Master’s Thesis

Supply Side Risks Assessment of the Supply Chain

- A case study of the Supply Side Risks Assessment in HUAWEI’s Supply Chain

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Abstract

Title: Supply Side Risks Assessment of the Supply Chain -A case study of the Supply Side Risks Assessment in HUAWEI’s Supply Chain

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Course: 4FE14E – Master thesis

Research questions
1. What kind of risks in the supply side of HUAWEI supply chain can be identified?
2. How can supply side risks of HUAWEI supply chain be assessed?
3. How can supply side risks of HUAWEI supply chain be mitigated?

Purpose
This paper describes supply side risks in HUAWEI in China, the types of risks identified, provides guidelines for assessment of these risks and suggestions for mitigation.

Methodology
In order to answer above research questions empirical data have been collected through observations, interviews at with logistics managers of HUAWEI in China, and from the official documents, annual reports and authentic web pages of the HUAWEI. Theoretical framework has been built through scientific articles, peer reviewed journals, authentic web based documents, and textbooks. The information is then assessed and analyzed, which result in conclusion and recommendations for the company.

Conclusion
There can be four major risks identified on the supply side. Manufacturing risk, logistics risk, information risk and inventory risk. The manufacturing risk include risks related to production, skill, and quality. The logistics risk further include delivery risk, lead time risk, and transportation risk. Production risk and skill risk are critical and they can be avoided by enhancing risk awareness, evaluating production feasibility, strengthen staff training, investing in high skills, strengthening R&D, and analysis of the external environment. The quality and inbound delivery risks can be reduced through supplier inspection and establishing good supplier relations. Lead time risk and inventory risk can be reduced by vendor based managed inventory system and mass customization. Meanwhile, transportation risk can adopt risk transfer strategy. The information risk can be reduced by increasing information sharing levels and adopting modern communication technologies.

Keywords: Supply Chain Risk, Risk Identification, Risk Assessment, Risk Mitigation, supply side, HUAWEI
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List of abbreviations

R&D          Research and Development
ITU          International Telecommunications Union
MSAN         Multi-Service Access Node
21CN         21st Century Network
UMTS         Universal Mobile Telecommunications System
HSPA         High Speed Packet Access
LTE          Long-Term Evolution
EPC          Electronic Product Code
TDC A/S      Tele Denmark Communications
GSM          Groupe Spécial Mobile
DC           Distribution Center
ERM          Enterprise Resource Management
MDS          Master Demand Schedule
MPS          Master Production Schedule
MRP          Material Requirement Planning
WIP          Working in Process
CEG          Commodity Expert Groups
TQM          Total Quality Management
VMI          Vendor Managed Inventor
PSI          Purchase Sales Inventory
1. Introduction

In the introduction chapter, authors will give a general introduction of Chinese multinational networking and telecommunications equipment company-HUAWEI. According to the problem discussion of HUAWEI, authors will determine the research direction and research questions.

1.1 Background

The HUAWEI Technologies Co. Ltd. was founded in 1987. It is a Chinese multinational networking and telecommunications equipment company headquartered in Shenzhen, Guangdong (Chou, Logistics Manager, 03-04-2017).

The main business of the company was to provide operation services and technical consulting to most of the global enterprises. HUAWEI has around 170,000 employees working and almost 48% of the staffs are involved in the research and development (Mathew, 2015). The R&D (Research and Development) department of the HUAWEI is all over the country and every places all over the world such as the United States, Canada, the United Kingdom, Germany, Sweden, Russia, etc. The products and services of the company are deployed in more than 170 countries and cities around the globe, facilitating over third portion of the world’s population (Chou, Logistics Manager, 03-04-2017). The HUAWEI products include mobile phones, media pads, televisions, watches, wireless network cards and wifi devices. HUAWEI mobile phones occupied the highest market share among their all products (HUAWEI, 2017).

From 1998 to 2003, HUAWEI signed the management consulting contract with IBM, it has undergone a major change in its management and product development structure (Chang et al., 2009).

After 2000, HUAWEI widened its international expansion, and by the year 2000 its international sales were more than $1 billion and establishing an R&D center in Stockholm, Sweden (Bloomberg News, 2011).

In 2001, HUAWEI joined the International Telecommunications Union (ITU) and some

In October 2013, HUAWEI was selected by TDC A/S to be the sole suppliers of Denmark to modernize the GSM/UMTS/LTE network and provide six years management services (Chou, Logistics Manager, 03-04-2017).

According to the latest rankings of The Economist, HUAWEI is the Chinese largest telecommunications provider (Micheli & Carrillo, 2016). Meanwhile, in 2015 HUAWEI was ranked 228th of Fortune 500 companies, (FORTUNE, 2017).

HUAWEI is a mature enterprise and it supports cooperation, challenges and success shared together with its shareholders (Chou, Logistics Manager, 03-04-2017), therefore, they actively seek the collaboration opportunity positively. Additionally, HUAWEI encourages its staffs to innovation in order to provide new products and improve customer satisfaction. However, nowadays due to the fast growth of companies, development of technology and globalization the complexity within businesses is increasing and it has been a broadly discussed topic over the last decades. It is still a recent phenomenon that companies have to deal with (Anthony et al., 2014).

In today’s highly competitive environment, a goal-oriented supply chain needs a coordination to manage not only the interdependent activities of supply chain partners but also between suppliers and consumers (Jayaram, 2015).

According to Drechsel (2010) coordination supply chain coordination can be defined as the targeted and orderly adjusted actions of the supply chain partners in order to achieve shared goals and objectives. The aim of coordination mechanisms is critical in achieving supply chain performance. It is argued that supplier coordination strongly influence performance regarding production, quality of products and manufacturing flexibility. Studies have shown that the performance of the supply chain is highly influenced by the fact of how well supply chain partners work together, ignoring the individual contribution of each partner.
In this joint goal view, the interdependent activities between supply chain entities need to be coordinated to achieve the best fit among supply chain partners. It has been shown that poor operations among supply chain members and risky business environment has negative consequences on performance, such as inaccurate forecasts, low capacity utilization, excessive inventory, poor customer service, inventory turns, inventory costs, time to market, order fulfilment response, quality, consumer focus and consumer satisfaction (Besterfield, 2009).

Moreover, HUAWEI and HUAWEI stores have corresponding mechanisms to control the store’s sale and stock which is called iRetail and PSI (purchase sales inventory) system (HUAWEI Technologies Co. Ltd., 2017). The iRetail system helps store manage its information system which includes sales volume, asset and performance measurement, and PSI system helps store manage its inventory and sales according to customer’ demand (Jayaram et al., 2010, Zhang & Tu, 2009).

Suppliers have a great influence on cost, quality, technology, speed and responsiveness of buying firms (Jayaram et al. 2010). Therefore, an effective combination must be developed both within and outside the firm in order to convert competitive advantage into profitability (Klasa et al., 2011), the poor operation appears within suppliers and HUAWEI instead of HUAWEI and stores. According to the related situations, the research is focused on risks exist on HUAWEI supply side.

1.2 Problem discussion

Lam et al., (2015) argued that in this hi-tech age, global organizations have large supply chains and are more interdependent which exposes them to more supply chain risks. Micheli et al., (2008) stated that suppliers and the manufacturing firms should understand the interdependency on one another, the risks involved in the respective processes, the consequences arising from those risks. The key drivers for supply chain profitability are responsiveness, efficiency and reliability (Hendricks & Singhal, 2005).

HUAWEI, the China's largest telecom equipment manufacturer, has identified supply side as one of its key supply chain management priorities for the coming years because of its riskiness (Chou, Logistics Manager, 03-04-2017).
Ghadge et al., (2013) argued that that the complexity of products and flow of raw materials increases the number of processes, delivery patterns, geographical locations and economic structures of different firms etc., which increase vulnerability in the supply chains. Trent and Monczka (2005) stated that risk increase as a result of extended material flows, total costs rising over the purchasing costs, increased regulations due to complexities in the chains as currency fluctuations, language, cultural & time differences, etc. until the product reaches the end consumer.

The structure of HUAWEI supply chain can be seen in figure 1. Sub-suppliers provide raw materials to suppliers, suppliers make these raw materials into different components which can be assembled in HUAWEI. It has different distribution channels such as E-Business, HUAWEI Stores, dealers and agents, the as shown below (Chen, 2016).

Figure 1 A sketch of current supply chain HUAWEI (Chou, Logistics Manager, 03-04-2017)

Shashank & Goldsby, (2009) stated that supply chain includes the flow of materials, goods and other logistics from one place to another. In this whole system, the products and materials and services incur changes to the ownership. Also, the modes of transportations also occur. In the process, the risk is identified as the uncertainty that at any instance, the deviations from the expected results that can cause companies financial consequences and a loss of the company’s value as well.

Fitzgerald (2005) outlined the following risks related to supply chains of the developing countries

1. Supply disruption due to poor infrastructure, communication and technical failures etc.
2. Long lead times due to slow processes and less use of modern technologies
3. Poor quality
4. Security issues including political instabilities and potential terrorists activities
5. Hidden costs due to changes in tariffs, duties and taxes etc.

According to HUAWEI’s feedback from its end customers, the customers are not satisfied with the delivery times. The HUAWEI stores/franchises sell and order in a proper way, but the major issue is coming from manufacturing and processing units. (Chou, logistics manager, 14-04-2017).

The poor coordination between suppliers and HUAWEI has been found due to risks in HUAWEI supply chain. HUAWEI cannot get the components in time of orders from its suppliers, the operations of HUAWEI are affected, and there are issues related to delivery, lead time and information sharing (Chou, Logistics Manager, 14-04-2017).

There are supply side risks which affect the coordination in HUAWEI, and they need to take risks into consideration (Chou, Logistics Manager, 14-04-2017).

Li (Production Manager, 28-04-2017) stated that there are risks related to the quality and skills in HUAWEI which has utmost impact on the production and sourcing of the company. This, together with other risks can create a cumulative impact which will increase the overall costs of the production which in turn decrease the profit margins.

Brindley (2004) stated that there are arguably three reasons due to which supply chain risks evolved rapidly.

1. Strategic structures relating to supply chains of the organizations are evolving faster to get the competitive advantage in the industry
2. Technical changes in the environments provide the opportunities to alter the shape and the relationships within supply chains
3. Exposure to global competitive pressures has increased exposing manufacturing and producing firms to new and additional risks impacting their supply chains more rapidly and severely than the previous times

There is a need to develop new methods for identifying, assessing and mitigating supply chain risks. Due to the importance and long lasting impact of supply chain risks, firms
are placing higher levels of importance on the ability of supply chain managers to effectively and efficiently manage supply chain risks (Ambulkar et al., 2016).

Di Chou (Logistics Manager, 2017) stated that long distance between HUAWEI and its suppliers due to the fact that China is very large country, the costs of the shipments, security related issues, natural calamities and man-made, the financial position of the suppliers and the transport careers etc create risks for the supply side HUAWEI which impact its overall goals and profitability.

The supply side risks discussed in this research are described in the following figure.

Figure 2: Supply-side risks in supply chain (Zeng et al., 2005)

These risks will be identified in details in this paper and potential effect of these risks will be assessed. In the end, suggestions will be provided to mitigate these risks.

1.3 Research questions

Based on the problem description, the following research questions are designed.

1. What kind of risks in the supply side of HUAWEI supply chain can be identified?
2. How can supply side risks of HUAWEI supply chain be assessed?

3. How can supply side risks of HUAWEI supply chain be mitigated?

1.4 Purpose

The purpose of this research is to describe the supply side risks and its impacts on the supply chain of the case company HUAWEI in China. The focus of the research is to identify and assess the critical risks and provide suggestions to mitigate these risks.

1.5 Structure of thesis

This master thesis starts with the introduction, background and the problem discussion in chapter 1, which leads to three research questions. The purpose and limitations are presented to show the scope of this thesis. In chapter 2, the different methodologies and the approaches of this thesis are presented. Chapters 3 give a view of the concept and theoretical frameworks. In chapter 4, empirical findings are presented for further analysis. In chapter 5, a deeper analysis, assessment of supply side risks in HUAWEI supply chain is discussed and the mitigation suggestions will also include. Next, the conclusion is in chapter 6, the references and appendices are in chapter 7 and 8 respectively. An overall thesis structure is given below.
Figure 3: Structure of the thesis (own figure)
2. Methodology

The following chapter will describe how the research was executed and how the research approaches were used in this paper. This will lead an overall direction of the paper structure and the data collection techniques.

2.1 Scientific perspective

The way researchers use to create the theory in the scientific research called the scientific perspective of a research (Bryman & Bell, 2015). There are two opposite points of view from the scientific perspective, positivism and hermeneutics.

According to Bryman and Bell (2015), positivism is from the position of epistemology that recommends the application of natural science method to social research. In terms of absorbing knowledge, positivism considers two methods, which contains logical issues (e.g. Mathematics) and sensible issues (e.g. observations and experiments). Hermeneutic, on the other hand, focus on study in the opinion of human beings which can be true or false. As a philosophy, positivism adheres to the view that only “factual” knowledge gained through observation.

