payment of few large customers will heighten the risk associated with receivables. For example, in case of a bankruptcy of one large client a business can be seriously hurt when payments are dependent on this single client. A firm can reduce risks associated with receivables by distributing goods evenly to many smaller customers than few large customers whereby, spreading the risk accordingly (SunGard press release, 2011; Chopra & Sodhi, 2004). Moreover the extent of the receivables risk is dependent on how soon the payment can be collected from customers and used in meeting other objectives of the business (SunGard press release, 2011).

3.2.11 Mitigation strategies for inventory risk

Inventory pooling, creating common components across products, postponing or delaying the last stage of production and agility in a supply chain is suggested in order to mitigate the effect of inventory risk. Follow on, an explanation of these strategies will be given.

Inventory pooling

Inventory pooling refers to the centralization of different inventories into one (Benjaafar et al., 2005). When an inventory is pooled into a centralized location system it will reduce inventory carrying costs and reduces the level of inventory
Theoretical background

(Baird, 2004; Eppen, 1979) consequently, reducing inventory risk (Chopra & Sodhi, 2004). It’s widely suggested to pool inventory or aggregate demand in order to mitigate inventory risk, forecast risk, to improve efficiency, and to have better management of inventory (Baird, 2004; Chopra and Sodhi, 2004; Yang & Schrage, 2009). However, inventory pooling also got disadvantages such as increased transportation cost (Cattani & Schmidt, 2005). Open (1979) argue that the benefits of pooling inventory are highly dependent on the correlation and the variety of the demands. Supporting this Benjaafar et al. (2005, p. 565) examines in detail inventory pooling in production inventory systems and concludes that several factors such as “utilization, demand and process variability, control policy, service levels, and the structure of the production processes” determines the benefits of inventory pooling.

Creating common components across products
The inventory pooling principle can be extended to the different processes of a firm including production (Cattani & Schmidt, 2005). During production, if common components are able to be produced which can fit into different variants of a product, then this will ensure the reduction of inventory level (due to risk pooling), reduces safety stock and improves the efficiency of the stock (Cattani & Schmidt, 2005; Chopra & Sodhi, 2004; Collier, 1981, Dogramaci, 1979) consequently, mitigating inventory risk (Chopra & Sodhi, 2004). The value of commonality also extends to mitigating forecast risks and maintaining the service level of customers at low investment in safety stock (Baker et al., 1986). Adding to this, Collier (1981) suggests commonality of parts offers other proportional advantages such as, reduction in manufacturing cost (due to economies of scale) and improved delivery performance. Commonality in product components also helps to achieve the standardization of parts where by initiating mass customization (Swaminathan, 2001). However, it is argued that the commonality of parts may reduce variety of products in the insight of customers (Cattani & Schmidt, 2005; Swaminathan, 2001).

Postponing or delaying the last stage of production
The increased need of product variety by customers laid a challenging task to the production environment (Hsu & Wang, 2004; Swaminathan, 2001). In order to satisfy this increased need of customers, a concept of product differentiation is enabled (Hsu & Wang, 2004; Swaminathan, 2001). Product differentiation denotes a strategy where “the final configuration of a product is postponed as much as possible, usually until a customer order is received” (Hsu & Wang, 2004, P.184). This strategy is proposed to mitigate the effect of uncertainties in the forecast and to improve the responsiveness of the supply chain (Hsu & Wang, 2004; Lee, 1996; He & Kusiak, 1997; He et al., 1998). In this concept, a semi-finished product is made and stored in the inventory which later will be differentiated into the desired specific product when demand is certain (Chopra & Sodhi, 2004; Swaminathan, 2001). This favor for reduced inventory level, improved customer satisfaction and
responsiveness (Chopra & Sodhi, 2004; Swaminathan, 2001) consequently, reducing the inventory risk (Chopra & Sodhi, 2004).

**Agility in supply chain**
Different researchers define agility in many ways (for e.g., see Goldman et al., 1995; Mason-Jones et al., 2000; Tolone, 2000). Tolone (2000, p. 109) states, agility refers to “effectively integrating supply chain and forging close and long term relationship with customers and suppliers”. By developing an agile supply chain, different benefits can be acquired including improved efficiency, better market responsiveness (Agarwal et al., 2004; Aitken et al., 2002), low manufacturing cost, better quality products (Goldman et al., 1995) and reduced lead time (Fliedner & Vokurka, 1997). The definition of agility by Christopher (2000) uncovers, agility also makes firms better react to customer demand. Moreover, the benefit from an agile supply chain extends to reduction of inventory risk (Agarwal et al., 2004; Chopra & Sodhi, 2004; Faisal et al., 2006). Working with highly responsive suppliers is also viewed mitigating inventory risk (Chopra & Sodhi, 2004).

**3.2.12 Mitigation strategies for risks linked with competitor actions and environment legislations**

Partners of a business need to work together to create a better environment and meet competitive advantages. The concept of corporate social responsibility is helpful to manage partner’s risks concurrently and to meet environmental expectations of their customers and the government. It is discussed here to manage risks linked to competitor actions and environmental legislations.

**Corporate social responsibility**
An organization is judged on how it is socially responsible and is concerned about the community (Doane, 2005; Faisal et al., 2006). Roberts (1992 p. 595) defines the concept of corporate social responsibility as “activities, policies or actions which identify a company as being concerned with society-related issues”. Ghartey (1987) explains, the purpose of corporate social responsibility is to create awareness to the public about their rights and let them to complain when the rules are not met. Issues such as unfavorable working conditions, use of child labor, working hour’s length (Ghartey, 1987; Faisal et al., 2006), Industrial wastes, usage of natural resource are considered largely in the concept of corporate social responsibility (Beamon, 1999). An organization that is socially responsible will react to the social and governmental regulations accordingly and doing this lets the firm to keep its reputation (Doane, 2005; Faisal et al., 2006).

Besides, firms are expected to manage concurrently the risk of their partners across the supply chain so as to green their supply chain (Ashley, 1993; Bergstrom, 1993; Speckman & Davis, 2004). The Principles are included in ISO 14000 which lets manufacturing firms to green their supply chains (Beamon, 1999). A green supply chain management is an approach to meet competitive advantages and increase profits, by mitigating environmental risks and their effects while raising the ecological performance (Van Hoek, 1999).
4. Results

This chapter presents the results of the research from the literature review and empirical study. The summary of the results of the interviews conducted with the representatives at the three companies will be presented separately below which will form the empirical basis of the study. A detailed summary of the interviews is presented in the appendix F. The results presented in this chapter lay the basis for the answer to the research questions.

4.1 Results from literature review

The following table below demonstrates a summary of the results of the literature reviews done to achieve the objective of this study. As it is stated earlier in the theoretical background section, in order to determine the supply chain risks that need to be considered while relocating a production system and the associated risk mitigation strategies the framework of Chopra and Sodhi (2004) is adopted. However, in order to make it more comprehensive, a modification is made to it by considering the framework of the supply chain risks by Tang & Tomlin (2008) and Kaku and Kamrad (2011). In the table that follows, the summary of risk mitigation strategies that can be used to mitigate the effect of each of the supply chain risks are also indicated.

<table>
<thead>
<tr>
<th>Supply chain risks</th>
<th>Drivers of the risks</th>
<th>Risk mitigation strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supply commitment</td>
<td><strong>Flexible supply strategy</strong> (Gottardi et. al, (2010), Tang &amp; Tomlin (2008), Tsay &amp; Lovejoy (1999))</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Inventory management</strong> (Cachon (2004), Lee &amp; Billington (1993), Zsidisin &amp; Ellram (2003))</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Inventory management</strong> (Cachon (2004), Lee &amp; Billington (1993), Zsidisin &amp; Ellram (2003))</td>
</tr>
</tbody>
</table>
### Results

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Capacity</td>
<td></td>
</tr>
<tr>
<td>Intellectual property risks</td>
<td>Global outsourcing</td>
<td>-Keeping core business in house (Chopra &amp; Sodhi (2004), Kim et al. (2009))</td>
</tr>
<tr>
<td></td>
<td>Vertical integration of supply chain</td>
<td>-Limiting the flow of intellectual property and Registration of patents (Chopra &amp; Sodhi (2004), Kim et al. (2009), Shavell &amp; van Ypersele (2001), Zhao (2006))</td>
</tr>
<tr>
<td>Behavioral risks</td>
<td>Lack of supply chain visibility</td>
<td>-Information sharing across partners in a supply chain (Faisal et al. (2006), Moberg et al. (2002), Lee et al. (1997), Simchi-Levi et al. (1999))</td>
</tr>
<tr>
<td>Disruption risks</td>
<td>Natural disaster</td>
<td>-Add inventory (Chopra &amp; Sodhi (2004), Sodhi (2005), Tang (2006))</td>
</tr>
<tr>
<td></td>
<td>Political risks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Source of supply bankruptcy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transportation risks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>System integration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E-Commerce</td>
<td></td>
</tr>
<tr>
<td>Forecast risks</td>
<td>Inaccurate forecast</td>
<td>-Keep an inventory (Chopra &amp; Sodhi (2004), Liu &amp; Nagurney (2011), Sodhi (2005))</td>
</tr>
<tr>
<td></td>
<td>Bullwhip effect</td>
<td>-Increase responsiveness (Chopra &amp; Sodhi (2004), Matson &amp; McFarlane (1999), Tang &amp; Tomlin (2008))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Collaborative relationships among supply chain partners (Chopra and Sodhi (2004), Hoyt and Huq (2000)),</td>
</tr>
</tbody>
</table>
## Results

<table>
<thead>
<tr>
<th>Procurement risks</th>
<th>Exchange rate risk</th>
<th>Procurement risks</th>
<th>Exchange rate risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single or multiple</td>
<td></td>
<td>-Creating financial hedges</td>
</tr>
<tr>
<td>Industry wide</td>
<td>source supply</td>
<td>Industry wide</td>
<td>(Allayannis &amp; Ofek (2001), Chopra &amp; Sodhi (2004))</td>
</tr>
<tr>
<td>capacity utilization</td>
<td></td>
<td>Type of supplier</td>
<td>-Long term contracts &amp; redundant suppliers (Chopra &amp; Sodhi (2004), Peleg et al. (2009))</td>
</tr>
<tr>
<td>contract</td>
<td></td>
<td>contract</td>
<td></td>
</tr>
</tbody>
</table>

### Receivables risk

| Number & Financial strength of customers | -Distributing products across many customers (Chopra & Sodhi (2004), Tang & Tomlin (2008)) |

### Inventory risks

| Rate of product obsolescence | -Inventory pooling (Baird (2004), Chopra & Sodhi (2004), Yang & Schrage (2009)) |
| Product value               | -Creating common components across products (Cattani & Schmidt (2005), Chopra & Sodhi (2004)) |
| Inventory holding cost     | -Postponing or delaying the last stage of production (Hsu & Wang (2004), Swaminathan (2001)) |
| Demand and supply uncertainty | -Agility in supply chain (Agarwal et al. (2004), Chopra & Sodhi (2004), Faisal et al. (2006)) |

### Risks linked with competitor actions and environmental legislations

| Competitor actions | -Corporate social responsibility (Doane (2005), Faisal et al. (2006), Van Hoek (1999)) |
| Environmental legislations |                     |

Table 5. Results of literature review
4.2 Results from the interviews

The tables below exhibit the list of supply chain risks faced/considered by the interviewed companies while relocating their production systems in a foreign market. The associated risk mitigation strategies used by the companies to mitigate the effect of each of the supply chain risks are also shown. The results from these interviews will be used as a complement to answer the research questions raised in this research. The risk mitigation strategies which are “Bold” in table 6 below are new empirical findings and are thus combined with the results of the literature review, specified in table 5 above, to develop a framework for managing supply chain risks while relocating a production system in a foreign market indicated in Fig.2.

4.2.1 Results of interview no 1

<table>
<thead>
<tr>
<th>Supply chain risks faced/considered by the company while relocating</th>
<th>Risk mitigation strategies used by the company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply risks</td>
<td>✓</td>
</tr>
<tr>
<td>- Dealing with certified suppliers</td>
<td></td>
</tr>
<tr>
<td>- Defining sourcing strategy</td>
<td></td>
</tr>
<tr>
<td>- Build buffer (Inventory)</td>
<td></td>
</tr>
<tr>
<td>- Flexible transportation</td>
<td></td>
</tr>
<tr>
<td>Demand risks</td>
<td>✓</td>
</tr>
<tr>
<td>- Increase responsiveness by being demand driven company (Pricing, product flexibility)</td>
<td></td>
</tr>
<tr>
<td>Process risks</td>
<td>✓</td>
</tr>
<tr>
<td>*Risk of keeping standards for the company</td>
<td>- Developing strong manufacturing processes and training of employees</td>
</tr>
<tr>
<td>Intellectual property risks</td>
<td>✓</td>
</tr>
<tr>
<td>- Signing intellectual property agreements</td>
<td></td>
</tr>
<tr>
<td>Behavioral risks</td>
<td>✓</td>
</tr>
<tr>
<td>*Risks linked with information (Culture and language barrier for the company)</td>
<td>- Sharing information</td>
</tr>
<tr>
<td>- Work closely with supply chain partners</td>
<td></td>
</tr>
</tbody>
</table>
### Results

<table>
<thead>
<tr>
<th>Category</th>
<th>✔️</th>
<th>✗</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disruption risks</td>
<td>✔️</td>
<td>✔️</td>
<td>- Improved supply chain flexibility</td>
</tr>
<tr>
<td>IT system risks</td>
<td>✔️</td>
<td>✔️</td>
<td>- Developing a secured IT setup</td>
</tr>
<tr>
<td>Forecast risks</td>
<td>✔️</td>
<td>✔️</td>
<td>- Increase responsiveness to changes in demand</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Better forecasting system</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Work closely with supply chain partners</td>
</tr>
<tr>
<td>Procurement risks</td>
<td>✔️</td>
<td>✔️</td>
<td>- Creating financial hedges</td>
</tr>
<tr>
<td>Receivables risks</td>
<td>☒</td>
<td>☒</td>
<td>- Monitoring the business receivables</td>
</tr>
<tr>
<td>Inventory risks</td>
<td>✔️</td>
<td>✔️</td>
<td>- Inventory pooling</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Ensuring inventories</td>
</tr>
<tr>
<td>Risks linked with competitor actions and</td>
<td>✔️</td>
<td>✔️</td>
<td>- Measuring the market share of competitors</td>
</tr>
<tr>
<td>environmental legislation</td>
<td></td>
<td></td>
<td>- Complying with international agreements and work accordingly</td>
</tr>
</tbody>
</table>

**KEY**

- ✔️ = Supply chain risks faced/considered by the company
- ☒  = Supply chain risks not faced/considered by the company

Table 6. Results from interview no 1
### 4.2.2 Results of interview no 2

<table>
<thead>
<tr>
<th>Supply chain risks faced/considered by the company while relocating</th>
<th>Risk mitigation strategies used by the company</th>
</tr>
</thead>
</table>
| **Supply risks** | - Assessing the performance of suppliers  
| | - Keep an inventory |
| **Demand risks** | - Keep an inventory |
| **Process risks** | - Flexibility in manufacturing process |
| **Intellectual property risks** | - Keep core business activities in house |
| **Behavioral risks** | - Sharing information across supply chain partners |
| **Disruption risks** | - Keep an inventory |
| **Information technology system risks** | - Information security system |
| **Forecast risks** | - Keep an inventory |
| **Procurement risks** | - Signing long term contracts |
| **Receivables risks** | - Monitoring the business |
| **Inventory risks** | - Centralizing an inventory |
| **Risks linked with competitor actions and environmental legislation** | - Applying the concept of corporate social responsibility  
| | - Signing contracts  
| | - Watching the action of competitors |