The aim of positivism is based on the current phenomena or logical data without any assuming elements to investigate the solution (Age, 2011); oppositely, the hermeneutics focus on understanding the human behavior (Remenyi, 1998)

A positivist is independent of research and the research can be purely objective. Hermeneutics is a wider discipline which includes written, verbal, and nonverbal communication (Bryman & Bell, 2015).

Throughout this paper, the method adopted is positivism, but in the assessment part a hermeneutic approach is also adopted to some extent where the authors deemed necessary. The empirical data and literature framework have been gathered and then analyzed to support this research. In the process, subjective knowledge of authors has been used, based on scientific references, peer-reviewed journals, books and e-books, articles related to the subject under study. Moreover, the objectivity of data has been taken into consideration.
2.2 Scientific approach

Scientific approach of a research is reflected by its extent to which theoretical knowledge adopted in the research influences the research methods. The authors can adopt either a deductive or inductive approach based on the nature of the research and on the basis of the literature review (Saunders, et al., 2009). The authors added more, that researchers can adopt a combination of both deductive and inductive scientific approach, whereas one approach is always the dominant one.

Bryman and Bell (2015) expressed that deductive reasoning adopts "top-down" approach. The research begins with thinking up a theoretical knowledge about a topic under investigation, then going more specific hypothesis testing, and then a collection of observations to address the assumed hypotheses. Inductive reasoning adopts the "bottom up" approach, i.e., the researchers begin with specific observations and measures to detect patterns and regularities, formulate some tentative hypotheses that can be explored, and finally end up developing some general conclusions or theories.

Marschan-Piekkari and Welch (2004) argued that deductive analysis focuses on quantitative information to deduce results whereas the inductive reasoning is mainly concerned with gathering qualitative data.

Throughout this study, a deductive approach is adopted. The theoretical framework is developed and thorough observations are carried out based on facts and figures as well as expert opinions through written, verbal and nonverbal communications, interviews and questionnaire with the management. Both The qualitative and quantitative data is used in the study.

2.3 Research approach

Abrams (2010) describe two kinds of approaches to carry out a case study research, the quantitative research and qualitative research. The quantitative research is based on numerical or statistical data to declare the meaning of research, and the qualitative research collect data through observations and interviews and it focuses on experience, opinions and knowledge (Shao and Wang, 2010).
In this research, the quantitative data is taken from case company directly (Jha, 2008), which is mainly related to stock volume and delivery frequency as well as the lead-times of HUAWEI and the processes within HUAWEI supply chain.

In order to comprehensively understand the process of HUAWEI supply chain, a qualitative approach has been adopted. Qualitative data is non-financial data which is used to find the information presented as quotes, narratives and explanations, etc. (Jha, 2008). It has been collected through observation and interview from key personnel within HUAWEI and the HUAWEI stores. The qualitative data analysis enables researchers to have a better understanding of the process, information flows and hidden risks in HUAWEI supply side, and this research is the main approach in the analysis.

2.4 Research design

The thesis followed descriptive research design which used to describe characteristics of phenomenon studies (Yin, 2014). It provides the answers to ‘how’ to identify supply side risks in HUAWEI supply chain. Based on descriptive research design, this thesis followed a case study approach by exploring, identifying and assessing risks of case company HUAWEI.

The case study approach is an in-depth study of a particular situation instead of a comprehensive statistical survey. Whilst it will not answer the question completely, it will give some indications of ‘what’ kind of risks in the supply side of HUAWEI supply chain can be identified at present and allow the further elaboration (Yin, 2012). The following sub-questions are ‘how’ supply side risks of HUAWEI supply chain can be assessed, and ‘how’ to mitigate them. Therefore, the exploratory case study was used in order to answer all research questions (Yin, 2012).

According to Wright et al. (2016), the research should be thorough, meticulous and systematic. In case study research, the authors required designing the case study, gathering necessary information, analyzing the collected data, presenting the case study and providing the results and case study implementation (Yin, 2012).

Furthermore, the study method is conducted to study, analyze and discuss the case company and the risks in the supply side of HUAWEI. Meanwhile, a successful case
study highly depends on the cooperation between case company and authors (Zikmund et al., 2010), various interviews with HUAWEI were established in order to ensure the successf
ulness of this study.

In addition, it is useful to show some numerical data to support researchers’ arguments (Krengel, 2016). Both quantitative and qualitative data are necessary to adopt multiple procedures to support the research. Moreover, different types of data can provide more possibility to answer complicated research questions and more detailed analysis due to the fact that researchers’ analysis is based on the data collected from interviews with the major personnel in HUAWEI supply chain and different kind of quantitative data.

2.5 Data collection

Because a variety of data collection methods can be used in this research, a serious issue is how to increase the data collecting efficiency and gain exact information to have a comprehensive and objective reflect the real situation of research after authors have selected relevant study framework (Jimenez-Soto et al., 2014).

2.5.1 Primary data collection

When the data are collected by the researchers for the first time, this is called the primary data which are essentially original, specifically for research being discussed (Persaud, 2010). Primary data is more timely and credible. This can explain specific questions which cannot be elaborated by secondary data (Thomas Metcalf, 2011). The following kinds of methods are used in gathering the data.

Ø Interviews

Ø Observations

Interviews

There are three basic types of research interviews, the structured, semi-structured and unstructured (Gill et al., 2008). In this case, authors select semi-structured interviews as the essential tool to pursue relevant information of HUAWEI.

Semi-structured research interview contributes to determining which unexplored domains should be explored. Additionally, this method allows disagreement between
moderator and interviewer in order to seek for an idea or reaction in more detail (Gill et al., 2008).

This approach is flexible, especially compared to structured research interviews. It also allows the discovery of information that is vital for authors but may not be found and forwarded by previous research from other research (Saci & Ouarezki, 2014).

The authors used the online communication tool WeChat to interview relevant managerial staffs in HUAWEI in China. The function of this method is to get easy contact with the key personnel because of the distance and time of the interviewees and to bring flexibility for the interviewees. Meanwhile, authors contacted the HUAWEI managers by email as well, because this method enabled the authors to grasp the details and more accurate information.

To support the analysis and ensure that not to rule out any information, authors have recorded interviews. This method signifies full engagement in an interview and to ask follow-up questions rather than being occupied with taking records. Due to time consumption and the security mechanism of some of the data, some interviews may not be transcribed. The appendices will show the relevant content of interviews to improve the quality of the interviews.

Interviews questions derive from the present theoretical framework. The currently studying pattern has been sent to managers in order to let them go through it and prepare for the future interview. This process lets the authors grasp the essential information during the interviews. The following pattern is adopted.
<table>
<thead>
<tr>
<th>Methods</th>
<th>Date</th>
<th>Respondents</th>
<th>Position</th>
<th>Type of interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviews</td>
<td>03-04-2017</td>
<td>Di Chou</td>
<td>Logistic Manager of HUAWEI Headquarters (Shenzhen)</td>
<td>Telephone interview</td>
</tr>
<tr>
<td></td>
<td>14-04-2017</td>
<td>Di Chou</td>
<td>Logistic Manager of HUAWEI Headquarters (Shenzhen)</td>
<td>Telephone interview</td>
</tr>
<tr>
<td></td>
<td>28-04-2017</td>
<td>Bo Li</td>
<td>Product Manager of HUAWEI Headquarters (Shenzhen)</td>
<td>Telephone interview</td>
</tr>
<tr>
<td></td>
<td>04-05-2017</td>
<td>Yuyong Shi</td>
<td>Channel Manager of HUAWEI Headquarters (Shenzhen)</td>
<td>Telephone interview</td>
</tr>
</tbody>
</table>

Table 1: Interviews detailed list

The interviewee was contacted at the beginning in order to understand the relevant content and prepared to interview in advance. This includes informing the interviewee about author's’ purpose and relevant explanation as well as methods and time frame for the case.
Observations

To increase the authors’ knowledge of the supply chain, production and operation of HUAWEI, the observation for HUAWEI’s manufacturing base and warehouse was also an important approach for data collection. By observing the actual situation of employees as they work in the enterprise operations, the authors could gather raw data that can sometimes not be collected in any other way (Nikhil, 2011). The observation was designed to collecting HUAWEI’s current and actual inventory and transportation management as well as its production procurement management and the way of operation. Based on these processes, a lot of data can be quantified. These processes are assigned to authors’ partners in China who handle the operations and field observations and to feed information to the authors. By this approach, a detailed observations pattern is listed as follow.

<table>
<thead>
<tr>
<th>Date</th>
<th>Area visited</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-04-2017</td>
<td>HUAWEI Headquarter in Shenzhen</td>
</tr>
<tr>
<td>24-04-2017</td>
<td>Warehouse in Shenzhen</td>
</tr>
</tbody>
</table>

Table 2: Observations detailed list

2.5.2 Secondary data collection

The secondary data is the data collected from other sources that are readily available. These data could be easier and faster obtainable than primary data collection and also may be usable when primary data cannot be sufficiently obtained (Crawford, 1997). The benefit of secondary data collection is that there are many prior observations already made and relevant data analysis are also very comprehensive, such as literature review and case study. The secondary data collection in this research includes HUAWEI’s current data and establishment, operational data, storage and transportation information, and the HUAWEI’ products.

The secondary data also involves the theory of literature collection in order to follow the deductive method for this case. The collected documents have formed the basis of the interviews. The theoretical framework is added to analyze data which has been collected. Therefore, authors will create a data framework based on HUAWEI’s published
operation and performance report as well as previous related research by other researchers to has a clear understanding and knowledge of HUAWEI’s business. Then, the observations will be next step for authors to understand the actual and current operation of HUAWEI management and add the information into the data framework. There are some data not typical, therefore, the last step is analysis special and author concerned information in order to perfect data collection.

2.6 Analysis method

Yin (2010) presented a research case study framework that provides a procedure to identify causal relationships and hidden consequences of events. The data analysis includes consistent patterns which make the collected data understood and summarizes the research.

Ghauri and Gronhaug (2005) stated that analysis is the process that organizes, structures and imports a large amount of data collected. The thematic analysis is mainly used to analyze the various criticisms. It is based on the code identified in the transcript (Bryman & Bell, 2015).

Yin (2014) model the conditions of use of a combination of theoretical and empirical data to match the research questions and analyze the results. This approach focuses primarily on qualitative research, (Saunders et al., 2009).

This study starts with risk identification. In the next step, risk assessment is carried out. In risk assessment authors have rated each risk against two different criteria by developing probability and impact. The risk interaction is then assessed to find out how each risk affect others (Vieira et al., 2012), it is followed by risks prioritization. The risk prioritization comprehensively identifies risks in a level matrix with probability and impact. Thus the risks are divided into different categories of risks. They require different risk management approaches (Eccles and Obe, 2010). Eventually, by various methods, all risks will be mitigated according to different risk mitigation strategies.
2.7 Scientific credibility

Bryman and Bell (2015) stated that scientific credibility of research is the feasibility to rely on the result of the undertaken study and its applicability in further research.

Yin (2014) suggested that the research reliability and justifiability determines the scientific credibility of the research. Reliability of research itself has an internal and external perspective. The internal reliability of a research paper is the extent to which the authors of the research are in accord their observations. On the other hand, external reliability is concerned with the extent to which other researchers or group of researchers rely on the undertaken study.

Yin (2014) further explained that validity of research depends on how the observations, identification and measuring of relevant information are carried out within the framework of theoretical knowledge and context in which the research is carried out.

The authors argued that a research’s internal validity depends upon the match between the researcher’s observations and the theoretical background whereas the external validity of research depends on the extent to which the findings of the research can be generalized.

To make sure that this research is scientifically credible and reliable, both primary and secondary data are used in the research paper based on the relevance and context of the study.

The theory is selected based on its relevance to the problem description and analysis sought. The data is taken from only authentic sources and interviews are conducted only with the personnel who have long-standing experience with HUAWEI and have the key role in the company in logistics and supply chain sector.

The questionnaires and interviews are carefully designed in order to be relevant and to have a clear insight into the purpose of the study and the pertinent information required for analysis. Statistical methods are used with keeping in mind that biases and errors occurring from the data are corrected. The results of the study can be utilized by the HUAWEI for organizational purpose or further research in this area.
2.8 Ethical considerations

Ethics refer to what an individual or group do to make sure they can be self-govern with the moral principles and values. Researchers should be responsible for the object of study, meanwhile, researchers need to follow high ethical standards to ensure that function or information will not be misunderstood (Pearson, 2011).

Ethical issues are critical for the successful of research, which has arisen at a variety of stages in the research of business and management (Saunders et al., 2007). Ethics are important principles and guidelines to help us to determine and maintain morality. According to Bryman and Bell (2015), there are four principles of ethics, which contain whether there is harm to participants, lack of information consent, an invasion of privacy, or deception is involved.

The ethics help to minimize errors, for instance, it is forbidden to forge research data, and aim to promote research purposes. Besides, it promotes the values of trust, mutual respect and collaborative work, such as copyright, privacy, patenting and data sharing policies of the ethics in the research. In addition, it helps to ensure that researchers are accountable to the public (Alzola, 2011).

According to Blumberg et al., (2011), the research should be done in a responsible method. Therefore, in this research study, authors considered the potential risks that would happen in the research process.

In order to ensure the interviewees to be aware of the outcomes of the interview and show the respect for the persons involved, they are pre-notice of what researchers want to know. All people involved in the research are informed about the outcomes that researchers expected. Besides, authors have to ensure the reliability and validity of the empirical data that are used in the study. Moreover, authors need to ensure that all participants agree with all research activities and guarantee their privacy.

2.9 Summary of methodology

A model of methodology was given to summarize the different approaches which are used in the research. This figure gives an overview presentation for readers to have a
better and clearer understanding of the methodology that is applied in this study. The figure can be seen below:

Figure 4: Summary of the methodology (own figure)
3. Theoretical Framework

The theoretical buildup will describe the supply side risks in the supply chain. The theory is selected with the important risks that influence the supply chain of HUAWEI in China. This part of the paper describes the literature on supply chain risks that are critical to the case company and relevant to the research questions under consideration. A brief sketch of the theoretical structure is given below.

Figure 5: Theoretical framework (own figure)

3.1 Supply chain risk management

Shashank & Goldsby, (2009) stated that supply chain involve the flow of materials, goods and other logistics from one place to another. In this whole system, the products and materials and services incur changes to the ownership. Also, the modes of transportations also occur. In the process, the risk is identified as the uncertainty that at any instance, the deviations from the expected results that can cause companies financial consequences as well as a loss of the firm’s value.

According to Hendricks & Singhal (2005), the key drivers for supply chain profitability are responsiveness, efficiency and reliability. Waters (2007) argued that dynamism in business environments creates barriers for supply chain risk management as the decision times are getting smaller. A risk factor can decrease their value and hence lead to a loss
for the firms. In the global environment, organizations are more interdependent which in turn caused companies more risks (Lam et al., 2015).

Ghadge et al., (2013) argued that that the products’ complexities and flow of materials increases the number of processes, ways of delivery, geographical locations and economies of different companies, etc., which enhance vulnerability in the supply chains. Trent and Monczka (2005) stated that risk increase as a result of extended material flows, total costs rising over the purchasing costs, increased regulations due to complexities in the chains as fluctuations in currencies, linguistics, cultures & differences in time, etc. until the product reaches the end consumer.

Ho et al., (2015) stated that a number of qualitative and quantitative methods had been developed depending on the nature and severity of the risks, and the complexity of supply chains, to deal with supply chain risks. Supply chain risks need to be first defined in a precise way, only then an effective risk management plan can be developed. The ability of a firm to identify the sources of risk in the chain helps in the development of proactive risk mitigation plan (Punniyamoorthy et al., 2013).

Kloben et al., (2015) stated that in an efficient risk mitigation strategy the available risk information is structured which further facilitates risk communication assessment for making informed decisions. The residual risks are communicated for further follow ups so that a cycle of risk identification, assessment and mitigation is set up.

Ritchie and Zsidisin (2008) outlined supply chain risk management in the following steps:

- Risk Identification
- Risk Assessment
- Risk Mitigation
- Risk Monitoring and evaluation

A detailed graphical structure of supply chain risk management is given by (Graver, 2008) in the following figure.
3.2 Risk identification

Ritchie and Zsidisin (2008), stated that this step involves identifying the sources and characteristics of risks supply chain risks, the causes that trigger the risks and its relationship to the effective and efficient function of the chain.

The identification is a complex process, therefore, different techniques have been developed for this purpose i.e., mapping of risks, developing checklists, cause & effect analysis, event tree analysis etc. (Brindley, C.,2004) It is the first step for risk management processes. It provides information, indexes, and chances that allow enterprises to raise risks before they affect enterprises’ operation and business (Zhang et al., 2015).

The objective of risk identification is to highlight unfavorable factors which can affect the enterprise's’ capacity to achieve performance outcome goals and it should be an early and continuous operant behavior (Garver, 2008). The process of risk identification can identify and distinguish greater and fewer risks (Segal, 2011). It also can adequately consider the potential drivers of risk, and the situations that risks can influence each other or small risks may add up to serious (Haselkorn et al., 2015). Generally, risk identification will put forward and discuss various factors of risks by systematic identification and careful planning, because these risks may come from internal or external sources (Chen & Zhao, 2010). Additionally, different kind of risks have various
degrees of importance, according to risk identification, enterprises can define which kind of risks are crucial and should be addressed.

There are many types of risks to identify for enterprises, such as manufacturing risks, logistics risks, information risks and inventory risks, etc. and all of these risks will affect the normal operations of the enterprises. Therefore, risk identification is a crucial step for enterprises to be carried out as soon as possible before the risks occur (Kildow 2011).

The purpose of risk identification is not only to identify but also to guide following countermeasure and plan, and authors will describe in the following research. According to these risk handling measurements, enterprises can nip trouble in the bud.

This research considers only the supply side of the supply chain, therefore, the supply side risks are discussed in detail in the following passages. The risks that are mentioned in the problem discussion, that impact supply side of HUAWEI supply chain, include manufacturing risks, logistics risks, information risk and inventory risks.

3.2.1 Manufacturing risk

Because of the effect of global presence, enterprises should provide better services and products to achieve the goal of responding faster to the business in order to keep long-term competitive advantage (Pinto, 2005). Although some goals can be fulfilled by the rapid development of production facilities and skills, the risks pose hazards to the enterprises’ profitability and efficiency and cannot be ignored. Many of these risks are labeled under the supply side, and manufacturing risks takes a significant proportion in this area (Poon et al., 2007).

Tang & Tomlin, (2008) argued that the poor performance with manufacturing side may lead to low efficiency of the supply chain. Although enterprises are investing massively in the management plan, such as total quality management, lean manufacturing mode, etc. to improve their internal management and integrated capabilities, their internal operation is still more affected by factors of production, skills, and quality. Factors associated with these three factors can be a source of manufacturing risk. Hence, identify the kind and form of manufacturing risk is crucial.
According to Punniyamoorthy et al. (2013), the main sources of manufacturing risks are: “production uncertainty risks (Shashank & Goldsby, 2009), production skill issues risks (Cucchiella & Gastaldi, 2006), product quality risks (Hauser, 2003), variability risks in the process of production (Van der Vorst & Beulens, 2002), variability risks of production cycle (Pujawan & Geraldin, 2009), under-productivity risks (Wu al., 2006; Manuj & Mentzer, 2008) and capacity inflexibility risk (Sheffii & Rice, 2005; Blackhurst et al., 2008)”.

Enterprises are seeking solutions to risks in manufacturing. Good product line management is a result of activities such as quality, price, skill, product and relationship management are that happen on the production side (Lam, 2003). Even the smallest mistake during production or operation can increase the manufacturing cost (Hales & Pronovost, 2006). Therefore, the risk management is very important. The authors identify three major risks which constitute a large proportion in the manufacturing risks are:

**Production risk**

The production risk includes the unexpected obstacles for enterprises such as raw material, equipment, technical personnel and production technologies, etc. (Webb, 2003). If there are any obstacles, then the production plan of the enterprises cannot be fulfilled on schedule, and the originally expected objects will not be achieved.

Raw material obstacles mean interruption in the material flow (Waters, 2007). Without a sustained and stable supply of raw material will lead to an uncertainty of production and operations, and it is hard to prevent the adverse effect of production by raw material price changes (Xu et al., 2011). Equipment obstacles, if enterprises’ equipment cannot satisfy the requirements of new products, enterprises cannot obtain necessary specialized equipment for new products and has a rational choice of production equipment (Zhou et al., 2015). It will have a significant performance impact on production efficiency and cost estimates (Yu et al., 2012). Technical personnel obstacles mean the requirements for technical personnel in producing new and high technology products. It is generally challenging and expensive to hire the technical personnel which can meet the requirements of enterprises is the key role to making production effectively and efficiently (Tarim, 2015). If production technology cannot follow the specific performance requirements of the product, the actual economic performance
index and correct methods, the defect rate of the products will rise and production quality will decrease (Netessine & Taylor, 2007).

**Skill risk**

There have been great changes in manufacturing in recent years, skill factor is still the hotspot in this area. Nowadays, more and more enterprises are dedicated to the design and manufacturing of high-quality products, because they are facing very strong market competition and cost pressure. Therefore, more and more requirement of good production management and skilled staff has become inevitable and this upward trend will continue (Zhou, 2011).

Due to manufacturing belongs to capital-intensive industries, it is sensitive to skill changes and requirements (Duan *et al.*, 2012). If technical skills do not match the skill requirements when production changes, not only for manufacturing side and focal firm but also its entire supply chain will be affected (Ji *et al.*, 2010).

Skill factor includes many different kinds of manifestations and all of them are indispensable. Because these manifestations represent that the way of process of the production to operate rationally in skill perspective, therefore, according to Zhou (2011), skill risks can be considered in following situations.

- Some of the skills are related to operation and control of machinery and equipment, if manufacturing industries cannot ensure proper operation, it will greatly reduce the production efficiency.
- For manufacturing, the machine maintenance skills are also vital, if enterprises lack professional or relevant skills to repair the machine at the first time and scheduled maintenance to keep the long-term and steady run, then, in the long-term, it will be a crucial risk.
- Knowledge and understanding are necessary skills for manufacturing. Without adequate knowledge and clear understanding, enterprises cannot respond to production information and requirement quickly and accurately, and it will delay the available opportunities.
Quality risk

The quality risk is the risk with uncertain quality, it caused by inconsiderable product design, substandard production technology level, inexact production process and so on. Tse & Tan (2011) point out that any quality problems of supply chain members (such as raw material, production, skill and logistic, etc.) will cause quality risk (Flynn, 2005). Therefore, it is hard for a supply chain network member to track, who handled what and when to the final quality of the product made by the enterprise and sold to the customers. When the product malfunction because of defects in either the enterprises’ units or the supplier’s units, the enterprise need to accept the responsibility (Tse & Tan, 2011).

Due to production and development of equipment is not only completed by a single enterprise, but it is done cooperatively by multiple supply chain members by job allocation (Zhou et al., 2015). The quality risk is included in the production of an unsafe product which will harm consumer interests, even if this defect is created by other companies, may be inherited by the focal firm (Gray et al., 2016).

If the product offered by the enterprise does not fulfill as expected, then it is lack of the qualification to meet the needs of market and customers, it will be a serious risk and problem (Hauser, 2003). Because the level of product quality is one of the embodiments of the enterprises’ core competitiveness, operate with a poor quality level will increase unnecessary costs while reducing market share in order to lead to enterprises’ operating problems.

3.2.2 Logistics risk

There are many aspects of supply chain risks, and logistics risk is one of the most important risks that need to be taken into consideration. The contradiction between supply and demand of logistics system result in higher operational risk (Lewis, 2003). Logistics can be defined as the science of an effective flow of materials, the goal is to ensure that all materials and products can at the right time, at the right place. Logistics management includes the transportation management, materials handling, supply planning and the third-party logistics service provider management (Jonsson, 2008). Risks can be considered as the potential threat and they are related to events that cause losses. Risks may be caused by internal or external vulnerabilities, but they can be avoided by precautionary measures (Klosa, 2013).
Logistics risk is one of the various categories of risks in the supply chain. Logistics risk is considered to be a critical risk category for enterprises. Not only third party logistics service providers but also traditional transportation companies are facing risks in the logistics services industry. Actually, risk management is a particularly prominent problem in the logistics system, when the level of uncertainty is high and the reliability of systems is being threatened by various internal and external factors (Chung et al., 2015). The main source of logistics risk is due to the poor logistics technology and management. And this type of risk also can be considered as the result of raw materials supply and price changes, changes in transport service, physical damage to infrastructures, which includes roads, railways, bridges, stores and market centers. Moreover, the improper truck loading, incorrect and interrupted communication services can also cause logistics risk (Rushton, 2006). Logistics risk usually does not stagnate at the place where it was created. It can be spread forward and backward in the supply chain. And according to Punniyamoorthy et al., (2013), logistics risk may come from the potential interference of products flow, uncertainty in freight transport operations, financial status of transport operations, transportation management issues, delays in delivery, lead time issues and warehousing issues.

**Transportation risk**

The risk of transportation is increased under the unstable market conditions. Moving a product from one location to another is usually a problem in the risk area. The corporate profits and customers satisfaction can be affected by transportation risks (Ekwall, 2012).

Transportation risks involve uncertainty in freight business, transport operations and transport management issues (Punniyamoorthy et al., 2013). One of the keys to assessing the existence of risks in the supply chain is to make sure that suppliers can provide products consistently and on time. It is necessary to ask for transport times (daily, weekly, etc.), mode of transportation (air, land or sea), and to ensure that the trade lanes can be reallocated timely when they are interrupted due to the natural disaster issues (Blanchard, 2009).