**KEY**

✓  = Supply chain risks faced/considered by the company  
✗  = Supply chain risks not faced/considered by the company

Table 7. Results of interview no 2
### 4.2.3 Results of interview no 3

<table>
<thead>
<tr>
<th>Supply chain risks faced/considered by the company while relocating</th>
<th>Risk mitigation strategies used by the company</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply risks</strong></td>
<td>-Dealing with certified suppliers</td>
</tr>
<tr>
<td></td>
<td>-Flexible sourcing strategies</td>
</tr>
<tr>
<td><strong>Demand risks</strong></td>
<td>-Increasing responsiveness</td>
</tr>
<tr>
<td><strong>Process risks</strong></td>
<td>-Manufacturing flexibility</td>
</tr>
<tr>
<td></td>
<td>-Training of employees</td>
</tr>
<tr>
<td><strong>Intellectual property risks</strong></td>
<td>-Core business activities in house</td>
</tr>
<tr>
<td><strong>Behavioral risks</strong></td>
<td>-Improving supply chain visibility</td>
</tr>
<tr>
<td><strong>Disruption risks</strong></td>
<td>-Applying flexibility in supply chain (e.g., Transportation flexibility)</td>
</tr>
<tr>
<td><strong>IT system risks</strong></td>
<td>-Developing an IT security system</td>
</tr>
<tr>
<td><strong>Forecast risks</strong></td>
<td>-Improved forecasting tools</td>
</tr>
<tr>
<td></td>
<td>-Increased responsiveness</td>
</tr>
<tr>
<td><strong>Procurement risks</strong></td>
<td>-Long term relationship with suppliers</td>
</tr>
<tr>
<td></td>
<td>-Creating financial hedges</td>
</tr>
<tr>
<td><strong>Receivables risk</strong></td>
<td>-Monitoring the business</td>
</tr>
<tr>
<td><strong>Inventory risks</strong></td>
<td>-Being flexible to existing situations</td>
</tr>
<tr>
<td><strong>Competitor actions and environmental legislation risks</strong></td>
<td>-Complying with rules and regulations</td>
</tr>
<tr>
<td></td>
<td>-Cope with competitor action</td>
</tr>
</tbody>
</table>

**KEY**

- ✓ = Supply chain risks faced/considered by the company
- ✗ = Supply chain risks not faced/considered by the company

Table 8. Results of interview no 3
5. Analysis

In order to evaluate the empirical findings of this research the summary of results from the interviews performed are analyzed against the theoretical framework. Then after a framework for analysis of this research is made to answer the research questions and which will form the basis for the discussion and conclusions presented in the next chapter.

5.1 Analysis of the Interviews

After doing the interviews, it was possible to understand that the companies consider and make an analysis of supply chain risks while relocating their production system in a foreign market as the importance is indicated by Harland et al. (2002) and Schoenherr et al. (2008). All the interviewed companies consider the supply chain risks, supply risks, demand risks, process risks, intellectual property risks, disruption risks, forecast risks, procurement risks, and risks linked to competitor actions and environmental legislations, while relocating their production system in a foreign market. The benefits of considering such risks to meet competitive advantages and stay competitive in a new market is stated by Chopra & Sodhi (2004), Tang & Tomlin (2008) and Kaku & Kamrad 2011. The companies also prepare for behavioral risks, IT system risks and inventory risks while relocating in a foreign market. The need of considering these risks to boost the performance of firms is indicated by Faisal et al. (2006), Chopra & Sodhi (2004) and Baird (2004) respectively. On the contrary, receivables risks are not seemed to be considered by the interviewed companies while relocating. Chopra & Sodhi (2004) note the significance of controlling receivables risks to increase the performance of a company and stay competitive in the global market.

The companies also note the importance of managing the different supply chain risks in the same way as stated by Chopra and Sodhi (2004) and Schoenherr et al (2008). The primary strategies used by the companies to mitigate the effect of the supply chain risks are by being an agile company that adopts flexibility in its supply chain and by keeping visibility in the entire supply chain network. The importance of these strategies to mitigate the effect of different supply chain risks is indicated by Tang and Tomlin (2008), Chopra & Sodhi (2004) and Faisal et al. (2006).

Dealing with certified suppliers, defining a flexible sourcing strategy, supply chain flexibility (e.g., flexible supply strategies, flexible transportation) and inventory management are the strategies used by the companies to mitigate the effect of supply risks. The importance of these strategies to reduce the effect of supply risks is indicated by Carter & Narasimhan (2006), Chopra & Sodhi (2004), Gottardi et. al, (2010), Tang & Tomlin (2008), and Zsidisin & Ellram (2003) respectively.

Increasing responsiveness by using methods such as use of better forecasting tools and inventory management are used by the companies to mitigate the effect of demand and forecast risks in the same way as stated by Chopra & Sodhi (2004) and Faisal et al. (2006). Similarly, the companies’ use of the strategies such as sharing information, collaborating across supply chain partners to improve visibility across the supply network is supported by Faisal et al. (2006) and Christopher & Lee (2004) to reduce the effect of forecast and behavioral risks.
Analysis

By adopting flexibility in manufacturing processes the companies mitigate process risks as its importance is implied by Tang & Tomlin (2008). Developing strong manufacturing process and training of employees are also the strategies used by the companies to mitigate process risks. The importance of training employees to create a stable manufacturing process and to produce products of acceptable quality is implied by Sethi & Sethi (1990) and Tang (2006).

The benefits of keeping core business activities in house and signing intellectual property agreements to reduce intellectual property risks are implied by Chopra & Sodhi (2004), Kim et al. (2009) and Zhao (2006) in the same notion used by the companies. Besides, increasing flexibility across the supply network (e.g. Transportation flexibility) and keeping inventory are the strategies used by the companies as Christopher & Lee (2004), Chopra & Sodhi (2004) and Christopher & Peck (2004) indicates its benefits to mitigate the effect of disruption risks.

The companies’ strategy of developing a secured IT setup is supported by Chopra & Sodhi (2004) and Radjou (2003) to mitigate the risks associated with disruptions in the IT system and to render other advantages such as improved flexibility in supply chain and to control other risks. Creating financial hedges, developing long term relationship with suppliers and signing long term contracts are implied by Allayannis & Ofek (2001) and Chopra & Sodhi (2004) as a strategy to mitigate the effect of procurement risks in the way as used by the companies. Besides, the companies monitor their business and customers to reduce the risk of loss due to receivables risks in the same notion stated by Chopra & Sodhi (2004).

The companies’ used the method inventory pooling and increased flexibility to existing situations to reduce the effect of inventory risks as the importance of these strategies noted by Baird (2004) and Yang & Schrage (2009). Finally by looking the action of competitors and by complying with the rules and regulations of the destination country and international agreements the company mitigates the effect of risk of loss associated with competitor actions and environmental legislations in the same way as stated by Doane (2005) and Faisal et al (2006).
5.2 A Framework developed for managing supply chain risks while relocating a production system in a foreign market

The success of relocating a production system is dependent on how well companies understand the risks embedded in their supply chains and their preparedness to apply risks mitigation strategies (Schoenherr et al., 2008). This makes supply chain risk management a crucial task for any company that relocate its production system in a foreign market. Thus, preparing a set of guidelines that assist managers in the management of supply chain risk offers a great help.