Transport operations link production and retail networks. During transportation, goods face many risk factors, which may impair the products’ quality, damage the goods, delay the transport and may even lead to the supply chain interruption. Transport damage and its consequences will incur additional costs and communication for all
supply chain members that are involved. The supply chain disruptions can have a significant impact on finance (Bendul and Skorna, 2016).

According to Taki and Teimoury (2016), the transportation mode has an impact on the delivery reliability. There are various optimal transportation mode that can be selected, the decision of optimal stocking and transportation mode selection is one key for the transportation risk management. If the transportation management issues are not treated well, the mode of transportation is not properly chosen, then it will cause damage to products or affect the delivery time and increase the unnecessary costs.

Some products turn to worn during transportation, loading and unloading activities. The proportion of damaged products during loading, transportation and unloading may lead to reduced transmission reliability. Besides, the accidents and risks which may be caused by human errors, technical factors or natural occurrences should be taken into consideration (Dehghanbaghi, 2017). Therefore, to meet the demands, the management of transportation issues is really critical, and it is necessary for shippers to carry out risk prevention activities aimed at mitigating the risk of transportation.

The transportation risk also involves the cost. Transportation expenses include many costs incurred during the circulation of the product. The fuel costs, labor costs, vehicle maintenance costs, insurance costs, transportation costs and route planning costs are included. In addition, the costs occurs when making adjustment according to the constantly changing of customers’ demand (Taki & Teimoury, 2016).

**Delivery risk**

According to Lumsden (2007), delivery is an important part of logistics services, it has to meet the requirement of delivery certainty (accuracy). It refers to delivery right products in the right quality, quantity and exactly at the right time and right place.

The timeliness of delivery is a critical issue for customers and many empirical studies demonstrate the importance of timely delivery in the supply chain (Arkader, 2007). On-time delivery is critical to the success of the supply chain, especially in the wholesale and retail industries. The deliveries that do not meet the term of delivery appointments may cause tense relationship, poor performance and also result in significant charge-backs for high-value goods. The delivery reliability between
suppliers-to-DC’s (distribution centers) and DC’s-to-retailers in supply chains are both key factors in determining supply chain risk levels and the level of safety stock (Taki & Teimoury, 2016). Delivery reliability maximization can make cost minimization. Besides, it plays a major role in improving supply chain design more reliably.

Supply chain delivery performance is evaluated by suppliers and buyers’ perspective. From the perspective of buyers, the delivery risk is that the lack of timely delivery may affect the inventory holding and costs (Anderson, 2011). If the delivery time is ahead of time, the buyers have to prepare more places to storage products which may cause the bullwhip effect and the cost of inventory can also increase. Oppositely, if the delayed delivery occurs, the inventory shortage may occur.

*Lead time risk*

The lead time can be different from vendor to vendor, therefore it makes it difficult to forecast when components are delivered and even harder to coordinate production (Glock & Ries, 2013). Bandaly, Satir and Shanker (2016) pointed out that on supply chain the variability in deliveries may create surplus inventory and stockouts. However, the latter has possible to slow down operations, and the former can be problematic which means order excess inventory will put more pressure on company’s budget (Bandaly et al., 2016). Meanwhile, it’s impossible to build a product when the manufacturer is missing the necessary components. Jian et al. (2015) described lead-time risk appear when company underestimate the volume of stock they need or company forget to reorder the replenishment orders before company run out of components. The risk for waiting for new inventory will bring long delivery time and waste of money, and this is especially problematic if the components are not common, the lead-time can be weeks or months (Jian et al., 2015).

On the other hand, lead time will pass between the layers of the risk of supply chain (Aqlan & Lam, 2016). Because of the delayed order delivery on upstream node enterprise, the node enterprise cannot finish the order production on time and lead time risk appears on delayed order delivery of downstream node enterprise (Liu et al., 2012). This kind of risk arose from upstream enterprise and happened on upstream node enterprise, through the supply chain structure risk is transferred to the downstream enterprise. Thereby, the losses caused to the downstream enterprise.
One effective strategy is to consolidate company's suppliers in order to eliminate this risk. Having one supplier means everything will arrive together, rather than ordering from numerous suppliers and receiving shipments at many times (Bandaly et al., 2016). This can help the company to decrease delivery costs and make it easier to build coordination and cooperation with the supplier.

### 3.2.3 Information risk

Correct and timely information is essential for the supply chain’s efficiency and coordination (Guo et al., 2006). Unavailability of information, information delays and information breakdowns, information security are factors of such risk (Punniyamoorthy et al., 2013). Because every company is an independent operation and management economy (Kaplan & Mikes, 2012), essentially supply chain is a loose company league. When the supply chain scale is enlarged day by day, and the structure is increasingly complicated, the opportunity of information errors on supply chain will be increased (Wankel, 2009). It means the lack of communication among upstream and downstream companies will be impacted by the delay of information transfer, further the disagreement of production and customer demands occur. It may bring bullwhip effect and lead to the excess inventory at the same time (Pramod et al., 2013).

An important mechanism in the supply chain is information flow between the members of the supply chain which can guarantee the effectiveness of coordination (Petter et al., 2013). Information is the vital link in the supply chain. In many areas, the inefficient system is mainly because of the information asymmetry (Guo et al., 2006). Therefore information sharing is important, the meaning of its effect on supply chain’s performance depends on what information shared, how it shared and who it shared with. The improvement of information flow and smoother logistics flow simplify the procedure and improve coordination among the supply chain members, at the same time it leads better decision-making within the supply chain and reduces the uncertainty relevant with the lack of information (Zhou & Benton, 2007). In the literature review the information risks include ‘unavailability of information’ (Guo et al., 2006), ‘information delay’ (Sharma & Routroy, 2016), ‘breakdown of information infrastructure’ (Eckles et al., 2014) and ‘security of the information system’ (Peltier, 2005).
3.2.4 Inventory risk

The company can quickly assemble a finished product by keeping all of the components to complete a product (Cachon, 2004). However, the company will lose a great deal of time with the items on its assembly list if the components supply warehouse is disorganized, especially the stock surplus parts will make this process even more challenging (Li & Ryan, 2012). Many manufacturing companies have a significant amount of inventory, also retailers and wholesalers have many inventories in their warehouse. Even though sufficient inventory can ensure the efficiency of the business process and prevent manufacturing delay (Jaques & Morgan, 2004), there are also certain risks associated with inventory occurred in the company. The company needs to understand these inventory risks completely to control risks first, and by doing this, the company will be able to make a plan of inventory risk mitigation strategy and control inventory in practice. A few key inventory risk types are mentioned below.

Theft – Theft is one of the biggest risks on the terms of inventory control, especially when the inventory has a higher value. If the internal employees are involved in the theft, it is much harder to arrest because they know the whole systems in the company and may probably elude all the tracks after the theft (Jaques & Morgan, 2004). Every year, company spend millions of dollars to precaution theft risk, this money is invested for cameras or hiring guards to prevent any incidents of inventory theft (Peltier, 2005).

Inventory Waste & Damage – Usually inventory will be destroyed when being using in the regular business process (Cachon, 2004). The damaged inventory cannot be used, and then the wastes are created, the cost of business is increasing as well. To avoid inventory waste and to reduce the cost, the company needs to create an efficiency inventory control and rules and regulations to minimize the damage and prevent waste (Chopra & Sodhi, 2004).

Shelf Life – Many products have a certain shelf life, this leads an inventory risk for the company (Guéant et al., 2013). Perishable products such as milk and eggs have smaller shelf life than other products so it may bring higher inventory risks to the company. Under this situation company should have a strict control over its manufacturing and
inventory, because producing less than required will not meet customer demand but producing surplus will increase waste cost (Chopra & Sodhi, 2004).

Lifecycle – All products have its own life cycle (Jaques & Morgan, 2004), those products have a high inventory risk when they are in the decline phase. Therefore, companies tend to tighten their inventory control and manufacturing process, they only produce sufficient products in order to meet the current demand requirement (Chung et al., 2014). The surplus inventory will be a heavy burden for the company when it is eliminated by the market.

3.3 Risk assessment

In the current business environment, the risk is an important factor that influences the enterprise operations and risk assessment is one of the key sections of risk management (Dong & Copper, 2016). Risks are always changing, adjusting the policy and control strategies to minimize the relevant risks are required.

Supply chains are more fragile to be affected due to the increasing internal and external risk events in the global competitive environments. Moreover, the lean management related trends, which include the reduction in inventory, lead to all partners in the supply chain to be more dependent on each other which will amplify the enterprises’ risks exposure rate in the supply chain. This requires more efficient management of supply chain risks (Aqlan & Lam, 2015).

With the rapid development of supply chain risk management, assessing and managing risks in supply chain operations is critical to the success of the business (Stoneburner et al. 2002). Supply chain risk assessment aims to adjust the enterprises’ strategy, in order to provide an opportunity to reduce the supply chain risks. As Dong and Copper (2016) explained, risk assessments are beneficial for enterprises to obtain the information needed to identify factors that have a negative impact on operations and products, which help them to have a better decision making and better planning of countermeasure to reduce risks.

The purpose of supply chain risk assessment is to ensure decision-makers can focus on the most important risks and threats, and prepare for the risk response. Besides, the
impact of each risks and the overall risks should be taken into consideration (Liu et al., 2017). In addition, all risks need to be reassessed regularly. Risk assessment is also about prioritizing of the risks’ levels.

Ritchie and Zsidisin (2008) outlined that the process of risk assessment includes quantifying the risks, finding out the potential consequences and impact level of the risks. Because different risks have various nature, arise at the different magnitude and at different times in the supply chain. Therefore, different types of risks have different assessment methodologies. It depends on the firm's’ management to select the right assessment method.

Aqlan et al., (2015) stated that risk assessment plan including risk modeling and impact measurement. The qualitative analysis is one of those risk modeling.

The risk assessment follows the events of developing assessment criteria, assessing risk interactions and prioritizing risks, which as shown in the figure below:

![Supply Chain Risk Assessment Process](image)

Figure 7: Supply chain risk assessment process (Cooper et al., 2005)

**Developing assessment criteria:** through the development of probability and impact to assess each risk in two-dimensional.

**Assessing risk interactions:** each risk does not exist in isolation, one risk may interact with other risks, to find out how each risk affects each other.

**Prioritizing risks:** the process of determining risk management priorities, to find out major risks which have high probability and high impact.

**Developing assessment criteria**

According to Aqlan, Lam (2015) and Cooper et al. (2005), one of the approaches of assessment in the step of assigning priority to the risk is qualitative analysis, which is based on developing an assessment criteria or descriptive scales such as low, medium,
high for describing the **probability** and **impact** of risks. This method is often used to allow enterprises to have an initial review of risks existed and assess risks quickly.

<table>
<thead>
<tr>
<th><strong>probability</strong></th>
<th><strong>impact</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>might occur in high frequency</td>
</tr>
<tr>
<td>Medium</td>
<td>might occur often</td>
</tr>
<tr>
<td>Low</td>
<td>might occur less frequently</td>
</tr>
</tbody>
</table>

Table 3: Probability and impact rating definition (Eccles and Obe, 2010)

**Assessing risk interaction**

ERM (Enterprise Risks Management) enables risks to turn into an integrated and holistic view (Fang and Marle, 2013). In risk management, risks do not exist in isolation and they are usually assessed individually. However, they have potential interaction and significantly amplify the impacts or quicken the speed of risks occurrence (Baillergeau, 2016). Thus, the impact of risk interaction is far more significantly than the impact of single risk. The key here is that the whole effects don’t equal to the sum of each part, and in order to understand risk association, the company needs to understand the individual risks and interaction risks which exist hedge and amplified effect (Kuang and Cho, 2016). In this ERM integrated framework, a risk interaction map is the simplest graphical form of representation which is formed by the x and y-axes (Fang and Marle, 2013). Then the risk interactions are indicated by X or another qualitative indicator.

Table 4: Illustrative risk interaction map (Dwonczyk, 2013)
The above table shows which risks interact with other risks. Risk assessment is all about measuring and prioritizing risks (Hurst, 2011), therefore there is a need to prioritize the risk level by according to the risk interaction.

**Prioritize risk**

The risk prioritization concerns with two aspects: probability and impact (Li et al., 2013). The four quadrants on the chart define different categories of risks, it requires different risk management strategies (Eccles and Obe, 2010). Once the probability and impact of risk are indicated, a risk classification chart can be showed below.

![Risk classification chart](image)

*Figure 8: Risk classification (Eccles and Obe, 2010)*

Critical risks are major risks with high probability and high impact which require management to keep them under control (Li et al., 2013).

Difficult/Insurance risks with high impact and low probability mean the risks which are unlikely to occur but which would have serious consequences if they did occur, and they are difficult to manage (Hurst, 2011).

Routine risks commonly occur risks which have only a minor impact on the organization. They occur frequently and the activity to mitigate the risk should be built on a routine process (Hurst, 2011).