In order to outline the results of this research, the framework below is developed. The framework can assist firms while implementing risk mitigation strategy, preventing or handling supply chain risks by providing a broad picture of supply chain risks and the associated risk mitigation strategy that need to be considered. Besides, it can help managers while making relocation decisions by providing a fast but comprehensive view of the supply chain risks that need to be tradeoff against the advantage of relocating a production system in a foreign market.

The design of the framework has been inspired by the template of Chopra and Sodhi (2004). However the framework constitutes the idea of many other researchers including Tang & Tomlin (2008), Kaku & Kamrad (2011) and Speckman & Davis (2004). In the framework, the supply chain risks, the risk mitigation strategies and the drivers of the supply chain risks are indicated. The list of supply chain risks with their drivers and the mitigation strategies are derived from the summary of the results from literature review done to achieve the objective of this research (For details see table 5). Besides, the results of the interviews are used as a supplement (See table 6). The supply chain risks indicated in the framework come up due to issues or problems emanating during the interaction of the basic enablers or components of a typical supply chain (supplier, logistics, producer, wholesaler, retailer and customer) during product flow from supplier to customer or during the flow of information from customer to supplier across the supply chain (See fig. 2 below). Thus, the basic enablers/ components of a typical supply chain are indicated in the framework. Besides, the need to show the connection between the supply chain risks and the success of relocating a production system in a foreign market determines the look of the framework as indicated in fig. 2.
Fig. 2 Framework for managing supply chain risks while relocating a production system in a foreign market (Inspired by Chopra & Sodhi (2004), Kaku and Kamrad (2011), Speckman and Davis (2004), and Tang and Tomlin (2008))

<table>
<thead>
<tr>
<th>Supply chain risks</th>
<th>Mitigation strategies</th>
<th>Drivers of the risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply risks</td>
<td>Define sourcing strategy</td>
<td>Supply cost</td>
</tr>
<tr>
<td></td>
<td>Dealing with certified suppliers</td>
<td>Supply quality</td>
</tr>
<tr>
<td></td>
<td>Flexible supply strategy, flexible transportation</td>
<td>Supply commitment</td>
</tr>
<tr>
<td></td>
<td>Inventory management</td>
<td></td>
</tr>
<tr>
<td>Demand risks</td>
<td>Developing a flexible product</td>
<td>Demand uncertainty</td>
</tr>
<tr>
<td></td>
<td>Pricing flexibility</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increase responsiveness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inventory management</td>
<td></td>
</tr>
<tr>
<td>Process risks</td>
<td>Flexibility in manufacturing process</td>
<td>Quality</td>
</tr>
<tr>
<td></td>
<td>Developing strong manufacturing processes and training of employees</td>
<td>Time</td>
</tr>
<tr>
<td>Intellectual property risk</td>
<td>Keeping core business activities in house</td>
<td>Capacity</td>
</tr>
<tr>
<td></td>
<td>Limiting the flow of intellectual property &amp; registration of patents</td>
<td>Global outsourcing</td>
</tr>
<tr>
<td>Behavioral risks</td>
<td>Information sharing across supply chain partners</td>
<td>Vertical integration of supply chain</td>
</tr>
<tr>
<td>Disruption risks</td>
<td>Inventory Management</td>
<td>Natural disaster</td>
</tr>
<tr>
<td></td>
<td>Redundant suppliers</td>
<td>Labor dispute</td>
</tr>
<tr>
<td></td>
<td>Flexibility in transportation modes</td>
<td>Political risks</td>
</tr>
<tr>
<td></td>
<td>Improved supply chain flexibility</td>
<td>Source of supply</td>
</tr>
<tr>
<td>IT system risks</td>
<td>Information security</td>
<td>Supplier bankruptcy</td>
</tr>
<tr>
<td>Forecast risk</td>
<td>Keep inventory</td>
<td>Natural disaster</td>
</tr>
<tr>
<td></td>
<td>Increase responsiveness, use of better forecasting tools</td>
<td>Labor dispute</td>
</tr>
<tr>
<td></td>
<td>Collaborative relationship among supply chain partners</td>
<td>Political risks</td>
</tr>
<tr>
<td>Procurement risk</td>
<td>Creating financial hedges</td>
<td>Exchange rate risk</td>
</tr>
<tr>
<td></td>
<td>Long term contracts and redundant suppliers</td>
<td>Single or multiple source supply</td>
</tr>
<tr>
<td>Receivables risk</td>
<td>Distributing products across many customers</td>
<td>Industry wide capacity utilization</td>
</tr>
<tr>
<td></td>
<td>Monitoring the company receivables</td>
<td>Type of supplier contract</td>
</tr>
<tr>
<td>Inventory risk</td>
<td>Inventory pooling, ensuring inventories</td>
<td>Rate of product obsolescence</td>
</tr>
<tr>
<td></td>
<td>Creating common components across products</td>
<td>Product value</td>
</tr>
<tr>
<td></td>
<td>Postponing or delaying the last stage of production</td>
<td>Inventory holding cost</td>
</tr>
<tr>
<td></td>
<td>Agility in supply chain</td>
<td>Demand and supply uncertainty</td>
</tr>
<tr>
<td>Risk linked with competitor actions and environmental legislations</td>
<td>Developing corporate social responsibility</td>
<td>Competitor actions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environmental legislations</td>
</tr>
</tbody>
</table>

Success of relocating a production system in a foreign market

Enablers/Components of a supply chain

- Supplier
- Logistics
- Producer
- Wholesaler
- Retailer
- Customer

Product flow to Information flow
The main findings from the research reflect that by adopting flexibility in their supply chain’s firms can mitigate the different supply chain risks including supply risks, demand risks, process risks, disruption risks and inventory risks. Flexibility can be experienced in a supply chain in many forms such as flexibility in supply strategy, flexibility in product, flexibility in the manufacturing process, flexibility in transportation etc. It’s viewed that flexibility in a supply chain can be applied to different enablers or components of a supply chain to mitigate the different supply chain risks.

The other main observation is on the effect of inventory management in a supply chain to lessen supply chain risks. Maintaining inventory at the proper level at the different points of the supply chain, say at the supplier and manufacturer side assists to reduce supply risk, demand risk and forecast risk. Moreover, inventories which are kept at certain strategic locations are found helpful to prevent the effect of major disruptions like earthquake and natural disaster.

It is also noticed that suppliers in a supply chain have a determinable role in mitigating the effect of supply chain risks. Dealing with a certified supplier, and selecting a suitable sourcing strategy which is consistent with internal policies and strategies of firms can reduce the effect of most supply chain risks including supply, procurement and disruption risks. Lastly, supply chain visibility and information sharing across the supply chain is also found helpful to reduce the effect of behavioral, demand and forecast risks.
6. Conclusions and discussions

In this chapter the conclusions from the above framework “managing supply chain risks while relocating a production system in a foreign market” conducted in the last chapter are drawn. These conclusions are the answers for the objectives of the research. Later on, discussions on method, results and evaluation of the report are presented.

6.1 Conclusions

The purpose of this thesis was to identify supply chain risks that need to be considered while relocating a production system in a foreign market and the related risk mitigation strategies that can be applied to lessen the effect of the risks.

The research has shown the potential supply chain risks that need to be predetermined while relocating production activities in a foreign market and the associated risk mitigation strategies that can be used to reduce the effect of the risks. For a summarized view of the answers to the research questions raised in this paper see the developed framework (see fig. 2).

Supply risks, demand risks, process risks, intellectual property risks, behavioral risks, disruption risks, IT system risks, forecast risks, procurement risks, receivables risks, inventory risks, and risks linked to competitor actions and environmental legislations are observed the potential supply chain risks that need to be considered while relocating a production system in a foreign market. For these supply chain risks, different risk mitigation strategies are presented which can be used to lessen the effect of each of the risks. However, it should not be forgotten that there is a need to deal with these risks in a holistic manner where the ultimate goal being to ensure continuity in the supply chain and achieve the firm’s objectives. Adopting different forms of flexibility in a supply chain (i.e. flexibility in supply, transportation, production, etc.), developing a better inventory management system, dealing with reliable suppliers, improving supply chain visibility and information sharing across partners of the supply network and collaborating with supply chain partners are found to be helpful in mitigating the effect of multiple (two or more) supply chain risks.