Low importance risks are with both low probability and low impact which are commited to lower levels in the organization. These risks are monitored in order to prevent they develop into more serious risks (Punniyamoorthy et al., 2013).
3.4 Risk mitigation

Supply chain risk mitigation includes highlighting future consequences for the firms that may arise due to the risks, judging their respective merits, devising different risk management plans for the risks, different consequences, selecting the most favourable solutions for the proposed risks, and undertaking implementations of the proposed decisions (Ritchie and Zsidisin, 2008).

Aqlan et al., (2015) suggested that mitigating supply chain risks is an important area of research as a part of the supply chain management. Nowadays, management in the firms is considering it as an area of importance and keen attention because of the increasing occurrence of risk events and their impact to supply chains. Different frameworks have been proposed in the literature for risk handling and mitigation.

The supply chain risk mitigation strategy adopted by the firm depends upon the nature of risk and the level of occurrence, the level of impact and the nature of harm caused by the risks (Waters, D. 2007).

Formulating appropriate risk mitigation strategy, the management can consider a range of parameters as shown in the following figure (Aqlan et al., 2015).

![Figure 9: Supply chain risk parameters (Aqlan et al., 2015)](image)

Aqlan et al., (2015) explained different mitigation strategies under different circumstances. The chart below shows different types of mitigation strategies and their...
<table>
<thead>
<tr>
<th>Response Strategy</th>
<th>Risk Description</th>
</tr>
</thead>
</table>
| Risk Avoidance    | ● Avoiding the risk completely by eradicating its causes. The residual risk in this case is zero  
|                   | ● This strategy is more appropriate in the case when there are risks with high probability as well as high impact  
|                   | ● Appropriate when the risks involve changing the operations, planning or re-engineering the whole supply chain |
| Risk Reduction    | ● In this strategy, risk is reduced rather than eliminating it  
|                   | ● Appropriate when risk has low or medium probability and high impact  
|                   | ● This strategy is suitable in managing the operational risks occurring on daily basis  
|                   | e.g., Examples of this strategy are redundancy checks, quality assurance tests, using better tools, operators training, etc. |
| Risk Transfer     | ● In this strategy, risk is transferred to another party (residual risk may exist)  
|                   | ● This strategy is most appropriate when risk has low probability but high impact  
|                   | ● Suitable to be used in unexpected risks such as natural disasters and terrorist attacks  
|                   | ● Examples of such strategies are buying insurance and third party contracts |
| Risk Acceptance   | ● The strategy is applied when the risk is acceptable enough, the residual risk remains the same  
|                   | ● This strategy is adopted when the risks involved have low or medium probability and low impact  
|                   | ● This strategy is most appropriate when the cost incurred by other strategies is much higher than their impact  
|                   | ● This strategy is adopted when the risks can be controlled by contingency plans |
| Ignoring Risk     | ● In this strategy, the risk is completely ignored.  
|                   | ● This strategy is applied with the risks having minor impact on the operations and low chances of occurring  
|                   | ● This strategy is similar with risk acceptance but this strategy identify and analyze the risk and at the end ignore it, however, analyze that the magnitude of the risk does not rise up i.e., have a watch over the risks. |
| Risk Exploit      | ● This strategy is applied when the impact of the risk is positive, i.e., in favor of the firm.  
|                   | ● This types of positive risks are assumed as opportunities  
|                   | ● The risk exploit strategies include enhancing the risk, realizing the risk, accepting the risk and sharing the risk. |

| **Table 5: Supply chain risks mitigation (Aqlan et al., 2015)** |

Chopra and Sodhi (2004) stated that there is not a single strategy to protect organizational supply chains against all risks, therefore, managers need to choose the proper mitigation strategy for each risk. The firms need to consider cost and benefits of one mitigation strategy over the other, the schedule, and performance of the strategies are also important.

Based on the analysis below, the authors found critical risks related to production and skills in HUAWEI. Therefore, the theoretical framework for mitigating for the production risk and skill risk mitigation is given below.

**Enhance risk awareness**

Enterprises need to face a variety of risks when involved in the market competition, especially skill risk. Skill risk is an objective reality, facing fierce competition, many enterprises continue to carry out technological innovation. But during this process enterprises need to fully understand the risk, with a strong risk awareness and assess the
risk that would exist during the process of innovation. According to Handfield and McCormack (2008), in enterprises, there must be a core team who has to take the challenge of raising risk awareness throughout the entire enterprises. In this way, it helps to overcome organizational barriers and improve operational awareness and responsiveness to risk events (Handfield & McCormack, 2008). With good risk awareness, enterprises can prevent the risk effectively, and minimize the risk level.

**Evaluate production feasibility and strength staff training**

For every manufacturing company, the process of production involves many aspects, which occur from the raw materials and purchase components to the finished products. The product and the possible technical solutions provide the basis for operations that required for manufacturing a finished product (Jonsson, 2008). As for the skill innovation, every company has to ensure the feasibility of it. Not only the evaluation for the skill itself, but also for the equipment, facilities, technical force, personnel conditions (e.g., staff skills), management conditions and market conditions that relate to the production plan (Wu & Zhao, 2007). This approach can assess the feasibility of production, avoid risk and reduce losses before being put into production.

According to Aguinis and Kraiger (2009), as a result of global economic competition, differentiation among the companies is based on staff skill, knowledge and motivation. Staff training benefits to the individual, teams, organizations and society. In addition, it can provide the solutions in case of dependencies on limited skill and knowledge.

**Analyze external environment in detail**

The company needs to focus on conditions which are intimately related to innovation, the conditions include laws and regulations, industrial policy, technology policy, culture, ethnicity, religion and mass psychology (LITAVNIECE and ZNOTIŅA, 2015). According to Song et al. (2017)’s description, the political and legal environment refers to the political elements and legal systems that restrict and influence the enterprise, as well as its operating status. LITAVNIECE and ZNOTIŅA (2015) pointed out that industrial policy and technology policy are parts of economic environment factors. The economic environment is socioeconomic status and national economic policy which can constitute enterprise’s survival and development. The elements of the economic environment are socio-economic structure, economic system, development status and macroeconomic policy. LITAVNIECE and ZNOTIŅA (2015) also point out that culture,
ethnicity, religion and mass psychology are included in the sociocultural environment, which are related to a major business decision such as the investment direction, product improvement and innovation. By analyzing the external operation environment, the enterprise can make sure its innovation products will not be subject to national laws, regulations and policies, and can meet the requirements of social environment better.

3.5 Summary of theoretical framework

A theoretical model was developed to summarize the different theories used in the research, which gives readers a better overview of the theoretical. This also provides a basis for the empirical data and a guide for the interview. The figure can be seen below.

Figure 10: Summary of the theoretical (own figure)
4. Empirical Data

The empirical data of supply side risks that have been gathered from the HUAWEI (China) are presented in the following chapter, which will include the manufacturing risks, logistics risks, information system risks and inventory risks. All the empirical data in this part is mainly targeted research question 1, and also include some information related to the frequency, impact of these risks and some mitigation suggestions from the view of managers. The sources of the data have mentioned in the methodology chapter.

4.1 Manufacturing risk

Production risk
According to interview with Li (Production Manager, 28-04-2017), HUAWEI had been using mass production mode in order to achieve the largest amount of the products based on the lowest cost of production. With the development of the times, this production mode became out of date, because in this mode enterprises provide a series of standardized products.

Additionally, as Li (Production Manager, 28-04-2017) said that according to the logic of Master Demand Schedule (MDS) - Master Production Schedule (MPS) - Material Requirement Planning (MRP), based on the MDS and the audit of research and development (R&D), purchasing and other related departments make an executable MPS in order to schedule the MRP. HUAWEI can adjust and develop production and purchasing plan, and release orders to related suppliers. Meanwhile, this information can help HUAWEI to carry out inspection and maintenance of their production attributes (WIP, lead time, and production capacity, etc.) and production parameters (security buffer quantity, key parts reserve and production efficiency percentage, etc.) However, Li (Production Manager, 28-04-2017) also pointed out that there are still some risks, their production and purchasing plan will affected by skills and quality aspect. Because the uncertainty of these two factors will disrupts their previous plan and arrangement which results in increase in cost and destruction of their strategic goals.

Chou (Logistics Manager, 14-04-2017) said that linear production levels also cause
production related issues. Mass production and use of economies of scale do cut cost but due to dynamism in the market, the product life cycle is very short and thus it lead to waste of resources.

Li (Production Manager, 28-04-2017) described that there are also some problems during the processes of HUAWEI’s production, they are mainly caused by quality of raw materials and finished products, and if HUAWEI does not timely make countermeasures, even the tiniest problem (e.g. substandard parts and raw material supply, etc.) in the processes will show up as a big risk for themselves. Therefore, authors will describes these problems in skill risk and analyze them separately.

Li (Production Manager, 28-04-2017) outlined that the major impact of production risks are on the production of quality products, production plans, purchase plans and supplier relations. The probability of risks production risks is generally low but because of the dynamic industry, the skills requirements and quality risks have greater chances. These risks needs to be mitigated on priority basis.

Li (Production Manager, 28-04-2017) also claimed that risk awareness and feasibility studies are of the most importance in production risks. HUAWEI still has to manage production risks on the basis of proper calculation of the causes and impact of the risk.

**Skill risk**

According to Li (Production Manager, 28-04-2017), HUAWEI is constantly seeking a breakthrough in technology skill aspect, it gained some achievements recent years. HUAWEI’s investment in technology research and development is increased recent years, its R&D investment ranked 8th in 2016. More specific data can be seen in the table below, released by European Commission in December 2016.
Table 6: Technology research and development investment ranking (European Commission, 2016)

<table>
<thead>
<tr>
<th>R&amp;D investment ranking</th>
<th>Headquarters</th>
<th>R&amp;D expenses (€ billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Volkswagen</td>
<td>Germany</td>
<td>136.12</td>
</tr>
<tr>
<td>2. Samsung</td>
<td>Korea</td>
<td>125.28</td>
</tr>
<tr>
<td>3. Intel</td>
<td>United states</td>
<td>111.40</td>
</tr>
<tr>
<td>4. Alphabet (Google)</td>
<td>United states</td>
<td>110.54</td>
</tr>
<tr>
<td>5. Microsoft</td>
<td>United states</td>
<td>110.11</td>
</tr>
<tr>
<td>6. Novartis</td>
<td>Switzerland</td>
<td>90.02</td>
</tr>
<tr>
<td>7. Roche</td>
<td>Switzerland</td>
<td>86.40</td>
</tr>
<tr>
<td><strong>8. HUAWEI</strong></td>
<td><strong>China</strong></td>
<td><strong>83.58</strong></td>
</tr>
</tbody>
</table>

But compared with Samsung and Apple, HUAWEI still cannot go over than them on many aspects. HUAWEI invested a lot on skill, but the capacity is not strong enough and the effect is far less than its competitors, such as Samsung and Apple. For example, in 2016, HUAWEI intent to apply the curved screen to their new high-end model mobile phone (Mate9 Pro), but HUAWEI does not have enough technical skill to support them produce the curved screen. As Li (Production Manager, 28-04-2017) said, the skill problem can be a key risk for their company. At present, there are no mature domestic suppliers except Samsung can support HUAWEI’s requirement.

Therefore, in terms of the technical skill of the curved screen, HUAWEI has a strong dependence on Samsung and according to HUAWEI’s estimates, it can only get 8% curved screen from Samsung in 2017. Besides, most high-end models mobile phones of HUAWEI have been suppressed by Samsung. Moreover, technological innovation of HUAWEI encounters bottlenecks, compared with the HUAWEI’s previous generation mobile phone and the same price phones from other brands, the newest mobile phone (Mate10) of HUAWEI does not have much real breakthrough in technical skill. Thus, Mr. Ren, the founder of HUAWEI publicly stated in Annual Report 2016 of HUAWEI that they need to learn from other outstanding manufacturers and focus on skill innovation of core components.

The manager production manager stated that the skill risk has most critical impact on the value and brand image of HUAWEI. The competitors can override HUAWEI as HUAWEI is outsourcing for manufacturing some parts from its own competitors. The skill risk affect the overall worth of the company and market share. The skill risk is the
most important deficiencies in HUAWEI and therefore, Samsung and Apple has competitive advantage over HUAWEI. The probability of skill risk is high as it has been the prevailing issue with HUAWEI and that this issue needs to be addressed through proper mitigation strategies, training of staff, skill enhancements and external and internal analysis of the company in acquisition of the right skill.

**Quality risk**

Li (Production Manager, 28-04-2017) said in the interview, HUAWEI produces parts of the components and also obtain from other suppliers. They have set up selection criteria and evaluation systems for the supplier quality control. Before establishing the relationship with suppliers, the purchasing manager of HUAWEI will contact the supplier in person to discuss cooperation. The process include send a delegation to visit suppliers’ factory and machinery. If the level of suppliers meets the requirements of HUAWEI, they will order directly.

However, Li (Production Manager, 28-04-2017) also pointed out that after ordering, HUAWEI will have no more quality control and supervision, the follow-up responsibility will be charged by suppliers. Besides, the price of raw materials is increased substantially, e.g., price of the material which is used to create screens increased 50%. It makes suppliers’ cost of producing increased and effect the components quality provided by suppliers in different levels.

A typical case is that the flash memory quality of HUAWEI’s newest version mobile phone (P10) is on different levels which occurs negative effects on the using of the phone. And sometimes they cannot produce products on time due to the low-quality components. Thus, Li (Production Manager, 28-04-2017) pointed out this is the responsibility of suppliers, because they did not provide high-quality components as required, some flash memories which provided by suppliers are defective products. The major risk of the quality is caused by the low reputation suppliers due to the increasing raw materials price and the raw materials shortage.

Li (Production Manager, 28-04-2017) stated that the quality risk happens when the company has no option other than sourcing from a supplier which has not a strong reputation regarding quality of the raw materials. This risk occur not so often but do occur and has a history of occurrence but the impact of this risk is very high as it affects
the quality of the final product of HUAWEI. This risk can delay production if HUAWEI do not get the required quality of the raw materials. This quality risk mitigation require suppliers’ selection procedures and avoiding low reputation suppliers. The supplier selection process of HUAWEI should focus more on quality rather than the price.

4.2 Logistics risk

Transportation risk

According to interview with Chou (Logistics Manager, 14-04-2017) authors know that there are four kinds of existing transportation modes for used by HUAWEI are:

- Air
- Sea
- Truck
- Railway

Below, it can be seen a figure summarizing the percentage of goods shipped by these four transportation modes from 2015 to 2016.

![Transportation Modes Utilization Rate](image)

Figure 11: Transportation modes utilization rate (Chou, Logistics Manager, and 14-04-2017)

However, Chou (Logistics Manager, 14-04-2017) pointed out that there are also some risks which will affect HUAWEI’s transportation, such as social, natural, political and so on environment, as well as economic, time and traffic factors, etc. Therefore, they will based on related results to make the correct choices of different transportation mode
for different parts in order to avoid risks.

Chou (Logistics Manager, 14-04-2017) described that the transportation risk also affect the inbound deliveries and increase transportation costs. The transportation related risk has less probability of occurrence, however this also need to be considered in the plan of risk mitigation system.

*Inbound delivery risk*

HUAWEI worked hard to ensure and contact more suppliers in the market to procure the components from more than one supplier with multiple manufacturing sites. This ensures the time delivery of components but also they are not relying on one supplier so that timely delivery can be obtained (HUAWEI Annual Report, 2015).

Also for the design of the components, HUAWEI prepare different solutions for key components in order to minimize as much as possible the impact of on the product supply and delivery if any of the suppliers withdraw or supply substandard products. According to Chou, Logistics manager (14-04-2017), HUAWEI's aim is to ensure the inbound deliveries in the right price, the right quantities, at the right time and from the right source

Chou (Logistics Manager, 2017) said that most often these objectives are not 100 percent met. There are many reasons for that including

- Long distance between the right suppliers and manufacturing units due to the fact that China is a big country
- If the shipment is done through air it costs a lot and if done through road it takes a lot of time
- The security reasons, natural disasters on the way and theft/loss/damages
- The cost of the suppliers, and currency fluctuations etc.

The Manager Highlighted key issues with inbound deliveries in HUAWEI are:

**Inbound delivery reliability**: Due to the fact that distances are high between China being a big country. The deliveries are often not reliable due to natural disasters, theft and loss etc. Sometimes the transport carrier has financial, communication and other problems due to which deliveries are not reliably done as planned. Other problems can
Deliveries include the road blocks, strikes etc.

**Delivery monitoring:** HUAWEI could not make a good monitoring system for the inbound deliveries to ensure that the deliveries are monitored throughout the way. The use of information Technology to monitor the deliveries and reengineer the process is needed.

**Supplier selection:** HUAWEI in their annual report of 2016 mentioned that they had always multiple suppliers on list with different manufacturing facilities at various sites which is useful in such situations. Assessing financial stability of supplier is important for manufacturing companies like HUAWEI, and multiple suppliers are essential in such situation if a supplier goes out of business. According to HUAWEI, (2017), HUAWEI has developed strategies for sustainable supplier selection, but it still struggles with improving its supplier selection, based on location, quality of the products, timely deliveries and reliable deliveries and the cost aspects. Multiple supplier have different qualities and standards, and some are low of the low standard as well.

Chou (Logistics Manager, 2017) stated that although the all the inbound delivery risks have substantial impact on the costs, production, stock level, and supplier relations, there are still less chances of these risks. Therefore the impact have a high level. But the probability can be assumed as low because these risk might happen but has no proven record of frequent appearance.

**Lead times risk**

In nowadays situation, sustainability has become a key element of product lifecycle in the mobile phone industry’s value chain, and strategies for cost reduction, differentiation and gaining competitive advantages. Reducing the lead time both on supplier and manufacturing side leads to improved productivity, output and operations of the company. The major obstacles leading to extended times in HUAWEI are as follows. (Chou, Logistics Manager, 14-04-2017).

**Stock outs:** In HUAWEI it is often experiencing the missing of necessary parts due to which delays in manufacturing occur. It is impossible to build and produce when missing the necessary parts of the product. And some manufacturing processes are waiting for other parts which extends lead times (Chou, Logistics Manager,
According to Chou (Logistics Manager, 14-04-2017), HUAWEI often underestimates or overestimates the stock needed. They often miss necessary parts. There are several reasons for that including changing market trends, changing brands, and customers’ likes and dislikes. Dynamism in IT sector increment or decrement the demand of certain brands of HUAWEI which in turn leads to underestimation or overestimation of the production of certain brands. Sometimes the parts are not easily available and it creates serious issues for the company and its production. Sometimes software or features renovation and applications also takes lead times because of the changing trends and brands.

**Lead time variability:** Chou (Logistics Manager, 14-04-2017) argued that one other issue in HUAWEI is the variation in suppliers’ production. Different parts providers have different schedules for different types of components. He give an example that the metal parts producers are slower than plastic parts providers. Besides that, there is a large number of suppliers from which HUAWEI procure.

The manager further explained that every supplier has its own uncertainties and it is difficult to predict when an item will be delivered. Variability also creates surplus and often it is observed for some parts, especially the brands that go old have surplus inventory of parts and of the newer brands, often shortage.

**Processing lead times:** Chou (Logistics Manager, 14-04-2017) identified another serious issue with HUAWEI as multiple procession occurring at the same time there the production processes are occurring linearly. He further explained in IT terms, a kind of bus topology is adopted while atomizing the manufacturing processes through system. The manufacturing system builds every component of the finished assembly which takes longer in completing a large number of products of the same type. The output is lower and fewer numbers of products are produced in per unit time.

The manager pointed out that another problem in HUAWEI manufacturing is the difficulty with implementing the concepts of change management and often some brands are ordered by the HUAWEI stores whose manufacturing take too late, and thus they are delivered late to the stores, which leads to dissatisfaction in the customers.
Chou (Logistics Manager, 14-04-2017) argued that overall the lead time risks strongly impact the operations of HUAWEI, delays production, increase costs, negatively impact efficiency of the firm and strongly affects the customer relationship. However, the lead times happen not quite often. Thus, the probability, of the lead times risks together, can be taken as low consolidation.

Chou (Logistics Manager, 14-04-2017), outlined that consolidating supplier can result in eradication of lead time variability, but due to large number of suppliers and distance it is not often possible. However for processing lead time, the production system needs modifications because the processing and production depends upon the types of brands HUAWEI still has mass production system.

### 4.3 Information risk

Shi (Channel manager, 04-05-2017) said HUAWEI believes that good communication breeds good business relationships. HUAWEI has built a specific procurement organization structure which is based on commodity. HUAWEI procurement department established a Commodity Expert Groups (CEG), and each CEG is responsible for procuring a class/group of materials to meet the needs of business department and requirements of regional markets.

In order to implement a better procurement operation, HUAWEI provides diverse channels of communications for the open dialogue and discussion between HUAWEI and suppliers. One channel is called single interface, each CEG internal system has a supplier contact person who is responsible for supplier contacting, communicating and managing any issues and questions that happened during the business process. Accordingly, suppliers are required to contact HUAWEI through this single interface also. Through this channel, CEG would send the procurement strategy and plan to suppliers which might impact suppliers’ operation. Another channel is supplier feedback channel, it is used to handle all issues related procurement which include suppliers’ complaint about unfair behavior and unethical behavior of HUAWEI employees or department. Suppliers can send these information to HUAWEI (purchase@HUAWEI.com) and that can be kept secret and responded quickly. The aim of channel for HUAWEI is to promote a more open and effective relationship with
suppliers to make sure the information correctly transfer to suppliers.

Shi (Channel manager, 04-05-2017) said there is information risk existing between suppliers and HUAWEI as the channel they communicate is single. When HUAWEI need to change the quantity of their orders, suppliers cannot receive the information in time only through one channel and the information risk appears. While interview with Shi (Channel manager, 04-05-2017), the information risk also appears in the internal side of HUAWEI. In HUAWEI, the useful information are controlled by people from different departments which are scattered, large and the information collection is not prompt. Thus, there is a serious case of asymmetric information and information blockage, which cannot be used to communicate and transfer functions. He also mentioned that the information risk caused by the functions of HUAWEI’s information department and information network department which are fuzzy, low-status and virtual.

Shi (Channel manager, 04-05-2017) stated that information risk has strong impact on the cost of products, and delivery time, however the chances of this risk is very low. However, this should be considered under the risk management practices. This problem can be solved by ensuring communication efficiency with suppliers.

4.4 Inventory risk

Inventory is a double-edged sword because on the one hand it increases supply flexibility, but on the other hand, it takes up a lot of money, Chou (Logistics Manager, 14-04-2017) said. There are many examples of companies going bust because of improper inventory, and the loss of inventory is always greater than the failure of product development. Even though the oval structure looks like a reasonable inventory structure, the inventory also appears in practice because of the products’ life cycle. According to interview from Chou (Logistics Manager, 14-04-2017), the surplus inventory is a heavy burden on HUAWEI to cause the huge inventory risk when it is eliminated by the market. According to the following two figures about the total amount of inventory and various inventory amount in HUAWEI from 2014 to 2016 that Mr. Chou show to authors, the inventory cost is increasing year by year because HUAWEI’s sales volume is increasing year by year. However, the surplus inventory amount
increased 2967 million from 2014 to 2016 which means the inventory risk existed.

Figure 12: HUAWEI total inventory amount from 2014-2016 (HUAWEI 2016)

Chou (Logistics Manager, 14-04-2017) said that manufacturing unit builds all of the parts to complete on-site which allows easy assembling of the finished products, but when component supply warehouse is disorganized, it takes a lot of time in manufacturing the items on your build list, especially when stock has much more surplus parts, and the excess inventory make this process even more challenging.

Figure 13: HUAWEI amount of all kinds of inventory from 2014-2016 (HUAWEI 2016)

Chou (Logistics Manager, 14-04-2017) informed that impact of surplus inventory
comes at the cost of HUAWEI, both on the financial side as well as the storage and handling side. However the surplus inventory is easily eliminated, so the inventory risks did not occur in recent years and bears a low level of probability of occurrence. A vendor managed inventory system, however, can mitigate this risk.

The table below shows the summary of different risks and impacts as outlined in the empirical data.

<table>
<thead>
<tr>
<th>Supply side risks of HUAWEI</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturing risk</strong></td>
<td></td>
</tr>
<tr>
<td>Production risk</td>
<td>Affect HUAWEI's production and purchase plan.</td>
</tr>
<tr>
<td>Skill risk</td>
<td>Lack of enough hi-tech components to support the new products which will obstruct normal production and lead to a long time out of stock.</td>
</tr>
<tr>
<td>Quality risk</td>
<td>The components quality provided by suppliers in different levels which lead to low-quality products or delay production time.</td>
</tr>
<tr>
<td><strong>Logistics risk</strong></td>
<td></td>
</tr>
<tr>
<td>Transportation risk</td>
<td>Affect HUAWEI's transportation plan and increase costs.</td>
</tr>
<tr>
<td>Delivery risk</td>
<td>Stops production, increase costs, affect stock levels, brand image, effect supplier relations.</td>
</tr>
<tr>
<td>Lead time risk</td>
<td>Delays production, increase costs, effects production efficiency, effects customer relations.</td>
</tr>
<tr>
<td><strong>Information risk</strong></td>
<td>Suppliers provide the wrong components or wrong volume of components which lead high cost of products and long delivery time.</td>
</tr>
<tr>
<td><strong>Inventory risk</strong></td>
<td>Surplus inventory becomes a heavy burden on HUAWEI.</td>
</tr>
</tbody>
</table>

Table 7: Supply side risks and impact of HUAWEI (by interviews)
This chapter is structured according to the three research questions. The first part will be the supply side risks identification of HUAWEI. The second part will be the risks assessment, which includes three steps. The first step is to analyze the probability and impact of each supply side risks of HUAWEI. Next step is to assess all supply side risks interactions. The last step involves prioritizing these risks. In the third research question, authors provide suggestions to mitigate the major risks.