After understanding the potential supply chain risks and the associated risk mitigation strategies firms are expected to respond to changes in a supply chain accordingly since any type of supply chain disruption have a direct effect on the firms’ ability to meet competitive advantages, continue operations, deliver the right goods at the right time and place and deliver the required service to the customers.
6.2 Discussions

6.2.1 Discussion of the methods

The methodology that is used to conduct this thesis was a qualitative method where data was collected mainly through literature review. Besides, a few interviews were also done at companies that have relocated recently to supplement the results of the literature review. The literature review as explained in the theoretical background section, enables to design the research questions and assists further to develop the theoretical framework. The framework developed later is the answer to the research questions.

Discussion on literatures

As it is explained in the methodology chapter, the major literatures reviewed to achieve the objectives of this research are literature in the field of production management and literature in the field of supply chain management. It is noticed that there exists an ample literature in the field of supply chain and production management which talks about the different supply chain risks and their effect on the performance of firms. But, it can be said that a general view connecting the supply chain risks and the relocation of a production system is missing to a certain extent. Besides, it is observed that researchers in the field determine the supply chain risks by using different ways. As a result, many frameworks about supply chain risks have been developed. However, there is no clear agreement on which type of the framework best encompasses the supply chain risks. Oke & Gopalakrishnan (2009) also, confirms to this statement.

After reviewing the classification of supply chain risks by different researchers this thesis adopts the template of Chopra & Sodhi (2004). The main motivation factor to select this template was the fact that it covers most types of supply chain risks and categorizes the supply chain risks based on the drivers of the risks than the other type of templates for examples risk classification by Tang & Tomlin (2008). On the contrary, the shortcoming of this template can be explained as there was no clear basis on how the supply chain risks are categorized. For example, in the template of Chopra & Sodhi (2004) (See appendix C) “information infrastructure breakdown” is stated under the driver of system risks which could also be a source of disruption risks. However, to make it more comprehensive it is combined with the work of other researchers. Based on the combined framework, the theoretical framework is designed and also the interview questions.

Discussion on the interview

This thesis aims to deeply understand the supply chain risks that need to be considered while relocating a production system in a foreign market and the associated risk mitigation strategies that can be applied to mitigate the effect of the risks. Thus, the author believes that interviews are suitable methods to collect primary data for the study. In order to get knowledge from industrial sectors about the subject matter an interview was conducted at three companies with the
“Vice President, Material Planning & Logistics personnel and with the “supply chain manager and company representative” of the respective industries. The job status of all the three interviewees makes them suitable targets for the study. However, due to the fact that only three interviews could not lay basis for any generalizations the results from the interviews are used as a supplement while analyzing the findings of this research.

Through the process of contacting companies to do an interview, getting the right personnel to make the interview was challenging. According to the answers received from the contacted companies, this can be explained in two ways. Some companies have responsible personnel who answer the interview questions but since the relocation decisions are taken at a very high level position in the organization, these personnel’s are often busy with their own tasks so it is found difficult to make the interview. The other view is companies have had relocated long years before and don’t have someone who can really answer the questions. Therefore, through the process of contacting companies for the interview a large effort was made to contact companies who are in the process of relocating their production system and recently relocate their production activities. All the interviewed companies are recently relocated from two to six years before and all the interviewees were from a company that sends its site.

During the interview, it was possible to understand that all the interviewees understand the effect of the supply chain risks on firms at different levels. Besides it was possible to understand that the risk mitigation strategies used by the companies differ according to the type of the source company and according to the current conditions of the destination country. (for e.g., keeping inventory is used as a strategy to mitigate forecast risk for a company that relocate to Ethiopia as the inventory carrying cost is lower in Ethiopia than Turkey).

Overall, the author believes that it was possible to find fruit full results from the interviews at the companies. However, this thesis believes that if more time is devoted further, more companies can be the targets of the study which could improve the results of the study.

6.2.2 Discussion on the results

Firms need to respond to supply chain disruptions in a timely manner to reduce losses and maximize their profits. In order to enable rapid response to supply chain disruptions, managers and supply chain experts need to be armed with risk management tools and methods that are capable of dealing supply chain issues in timely and cost effective manner. The consequences of ignoring risks embedded in supply chains have also become more severe. Thus for any company a comprehensive and structured way of analyzing supply chain risks is crucial to reduce loses, manage risks proactively and thus meet competitive advantages and stay competitive in the global market.
The results from this research successfully addresses the potential supply chain risks that need to be considered while relocating a production system in a foreign market and the associated risk mitigation strategies that can be applied to reduce the effect of the risks by developing a framework (See fig 2). The main findings of this study are indicated in section 5.2. Among the findings of this study the use of adopting flexibility in a supply chain is indicated to mitigate the effect of most potential supply chain risks including supply risks, demand risks, process risks, disruption risks, forecast risks, procurement risks, and inventory risks.

This result from the study leads the author of this thesis to further questions of practical relevance like how much flexibility a firm need to have in its supply chain to reduce the effect of such potential supply chain risks and is there any clear way to measure flexibility in a supply chain?

On the other side, the visible limitation of the developed framework is that it does not show the relationship between the different supply chain risks and the associated risk mitigation strategies. A risk mitigation strategy that is applied to reduce one supply chain risk may found to heighten the other supply chain risks (for e.g., keeping inventory can reduce forecast risks while increasing inventory risks). Thus, while using this framework there is a need to view the risks in a holistic manner and thus a risk mitigation strategy need to be chosen accordingly.

### 6.2.3 Evaluation of the report

Validity and reliability determine the quality of a scientific report (Jacobsen, 2002). Validity guarantees that the research is executed accurately and the findings of the research are demonstrated correctly (Jacobsen, 2002). The forms of validity are internal and external validity (Jacobsen, 2002). Internal validity refers to the validity of internal measurements used where as external validity denotes the possibility of making generalizations (Jacobsen, 2002; Williamson, 2002).

In this research in order to increase the internal validity of the study primarily the appropriate methodology is used and the research takes the attitudes of experts in the subject matter as indicated by Saunders et.al (2003) procedure for exploratory research. All the in-depth interviews of participants are recorded and a note is also taken from the interview which contributes to improve the internal validity according to Jacobsen (2002). Besides, the interviewees are put at ease by asking easy, general questions first, avoiding leading questions and letting know that their answers and the particular company can be made anonymous in the same way as Saunders et al (2003) express method to increase internal validity of a qualitative research. Moreover, in this research method triangulation has been used where data collected in the form of interviews and literature reviews which contributes to the internal validity as Williamson (2002) states. Furthermore, this research relies on additional researchers for data analysis which boosts the internal validity of the research according to Jacobsen (2002).
Conclusions and discussions

In order to increase the external validity of this research a thorough job is done in describing the context of the research to the respondents as Saunders et.al (2003) indicates its importance. The multi method employed in data collection strategies also contributes to the external validity according to McMillan and Schumacher (1997). The author of this thesis believes that the findings of this research can be applied to the real world and can be used as a ground for further extensions of the findings. If the study is repeated with another method say survey, many numbers of manufacturing companies can be suitable targets of the study and a slight variation on the findings could happen. This is due to the fact that most supply chain risks and supply chain risk mitigation strategies could be revealed in the practical world which contributes to the study.