5.1 Risk identification (Research question 1)

What kind of risks in the supply side of HUAWEI supply chain can be identified?

The first step in the supply chain risk management is the risk identification (Brindley, 2004). As stated by Ritchie & Zsidisin (2008), this involves identification of the causes why the risks arise and what behavior the risks can adopt and its relationship to the organizational functions.

Garver (2008) argued that the purpose of risk identification is to put forward before the management the unfavorable factors which can affect the firm’s performance objectives. Risk identification should be done in a proactive manner to be safe from the consequences happening due to risks and early and the process should be continued and part of the management guidelines of the firms.

While going through the research, the authors explored that in the supply side of HUAWEI there are many types of risks including manufacturing risks, logistics risks, information risks and inventory risks. These risks and their causes are briefly highlighted as follows

5.1.1 Manufacturing risk

The manufacturing related risks in HUAWEI include production risks, skill risks and quality related risks (Di Chou, Logistics Manager). The poor performance with manufacturing side result in low efficiency in business processes, therefore, companies strive to invest more in lean manufacturing, TQM, etc., however, their internal
operation is still more affected by production, skills, and quality (Tang & Tomlin, 2008).

**Production risk**

The production risk in HUAWEI includes problems with the raw material, equipment, technical personnel and production technologies. The major causes are inefficient production strategy and lack of advanced skills and quality aspects for some products of the market importance.

**Skill risk**

On the skill side, HUAWEI has advanced, but still there are weak areas which it needs to improve especially the new innovative products, in which Samsung and iPhone always beat HUAWEI. It has a lack of enough hi-tech components to support the new products which will lead to a long time out of some stocks.

**Quality risk**

HUAWEI has quality related issues as well. The components quality provided by suppliers in different levels lead to low-quality products or delay production time. The main reasons of this are because HUAWEI source some products from low reputation suppliers because of many factors including, price, distance, market demand, etc.

**5.1.2 Logistics risk**

Logistics risks are the critical category of risks on the supply side as and both the sourcing firms, logistics service providers and the suppliers all are facing risks these risks (Chung et al., 2015). On the supply side, the inbound transportation management, goods handling, supply planning and Transportation companies’ are partly affected by such risks (Jonsson, 2008).

On the supply side of HUAWEI, the empirical study highlighted three major risky areas, i.e., transportation risks, inbound inventory risks and lead time risks (Chou, Logistics manager).

**Transportation risk**

The transportation risk mainly caused by mode choice and natural environment. Because generally, there are four modes for HUAWEI, costs and time for each mode is
Therefore, without a reasonable selection of transportation mode will lead to increased transportation costs and delayed transportation. Meanwhile, these two factors affect each other, although HUAWEI has selected the most reasonable mode of transportation, the extreme weather or natural conditions also will affect transportation.

**Inbound delivery risk**

The inbound delivery risks can further be subdivided into inbound delivery reliability, delivery monitoring and supplier selection risks. The deliveries are unreliable because of many factors such as a long distance within China, natural calamities and man-made disasters, theft, damages, losses, etc. This can stop production and come at the financial loss both for suppliers and HUAWEI. The Other risk is the unavailability of an efficient tracking system for inbound deliveries which can further result in loss or theft of shipments or delayed deliveries. The third risk related inbound logistics in HUAWEI is supplier selection related risks. The causes of these risks are time, the location of the suppliers, the right quality and quantities asked by HUAWEI, and cost of the shipments and products. This can be a source of increased cost of production, low quality which can further lead to low-quality products, or shortages in quantities.

**Lead time risk**

Lead time risks occurring in HUAWEI can also be sub-divided into stock outs, lead time variability and processing lead time (Chou, Logistics Manager, 03-04-2017). Stock outs happen because of underestimation or overestimation of stock. This can stop production for HUAWEI. Variability in in lead time of different suppliers can delay production of HUAWEI and bring inefficiency in operations. This is because of Supplier's own schedules and uncertainties. There are processing lead time risks in HUAWEI which are mainly caused by linear production system and low adaptability of the change management concept in manufacturing operations. On site production also plays an important role in it. This leads to low output per unit and surplus of some products while deficiency of some brands.

**5.1.3 Information risk**

Guo *et al.*, 2006 argued that consistent and timely information among partners in the supply chain is essential for efficiency and proper coordination. Unavailability, delays or breakdowns in information, as well as information security, are causes of this risk.
Because every enterprise is independent operation and can have different communication or information system, prediction, forecasting and calculation capacities, the information errors can happen (European Chemicals Agency., 2013).

Based on empirical and study of HUAWEI, the information risk arises mainly because of the use of single communication channel. The effect of the information risk is that suppliers provide the wrong components or wrong volume of components which lead high cost of products and long delivery time.

5.1.4 Inventory risk

The optimum inventory level leads to effectiveness in business process and avoids the manufacturing delays (Jaques & Morgan, 2004). Due to dynamism in mobile phones industry, the new electronic products becomes soon become out of want. The company needs to understand the inventory risks in order to alleviate risks, and by doing this, the company will be able to plan risk management strategy and control inventory in practice. (Jaques & Morgan, 2004). HUAWEI update telephone products once a year and stops the production of old types after four years. The rest of products which have no market become the surplus inventory in HUAWEI warehouse (Chou, Logistics Manager). The major cause of this risk is the short life cycle of electronics products. This other reasons of inventory surplus are the disorganized warehousing. This risk increases cost for production, storage and recycling of unsold products, slows manufacturing operation of the build list.

The supply side risks of HUAWEI and causes of these risks are presented in the figure below.
5.2 Research assessment (Research question 2)

*How can supply side risks of HUAWEI supply chain be assessed?*
5.2.1 Assessment criteria

Authors rated each supply side risk of HUAWEI against two dimensions by developing probability and impact, which can be seen in the table. More detailed analysis about this is presented below.

<table>
<thead>
<tr>
<th>Supply side risks of HUAWEI</th>
<th>Probability/Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing risk</td>
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<tr>
<td>Production risk</td>
<td>High/High</td>
</tr>
<tr>
<td>Skill risk</td>
<td>High/High</td>
</tr>
<tr>
<td>Quality risk</td>
<td>Medium/High</td>
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<tr>
<td>Logistics risk</td>
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<tr>
<td>Transportation risk</td>
<td>Low/Low</td>
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<tr>
<td>Inbound delivery risk</td>
<td>Low/Medium</td>
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<tr>
<td>Lead time risk</td>
<td>Low/High</td>
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<tr>
<td>Information risk</td>
<td>Low/High</td>
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<tr>
<td>Inventory risk</td>
<td>Low/Low</td>
</tr>
</tbody>
</table>

Table 8: Probability and impact rating of supply side risks (own figure)

5.2.1.1 Manufacturing risk

Production risk

According to interview with Li (Production Manager, 28-04-2017), the existing or previous mode of HUAWEI’s production is mass production mode. Although HUAWEI is shifting production mode, the reform has not finished yet. This mass production may be used in some type of industry but not a high-tech industry like HUAWEI.

The reason why it does not apply to HUAWEI is because this mode leads to some bad impacts which are:

Waste resources: By this mode, although the total expenditure of each unit will decline, HUAWEI using automation machine tool requires a lot of investment, and if there is something wrong with the machine can cause terrible losses because the price of machinery purchase is very high, it means that production line is very expensive as well. Meanwhile, some other raw materials in the product design plan are also very expensive
and need a quick response procurement, however, it will cause HUAWEI to redraw their purchase plan and the cost of purchase will increase. All these impacts will result in a huge waste of resources.

**Lack of guarantee:** HUAWEI’s production and product plan are crucial to ensure the success rate of mass production, HUAWEI should consider product positioning and company need. Sometimes, if the product design is not reasonable, then their production cycle will be affected and all the products will be wasted. Because this production mode has a lack of flexibility, and it is hard for the production line to be adapted to new product and production plan. Additionally, during the production process, if the part of the line is interrupted, the whole production process will have to stop until that part is repaired.

**Simple product structure:** The similarity is the attribute of a mass production but fails to meet an innovation requirement of the high-tech industry. Mass production of a simple product will lead to the product backlog. Meanwhile, with the use of mass production strategy, there is no new variety to be introduced, all the products have same skills, quality, size and so on. It will cause workers' lack of motivation because they are always doing repetitive and single tasks.

Li (Production Manager, 28-04-2017) also pointed out that there are two major risks in the production process. The first is, although HUAWEI has their own execution monitoring supervisors for suppliers to ensure that suppliers stick to the program and conform to the skills and quality requirements for HUAWEI’s products, their follow-up supervision is incomplete. The second risk is that HUAWEI uses the logic of MDS - MPS – MRP to adjust and develop production and purchasing plan, however, this pattern will also be affected by skills and quality. Therefore, skills and quality risks make up a large proportion of production (detailed in skills and quality risks).

Taken together, the probability of risks for production mode is greatly reduced, because although the reformation is not finished yet, HUAWEI has been working hard to change. Therefore, authors hold that the probability of this risk for production is low. However, compared with skill and quality risks, this production mode risk does not carry the same weight. As authors described, skill and quality risks are very important and are involved
in many aspects, therefore, according to overall consideration, the authors thinks that the probability of production risks is high, and it needs careful treatments to be avoided.

**Skill risk**

Facing the strong market competition, more and more enterprises are dedicated to the design and manufacturing of hi-tech products. In addition, the technical requirements of enterprises are getting higher and higher (Zhou, 2011). Skill is always big issue for a technology company, skill risk is critical to the success of a technology company. Thus, HUAWEI continuously strengthened its own strength. In terms of technical skill research and development investment, HUAWEI invested a lot. However, as mentioned in the empirical data, when compared with Samsung and Apple, HUAWEI still cannot go over than them in many aspects. According to the interview, this is considered as skill risk for HUAWEI and this kind of risk issues has been plagued by HUAWEI recent years, which impact its breakthrough in the electronics industry. This skill risk will bring huge negative impact to HUAWEI because HUAWEI is a multinational networking and telecommunications equipment company, its development level has a high dependence on technical skill. If technical skill does not match the skill requirements, the manufacturing side, focal firm and its entire supply chain all will be affected (Ji et al., 2010). According to the interview, the R&D of HUAWEI in 2016 is less than Samsung and the skill capacity is also far less than Samsung. HUAWEI committed to producing the high-tech products, but they have not enough skill ability to support that. Skill and knowledge of staffs are necessary for manufacturing. Without sufficient skill capability and knowledge, enterprises cannot respond to production information, requirement quickly and accurately, then it will delay the available opportunities. For HUAWEI, they intent to apply the curved screen to their new model mobile phone (Mate 9 Pro). However, HUAWEI cannot produce the curved screen by using their own skill. What is more, besides Samsung there are no mature domestic suppliers can support HUAWEI’s requirement. This will impact the normal manufacture of HUAWEI, they would have a strong dependence on Samsung in terms of this screen skill, which means the core technical skill of a product in HUAWEI needs to rely on another company. What is worse, it can only get 8% curved screen from Samsung in 2017. If it cannot get enough curved screen, HUAWEI will lack the curved screen to support the new model products that they intent to manufacture. The impact of this is that HUAWEI will undoubtedly lead to a long time out of stock in terms of their
new model products. This result may influence their previous arrangement and manufacturing operation of HUAWEI and increase their cost, which will bring huge losses to HUAWEI. In this condition, on the one hand, HUAWEI cannot produce the products they required and cannot meet the customers’ needs, so the market sharing of HUAWEI may decrease, meanwhile, they cannot gain benefit. On the other hand, if they still cannot grasp the advanced skills they need, the technological innovation of HUAWEI encounters bottlenecks and their products will remain at the current level. That means HUAWEI will not have a much real breakthrough in technical skills in terms of their new products, which will bring HUAWEI a negative impact that they will be suppressed by their competitors and cannot go beyond their competitors in the short term. Overall, the skill risk has a high probability and impact for HUAWEI because as mentioned in empirical part the frequency of skill risk issues always occur in HUAWEI recent years and according to Eccles and Obe (2010), if a risk occur in high frequency, this risk can be defined as high probability risk. In addition, these skill risks are directly related to the success of HUAWEI this kind of technology company and will result in a high value of the loss.

**Quality risk**

As Tse and Tan (2011) pointed out, any quality problems of supply chain members (such as raw material, production, skill and logistic, etc.) will lead to quality risk (Flynn, 2005). Although HUAWEI has a good quality control system for their supervisors, managers, staffs and also set up selection criteria and evaluation systems for suppliers. They produce parts of the components and also obtain from other suppliers. According to Gray et al., (2016), since production process is done cooperatively by multiple supply chain members, even if the defect is created by other members (e.g., suppliers), the result may also be borne by the focal company.