Reliability denotes how reliable and consistent a certain data is (Bryman & Bell, 2003; Williamson, 2002). According to Patton (2001), reliability in qualitative paradigm judges the trustworthiness and dependability of a research. In this research, to increase the reliability the research it relies on the shoulders of the giants on the field through the whole process of the research and further used the opinions and attitudes of experts in the practical world. Besides, during the interview, the researcher asked clarification for unclear or uncertain facts which contributes to the reliability of a qualitative research according to Saunders et.al (2003).
7. Suggestions for future research

This section presents suggestions for future research on the subject matter.

To undergo further research on this thesis topic it can be interesting to devote more time to collect data by using the survey method where many other companies can be suitable targets for the study.

Using a survey method to collect primary data could reveal new findings and insights to this research area. In order to broaden further the collective understanding of this thesis topic, for example, a research can be done on how the supply chain risks associated with relocating a production system in a foreign market can be prioritized based on the destination country of the relocation. By taking the opinions of experts from the survey some form of categorization of countries can be made so that it is possible to know the risks that need to be given priority while relocating to a certain category of countries.
8. References

8.1 Journals, books and other publications


References


Brenchley, R. (2000). Project report to understand how trade compliance risk should be identified, assessed and managed in increasingly dis-integrated global supply networks at Hewlett Packard. Part time Executive MBA, University of Bath: Cambridge University Press.


Economic Intelligence Unit (EIU), (2004). *Scattering the seeds of invention: The globalization of research and development*. (September). London, UK, New York, Hong Kong.


References


References


References


References


### 8.2 Web -References


References


9. Appendices

The appendix contains the documents used to carry out this Master thesis research. The contact letter used at the companies, the interview questions and the summary of the interviews are also included here.

Appendix A: List of supply chain risks (Tang and Tomlin, 2008)

<table>
<thead>
<tr>
<th>Major types of supply chain risks that occur regularly,</th>
<th>Supply Risk</th>
<th>Process Risk</th>
<th>Demand Risk</th>
<th>Intellectual Property Risk</th>
<th>Behavioral Risk</th>
<th>Political Risk</th>
<th>Social Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix B: Supply chain risk matrix (Kaku & Kamrad, 2011)

<table>
<thead>
<tr>
<th>Type of Event</th>
<th>Quadrant I</th>
<th>Quadrant II</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-Frequency, Low-Impact</td>
<td>Minor design issues</td>
<td>Availability and cost of resources</td>
</tr>
<tr>
<td></td>
<td>Quality problems</td>
<td>Availability, cost, and quality of inputs (e.g., fuel)</td>
</tr>
<tr>
<td></td>
<td>Scheduling issues</td>
<td>Availability, cost and quality of information (e.g., demand)</td>
</tr>
<tr>
<td></td>
<td>Machine breakdowns</td>
<td>Competitor actions such as discounts and promotions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Event</th>
<th>Quadrant IV</th>
<th>Quadrant III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-Frequency, High-Impact</td>
<td>Employee strike</td>
<td>New materials and technologies</td>
</tr>
<tr>
<td></td>
<td>Major design flaw</td>
<td>Competitors’ actions</td>
</tr>
<tr>
<td></td>
<td>Intellectual property theft</td>
<td>Demographics</td>
</tr>
<tr>
<td></td>
<td>Interruptions to company operations due to natural disaster, major fire, terrorist actions</td>
<td>Political instability</td>
</tr>
<tr>
<td></td>
<td>Financial crisis-poor investment decisions, embezzlement</td>
<td>Environmental, other legislation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Financial crisis at national or global level</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Severe shortages of inputs (e.g., oil embargo)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Financial issues at a major supplier leading to disruption in supplies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Major fire or other mishap in a supplier facility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Natural disaster affecting suppliers or customers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>War, terrorist actions affecting suppliers or customers</td>
</tr>
</tbody>
</table>
Appendix C: Supply chain risks by Chopra and Sodhi (2004)

<table>
<thead>
<tr>
<th>Supply chain risks</th>
<th>Drivers of Risk</th>
</tr>
</thead>
</table>
| Disruptions        | • Natural disaster  
                    | • Labour dispute    
                    | • Supplier bankruptcy  
                    | • War and terrorism  
                    | • Dependency on a single source of supply as well as the capacity and responsiveness of alternative suppliers. |
| Delays             | • High capacity of utilization at supply source  
                    | • Inflexibility of supply source  
                    | • Poor quality or yield at supply source  
                    | • Excessive handling due to border crossings or to change in transportation modes |
| Systems            | • Information infrastructure breakdown  
                    | • System integration or extensive systems networking  
                    | • E-commerce |
| Forecast           | • Inaccurate forecasts due to long lead times, seasonality, product variety, short life cycles, small customer base  
                    | • “Bullwhip effect” or information distortion due to sales promotions, incentives, lack of supply chain visibility and exaggeration of demand in times of product shortage |
| Intellectual property | • Vertical integration of supply chain  
                        | • Global outsourcing and markets |
| Procurement        | • Exchange rate risk  
                    | • Percentage of a key component or raw material procured from a single source  
                    | • Industry wide capacity utilization  
                    | • Long-term versus short-term contracts |
| Receivables        | • Number of customers  
                    | • Financial strength of customers |
| Inventory          | • Rate of product obsolescence  
                    | • Inventory holding cost  
                    | • Product value  
                    | • Demand and supply uncertainty |
| Capacity           | • Cost of capacity  
                    | • Capacity flexibility |
Appendix D: Contact letter

Dear ______________________

In my master thesis project at Jonkoping University, I am studying about supply chain risks associated with relocating a production system in a foreign market. The purpose of the study is to determine supply chain risks that need to be considered while relocating a production system in a foreign market and to demonstrate mitigation strategies that can be used to reduce the effect of such risks.

It’s evident that firms use different kinds of strategies to reduce the effect of supply chain risks and increase their performance. Therefore, the purpose of the interview is to understand what kind of supply chain risks the company faced and considered while relocating a production system in a foreign market and to learn the different risk mitigation strategies used by the company to overcome the effect of such risks.

Thus, the interview is part of a research on supply chain risks. I am really grateful for the cooperation you make to do the interview. On your interest, the result from the study can be sent to your company.

If you have any further inquiries or concerns, please do not hesitate to contact us.

Kind regards,

Elizabeth Gultie
Master student in the program of production systems

For information please contact,

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Phone: +46 (0) 36 10 16 38
Appendix E: Interview questions

Part I: General Information
1. What is the company’s main field of production?
2. What is the size of your company?
3. What is your job title?
4. Where are the company's production plants located? (Which countries?)
5. When did the company recently relocated its production activities? And where?
6. What were the major reasons for relocating these production activities?

Part II: Supply chain risks and their mitigation strategies
7. Have your company ever face risk of loss due to problems linked with suppliers while relocating production activities? (e.g., sudden increase of price by suppliers, problems in quality of incoming supply etc.)
   a. Generally, what kinds of methods used by the company to solve the problems related to suppliers while relocating production activities?
   b. Were these problems predetermined while relocating production activities?
8. Have your company ever experience risk of loss due to fluctuation in market demand while relocating production activities?
   a. Generally, what kinds of strategies used to deal with such fluctuations in market demand while relocating production activities?
   b. Were the fluctuations in demand determined by the company before relocating?
9. Have your company ever encountered risk of loss due to problems that occur during the manufacturing of products (e.g. Production of defective products) while relocating production activities?
   a. Generally, what kinds of methods used to reduce such risks while relocating production activities?
   b. Were such risks predetermined while relocating production activities?
10. Have you ever seen any risk that someone copies the company’s intellectual property while relocating production activities?
   a. Generally what kinds of methods used to deal for such problems while relocating production activities?
   b. Have you prepared for such risk before relocating production activities?
11. Have your company ever faced problems due to communication gap resulting between suppliers, logistics providers and wholesalers while relocating production activities?
   a. Generally, what kind of methods used to deal for such problems while relocating production activities?
   b. Were such problems predetermined while relocating production activities?
12. Have your company ever encountered risks of loss due to occasions such as natural disaster, labor dispute, political problems etc. while relocating production activities?
   a. Generally, what kind of methods used to mitigate such risks while relocating production activities?
   b. Were the occurrences of such risks predetermined while relocating production activities?
13. Have your company ever met any risk of loss due to instability in the information technology system while relocating production activities?
   a. Generally what kind of methods used to deal such risks while relocating production activities?
   b. Were such risks considered before the actual relocation of the production activities?
14. Have your company ever encountered risks of loss for reasons that the forecast made about supply and demand is wrong while relocating production activities?
   a. Generally what methods used to mitigate such risks while relocating production activities?
   b. Have you considered the possibility of such risk of loss before relocating production activities?
15. Did the company ever exposed to risk of loss due to a sudden increase in purchasing cost of materials or fluctuating exchange rates while relocating production activities?
   a. Generally, what kind of strategies used by the company to deal such occasions while relocating production activities?
   b. Were these risks of loss predetermined while relocating production activities?
16. Have your company ever met a possibility of being unable to collect on receivables while relocating production activities?
   a. Generally, what kind of strategies used by the company to reduce the effect of such uncertainties while relocating production activities?
   b. Were the possibilities of such occurrences predetermined while relocating production activities?
17. Have your company ever encounter the risks of loss due to carrying excess inventory while relocating production activities?
   a. Generally, what kinds of methods used to reduce the effect of such losses while relocating production activities?
   b. Were losses due to carrying excess inventory predetermined while relocating production activities?
18. Have your company ever face risk of loss due to the large market share of competitors while relocating production activities?
   a. Generally what kinds of methods are used by the company to deal with such occasions while relocating production activities?
   b. Were the losses due to large market share of competitors predetermined while relocating production activities?
19. Have your company ever encounter the risk of loss due to the environmental rules and regulations of the destination country?
   a. Generally what kinds of methods used to reduce the effect of such losses while relocating production activities?
   b. Were the losses due to environmental rules and regulations of the destination country predetermined while relocating production activities?

≈ Thank you! I am really grateful for your willingness to make the interview! ≈

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Appendices

Appendix F: Summary of the interviews

Interview no 1

Volvo car cooperation is a global automotive manufacturing company which is located in Goteborg, Sweden. It has production facilities in Sweden, Belgium, China and also assembly plant in Malaysia. The company has 22,000 employees worldwide including 16,000 in Sweden. The Volvo Car company has recently relocated to China since 2010, and is ready to begin production in September 2013. The following table shows a brief description about the interview.

<table>
<thead>
<tr>
<th>Interview no 1</th>
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<tbody>
<tr>
<td>Company name</td>
</tr>
<tr>
<td>Type of company</td>
</tr>
<tr>
<td>Country of origin</td>
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<tr>
<td>The company’s area of relocation</td>
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<tr>
<td>The company’s most recent area of relocation</td>
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<tr>
<td>Name of the interviewee</td>
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<tr>
<td>Job title</td>
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<tr>
<td>Type of interview</td>
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<tr>
<td>Duration (Minutes)</td>
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<tr>
<td>Interview date</td>
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</tbody>
</table>

Table 2. Interview no 1

According to the interview made with Mr. Uyttendaele, Vice President Material Planning & Logistics, the main reason for Volvo Cars to relocate is mainly due to the need to expand in the new market. From the interview, the opportunity to relocate to China came when Ford Company decided to sell Volvo cars and Geely Holding Group then acquired Volvo from Ford in 2010.

According to Mr. Uyttendaele, when the company is trying to operate in different geographical locations and cultures, different supply chain risks are considered in a holistic manner. Besides, detailed planning and sensitivity analysis is done to mitigate any possible risk and to enable predict the unforeseen risks said in the interview. Moreover, in order to understand the investment environment in the new market, and to realize any possible risks the company benefits from the use of consultants who are experts in assisting companies relocate or set up a new facility in a new country mentioned in the interview.

Mr. Uyttendaele pointed out that different supply chain risks are predetermined when relocating. For example while relocating to China the supply chain risks considered include supply risk, demand risk, manufacturing process risk, disruption risk; procurement risk, forecast risk, Intellectual property risks, Inventory risks, IT system risks, risk of loss due to communication gap resulting between supply chain partners (i.e. Suppliers, logistics providers and wholesalers etc.) and risk linked to competitor actions and environmental legislation of the
country. Besides, other risks such as risk of keeping standards, the risk of loss due to the culture and language barrier are also considered. Moreover, according to the interview, the existence of further unplanned risks which could pop up during operation is also understood.

During its long years of experience in different countries, Volvo Cars faced the risk of loss due to these risks at different times and situations expressed in the interview. The company mitigates these risks by being an agile company that can respond to the situation accordingly. According to the interview, the company also has a very flexible supply chain that can adapt or even redesign its supply chain quickly when disruptions are persistent in the supply chain and whenever a change is required. This flexible strategy is adopted by developing a contingency plan with the logistics providers, suppliers and other partners said in the interview. According to Mr. Uyttendaele, the company also gives great emphasis to keep visibility in the entire global supply chain so as it is possible to mitigate supply chain risks.

In order to mitigate the risk of loss due to suppliers, the company deals with reliable suppliers Said Mr. Uyttendaele. Moreover, according to him, the performances of suppliers are assessed based on factors such as quality, reliability, flexibility and availability (geographic presence). As a sourcing strategy the company chooses to source locally. However, there are cases when this is not 100% possible referring the interview. For example, it’s explained that for Volvo Cars Company in China the sourcing turns at the end to be 60-40% , i.e. 60% source from European suppliers and 40% source from China suppliers. Rendering Mr. Uyttendaele, the company’s other strategy to mitigate supply risks include to build a buffer and then to redistribute when this is required and also by using a flexible transportation (fly electronic components).

According to the interview, the Volvo Cars Company is a demand driven company and is able to increase or reduce capacity of production according to the market demand which helps to mitigate the effect of demand risks. Moreover, Mr. Uyttendaele pointed out that the use of better forecasting techniques is used by the company to reduce the effect of demand risks.

The company also has very strong processes which let to reduce the risk of loss due to manufacturing processes, according to the interview. Demonstrating this, Mr. Uyttendaele told, the new manufacturing system in China is gradually fed and tested to reduce the effect of risks associated with manufacturing process and also to keep standards.

The company’s strategy to mitigate the effect of intellectual property risk is by signing intellectual property agreements said Mr. Uyttendaele. Moreover, according to him, to mitigate the risks of loss due to communication gap resulting between suppliers, logistics providers and wholesalers the company improves the visibility of the supply chain by sharing information and working closely with suppliers and partners of the supply chain.
According to Mr. Uyttendaele, the company’s risk of loss due to disruptions such as earthquake and political risk is mitigated by developing a network of contacts around the globe to collect information and then increasing the flexibility of the supply chain to cope with the situations. Moreover, considering IT system risks the company prepares well to solve issues resulting from IT system risks mentioned in the interview. According to the interview, the newly relocated company in China constitutes the best IT set up in Volvo Cars.

To mitigate the risks of loss due to forecast risks the company increases its responsiveness to changes in the market demand, develops and use better forecasting system and works closely with customers, suppliers, dealers, and other partners in the supply chain referring the interview.

According to Mr. Uyttendaele, the company uses some form of financial hedges in order to reduce procurement risk. Moreover, it’s said that the company work closely with dealers and monitors the business to reduce uncertainties to receive a payment for the goods and services delivered. Being the company a customer oriented company, it does not produce for stocks said Mr. Uyttendaele. However, according to him, to mitigate the risk of pipeline inventory, methods such as insuring the whole pipeline inventory for catastrophic and inventory pooling is used.

According to the interview, to reduce the risk of loss due to the action of competitors, the company decides where to sell the product, understand who the competitors are and then measures the market share of the competitors to take actions. Finally, Mr. Uyttendaele told, to reduce the risk of loss due to the environmental rules and regulation of the destination country the company complies with international agreements and work accordingly.
Interview no 2

Relocating production activities in Ethiopia was the first relocation experience for the company no 2. The table below shows an overview of the company. According to the interview made, the primary reasons for the company to relocate to foreign market is to meet the global requirements of textile demand at competitive prices. Besides, the progressive policies and investment incentives provided by the government of Ethiopia has made its own contributions to the relocation decision.

<table>
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<td>Country of origin</td>
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<td>Job title</td>
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<td>Type of interview</td>
</tr>
<tr>
<td>Duration (Minutes)</td>
</tr>
<tr>
<td>Interview date</td>
</tr>
</tbody>
</table>

According to the interview, the relocation of the company in Ethiopia is viewed as an integral part of the main company’s strategic risk plan in Turkey. It's informed that at the beginning of the relocation (i.e., before six years) a preparation was made, clear objectives were set and a project management group was formed that directs the relocation activity and performs the regular reporting activity.

Referring the interview, most supply chain risks including supply risks, demand risks, process risks, intellectual property risks, disruption risks, IT system risks, forecast risk, procurement risks and risk of loss linked to competitor actions and environmental legislation were predetermined while relocating the production activities. However, high priority was given to consider the risk of loss due to supply, intellectual property and disruption risks expressed in the interview. Through its six years of manufacturing experience in a foreign market, the company faced the risk of loss due to the supply chain risks supply, demand and disruption risks informed at the interview.

The primary strategy of the company to reduce the effect of supply chain risks is by developing greater supply chain flexibility and better inventory management systems according to the interview. It is pointed out that by using these methods the firm is able to manage two or more risks consequently.

In order to reduce the effect of supply risks the supply chain manager and the company representative noted that primarily the local raw material suppliers are well researched for criteria’s such as quality, reliability and flexibility. Moreover,
they are assessed based on awareness of IT governance practices (i.e., good internal control and well documented process) remarked in the interview.

According to the interview, few well capable local suppliers were elected through this selection process. The supply chain manager adds, the selection of the local suppliers was given great attention. This was due to the already established long-term relationship with other suppliers through its long years of manufacturing and the need to sign long term contracts with reliable suppliers to mitigate supply, procurement risks and other risks which arise due to supplier problems, said in the interview. Besides, it was informed that keeping inventory is used as a strategy to mitigate the effect of supply risk and others including, demand, disruption and forecast risks in the company.

To mitigate the effect of process risks in the new market the company adopts a determined level of flexibility in the manufacturing process in order to adopt changes to the market demand said in the interview. Besides, to improve the quality of the products the employees received a certain week of training to produce as per the required standards according to the interview.

In order to manage the risk of loss of due to theft of intellectual property, the supply chain manager told the company is under direct company control of the main company in Turkey. According to him, this also helps to create better communication with partners in the supply chain where by reducing behavioral and information technology related risks. Besides, according to the interview, the main company in Turkey controls the whole business that assists also to reduce the company loss due to receivables risk.

According to the interview the company benefits from lower inventory carrying cost experienced in Ethiopia as compared to in Turkey. This helps the company to store inventories so that they can be used in times of uncertainties referring the interview. However, from the interview, some form of centralizing inventory is used to reduce the effect of inventory risk.

The company risk of loss due to competitor actions is very low according to the interview. It is also stated that the company watches the actions of competitors to understand the market and to predict the future demand for further expansions. Finally, the supply chain manager told in order to reduce the risk of loss due to environmental legislations, a contract agreement is signed to comply with the rules and regulations. Moreover, according him, projects are being made to support the environment in the development of sustainable cotton production and its global distribution in Africa.
Interview no 3

The third interview is performed in a manufacturing company of motorcycle and automobiles. An overview of the company is stated in the table below.

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<tbody>
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<tr>
<td>Country of origin</td>
<td>China</td>
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<td>The company’s area of relocation</td>
<td>Russia, Azerbaijan, Vietnam, Iran and Ethiopia</td>
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<td>The company’s most recent area of relocation</td>
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<td>Name of the interviewee</td>
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<tr>
<td>Job title</td>
<td>Supply chain manager and company representative</td>
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<tr>
<td>Type of interview</td>
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<td>Duration (Minutes)</td>
<td>110 min</td>
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<tr>
<td>Interview date</td>
<td>2012-12-20</td>
</tr>
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</table>

Table 4. Interview no 3

According to the interview, the main reason that motivates the company to relocate in a foreign market is the need for expansion in the new market and to take the relative advantage of lower labor cost. The supply chain manager states, while relocating in a foreign market, different supply chain risks are considered in a comprehensive manner. In relocating, the company uses previous experience in recent production relocation activities said the supply chain manager. According to him, while relocating production activities, the relocation is studied well and the company makes an analysis of risks before making the relocation decision.

The company predetermines supply chain risks in relocating production activities according to the interview. For example, the company predetermined supply risks, demand risks, process risks, intellectual property risks, disruption risks, forecast risks, procurement risks, inventory risks and risks linked with environmental legislations of the country while relocating to Ethiopia mentioned the supply chain manager. Referring to the interview, among these risks, a very high priority was given to the risk of loss linked to disruption risks. The supply chain manager pointed out that the company faces the risk of loss due to these risks at different occasions and times. For example, there were significant losses linked to the manufacturing process at the beginning of the production in Ethiopia mentioned in the interview. The main cause for the losses in the manufacturing process was due to problems in the quality of the products referring the interview. On the contrary, the company does not consider the supply chain risks behavioral risks, IT system risks, and receivables risks expressed in the interview.

Even though the company does not predetermine behavioral risk, IT system risks and receivables risk there are measures taken by the company if such risks happen said the supply chain manager. Improving the supply chain visibility, developing an IT security system and a system that evaluates the payments to the company;
the creditworthiness of customers is used as a strategy to deal with these risks consequently stated in the interview.

According to, the supply chain manager, to mitigate the effect of supply risks the company deals with reliable suppliers. Besides, according to him the company uses strategies such as flexible sourcing strategies to deal with supply risks. Similarly, in order to reduce the risk of loss due to fluctuation in demand, the company is continuously making an effort to be a responsive company said the supply chain manager. According to him, the company uses improved forecasting tools and integrates these tools to the already existing supply chain to improve visibility across the supply chain where by reducing demand risk, forecast risks, behavioral risks and consequently inventory risks. Besides, using a collaborative approach that brings the different department of the company for a comprehensive plan and being more flexible for the existing situation is used by the company to mitigate demand; forecast, inventory, behavioral risks and other related risks said the supply chain manager.

The company had significant loss due to manufacturing process mentioned in the interview. Therefore to reduce such effects the company invests in training of employees to perform as the needs of the company said the supply chain manager. Besides, according to him the manufacturing process is flexible enough to handle changes due to the existing demand.

The relocated companies are under direct control of the main company in China. Referring to the interview, this enables the company to have a direct control over the company’s intellectual property and assists the partners in the supply chain to cooperate where by increasing the visibility of the supply chain network.

In order to deal with disruption risks the company applies flexibility in a supply chain said the supply chain manager. For example, a flexible transportation approach is used to deal with disruptions due to transportation problems said in the interview.

To mitigate the effect of losses related to procurement risks, the supply chain manager mentions that the company deals with reliable suppliers to create long term relationship and make purchasing contracts when the exchange rate is good for the company.

The company sees as an opportunity to grow when there is a competitor in the market said the supply chain manager. According to him the company has the capability to offer better products than competitors. By developing the flexibility to work under different geographical locations and by complying with the rules and regulations of the destination country the company is able to cope with the risks linked with competitor actions and environmental legislations referring the interview.