Thus, in this condition, it is difficult for HUAWEI to track activities of suppliers and to know who handled what. In addition, companies need to be held accountable when a supplier unit occurs mistakes (Tes & Tan, 2011). As shown in empirical data, HUAWEI will have no more quality control and supervision after they choose the suppliers, the follow-up responsibility will be charged by suppliers, which show up as a big risk lead to some negative impacts. After selecting suppliers, HUAWEI have no more quality
control. Therefore, one of the impacts is that they cannot guarantee the suppliers’ procurement and production activities be completed in high-quality.

What is more, once any quality problems occurred, HUAWEI will bear the bad consequences of this. As described by the managers, HUAWEI sometimes may obtain low-quality components from the low reputation suppliers, which brought them troubled. Once they cannot get the high-quality components they required before, normal production will be hampered.

On one side, if HUAWEI uses these low-quality components to complete the production in order to achieve delivery on time that will lead to low-quality products. The quality level is one of the core competencies of the enterprise. If the product does not meet the expected requirements, its products cannot meet the needs of the market and customers, which means that the market share may be reduced and lead to operational problems (Hauser, 2003). Thus, the low-quality products will decrease the market sharing of HUAWEI and bring operational problems to HUAWEI.

On the other side, if HUAWEI refuse to use these low-quality components from the low reputation suppliers, they cannot have enough high-quality components to complete products on time which will delay the production time. And if HUAWEI wants to finish on time, they have no choice but to order new components from other suppliers timely, which will make the cost of HUAWEI increased.

Overall, the quality risk has a medium level of probability and high impact for HUAWEI due to the facts, as mentioned in empirical data, that the phenomenon of getting low-quality components from low reputation supplier occurs not often and according to Eccles and Obe (2010), if a risk might occur often, this risk can be defined as medium probability risk. But both impacts of low-quality products and delay production time will lead to a huge loss for HUAWEI.

5.2.1.2 Logistics risk

Transportation risk
Chou (Logistics Manager, 14-04-2017) pointed out that the main risk of transportation mode is a choice, HUAWEI needs to consider that what kinds of parts or products
should transport by which types of transportation mode. Because transportation risks refer to the costs, there are many different costs during the process of transportation such as fuel costs, labor costs, maintenance costs and route planning costs, etc. (Taki & Teimoury, 2016).

Meanwhile, transportation mode risks also involved in the problem of uncertainty in freight transport operations (Punniyamoorthy et al., 2013), therefore, ensuring that suppliers are able to provide products consistently and on time is one of the keys to assessing the existence of risks in the supply chain, for instance transport times (daily, weekly, etc.) and mode of transportation (air, land or sea) in order to ensure that transportation will not be interrupted by some emergencies (Blanchard, 2009).

Additionally, according to Taki and Teimoury (2016), the transportation mode also has an impact on the delivery reliability. The choices of transportation mode are the key to the transport risk management because if the transportation management issues are not treated well and in the case of the improper selection of the mode of transportation, these risks will cause damage to products or affect transportation time in order to increases costs unnecessarily.

Chou (Logistics Manager, 14-04-2017) described that there are four kinds of existing transportation modes are used by HUAWEI:

**Air:** Flight provides a very fast transportation mode, but it is also costly. As an international company, when some type of parts meet the conditions of relatively low amounts and high value or time-sensitive and has to travel long distances, they are the most suitable for transport by air. HUAWEI uses this kind of transportation mode to transport international goods from suppliers often scattered around the world to China or their production base in other nations.

**Sea:** Compared with the air, sea transportation can shoulders greater load. HUAWEI also uses this mode for international transportation. However, the negative factor of this mode is that its speed is very slow. Therefore, generally, some if goods which are standardized with large batch will be transported by this mode.

**Truck:** Truck is the most frequent national transportation mode. Its mode is widely used in HUAWEI’s regional transport.
**Railway:** It is an ideal mode for carrying heavy, large, or high-density products within a certain range, but the transportation time may be long. Due to HUAWEI normally offers portable electronics, therefore, this mode has limited use at HUAWEI.

At the same time, in either mode, will be affected by environmental factors, although these factors are not only natural environment but also the political and social environment. However the main influence on transportation is from the natural environment. Because in transportation risk, authors mainly express the effect of choice, and for the natural environment, unfavorable weather conditions will influence HUAWEI in their choice of transportation mode which can disrupt their transportation arrangement. This all carries a risk of disruption in the supply chain. The risk is also part of the transportation like a natural, economic, environmental, political and traffic jams, etc. The leading companies in the world identify, assess and monitor the risks of time. HUAWEI has mentioned that they have explicit risk management structure. The risk management structure enable HUAWEI in minimizing the transportation risk, the contracts with the carriers are documented, and any theft during delivery or damage to the brand are kept in mind during the selection of the carriers and laid out in the contracts with the shipping agency used for transportation which is essential for any transportation.

In view of the above empirical data facts and figure 11, the choices of HUAWEI for a different type of transportation mode is relatively reasonable. Therefore, the authors’ opinions are that the probability of transportation mode risks is low.

**Inbound delivery risk**

As Arkendar (2007) described, timely deliveries are critical to the success of the supply chain. The impact of unreliable deliveries is severe. Items delivered late stops production for the HUAWEI and the business relationships with its suppliers are affected. The business can lose its market value and brand image. Unreliable deliveries can also result in significant charge-backs for suppliers depending on the terms and conditions between the two firms. It often occurs when the items are sourced from an unreliable or cheap transport carrier is hired to deliver the goods. Delivery unreliability can also be caused by the external environment such as natural disasters, storms floods, tornados, etc. and theft/loss.
As described by Taki and Teimoury (2016), the delivery reliability between suppliers and HUAWEI are both key factors in determining supply chain risk levels and the level of safety stock. The more reliable the deliveries are, the less inventory level both of the firms keep and hence it minimizes the cost for both and thus improves supply chain design. Chou (Logistics Manager, 14-04-2017) present that the overall delivery risk did not happen in recent years, therefore the probability of delivery risk is low and it has a medium impact.

**Delivery reliability:** There are difficulties and risk involved, as China is a big country some components suppliers located at a long distance from HUAWEI manufacturing site takes too long to deliver the components to the manufacturing company. If it is delivered by air cargo it cost a lot and by sea transportation, it takes too much time also it has the risk of theft and damage as well. HUAWEI still need an inbound delivery monitoring system and could use the modern technology, it will help in reducing the damage or theft issues

**Delivery tracking:** As stated by Mr. Chou that there is no improved monitoring system for the deliveries during the way from the suppliers to HUAWEI, it makes the deliveries less reliable because of theft and loss. The Chinese environment is critical to these risks because it is a developing country and also because of the fact that freight is very costly. It is a fact that China these crimes are higher than the European countries, and it requires more safety measures for delivery tracking, monitoring and surveillance. HUAWEI, however, do not have this system and thus it makes supply riskier. A big theft, loss or criminal activity can result in stopping of the production cycle for HUAWEI. The impact can be severe in this case will cause huge financial loss, but these problems often don’t happen so as a precautionary.

**Supplier selection:** HUAWEI in their annual report of 2016 mentioned that they always had multiple suppliers on the list with different manufacturing facilities at various sites which are useful in such situations. Assessing the financial stability of supplier is important for manufacturing companies like HUAWEI, and multiple suppliers are essential in such situation if a supplier goes out of business. Although HUAWEI has a mechanism for the supplier selection, It however still struggles with supplier selection. The main aim is to select the suppliers who deliver the right quantities, at the right time with the right quality of goods and services. This can
significantly cut the cost of HUAWEI as said by Chou (Logistics Manager, 03-04-2017). Because of the competition and good relationship with its suppliers, and stated framework for supplier selection, however, is capable of sourcing from suppliers who are not so costly. The major suppliers of HUAWEI are in line with the production at HUAWEI and some are owned by HUAWEI. Therefore, the supplier selection in this case has a medium impact.

*Lead time risk*

This risk occurs in less frequency, so the probability of this risk can be considered low. The overall lead time impacts delay production, increased costs, the influence of production efficiency and customer relations effects, these all elements drive the high level of impact on HUAWEI.

**Stock outs:** As Jian *et al.* (2015) argued, it is impossible to build a product when HUAWEI is missing the necessary components. The lead-time risk appear when HUAWEI underestimated the volume of stock they need or management forgets to reorder the replenishment orders before running out of necessary components. The risk for waiting for new inventory costs money and time and has a more severe impact if the components are not common, the lead-time can go to weeks. In HUAWEI, some parts can always be missing. According to Mr. Chou, in HUAWEI it is often experiencing the missing of necessary parts due to which delays in manufacturing occur. Until the necessary parts are available, the final product is incomplete. This makes at the cost of HUAWEI, the time wastage and less market supply HUAWEI, which further has an effect on the brand image. The impact of stock outs is severe.

**Lead time variability:** As Glock & Ries (2013) stated that lead time could different from vendor to vendor, therefore it makes difficult to forecast when components will be delivered and even harder to coordinate production activities. Suppliers have own uncertainties, Chou (Logistics Manager, 03-04-2017) argued that one other issue in HUAWEI is the variation in suppliers’ production. Different parts providers have different schedules for different types of components. He gave an example that the metal parts producers are slower than plastic parts providers. Besides that, there is a large number of suppliers from which HUAWEI procure. Based on the interview, the solution for this can be a consolidated inventory system. Rather than ordering from different suppliers and randomly receiving and parts and arranging them makes it
difficult. Consolidation can cut the cost and facilitate on time arrival of different parts needed for production. But due to a large number of suppliers and an extensive range of different parts makes the consolidation tough and HUAWEI still have this difficulty in the procurement. An added problem is the dynamism and innovation in the mobile phone industry and strict competition which leads to change in orders frequently and with less reliable forecasting.

**Processing lead time:** In HUAWEI, production is more like done linearly, which causes fewer products per unit time. This risk occurs when more demanding products are required in more quantities. The impact of this risk is not so much but it does decrease the earnings for HUAWEI. The concept of change management is not adopted in a better way so that production activities are formulated according to the market trends and demands and the required quantities and qualities of the products are met. This, however, has less impact because HUAWEI, spend huge money on R&D and the products are designed carefully.

There can be two possibilities to this. One, the same types of brands are produced in the similar processing in short time and the manufacturing system has to be built in a way that it feeds up the market. The other possibility is that different brands are produced in such a way that at the same time, a good number of these products are produced which cater to the needs of the market and fulfills the dynamic requirements of the market.

Moreover, the manufacturing system of HUAWEI needs to adopt change management strategies, i.e. to build the market-based products and having the ability to modify and renovate the products quickly and at the same time produce the demanded products in bulks.

The current manufacturing can be further improved by having subassemblies built off-site as per the need for the renovated products, which will save time in production but this requires investment. The required products will take less time to complete, so in order to fulfill the market demands but again the manufacturing system has the faults of overproduction of some products unwanted in the market. This needs to be fixed in a systematic way. Another risk is a severe competition of other brands like Samsung, iPhone, etc. which uses a different operating system and people have become habitual to
5.2.1.3 Information risk

As Guo et al. (2006) said the correct and timely information is the key point for the supply chain’s members to work effectively and coordinately, therefore the unavailable information, information delays, information breakdowns and information security are factors of information risk.

Shi (Channel Manager, 04-05-2017) provide that HUAWEI and its suppliers have different information system with non-uniform information input and output. This non-effective information sharing mechanism brings the incorrect information and low efficiency from HUAWEI to suppliers if HUAWEI changes any orders. Because the information asymmetry exists, this single channel between HUAWEI and suppliers is hard to communicate perfectly, then the information transportation with distortion and lag will exist. HUAWEI’s information risk has, however, low impact because the low response and incorrect orders of information transportation only make trouble for a while, and that risk can be eliminated when HUAWEI and suppliers communicate in a good way. Shi (Channel Manager, 04-05-2017) said that according to statistics the information risk did not happen in recent years, the probability of information risk is low level.

5.2.1.4 Inventory risk

According to Jaques and Morgan (2004), enough sufficient inventory can ensure the effectiveness of the business process and avoid the manufacturing delays, at the same time the inventory risk occur.

Nowadays electronic and information technology develops fast, and the new electronic products update soon. HUAWEI update products once a year and stop the production of every type product after four years. Chou (Logistics Manager, 14-04-2017) said after the production stopping, the rest of products which have no market become the surplus inventory in HUAWEI warehouse. At the same time, the specific raw materials (curved screen, etc.) piled up in a warehouse because of production stopping. On the other hand,
because of the order cancellation or different customer standards, the components become the surplus materials inventory in HUAWEI as a common phenomenon. Mr. Chou said HUAWEI long-term actual inventory excess became inevitable, that backlog has led to a smaller space to be redeployed in the warehouse, the reduced working capital and increased operation pressure on HUAWEI. In addition, the long-term existence of surplus material in stock also creates obstacles to the production management of HUAWEI, the errors or omissions in the classification of materials and products will bring a certain amount of risk to the company thereby the cost increased.

Besides that, in the production process HUAWEI sometimes also faced with the raw material falling prices risk. It means HUAWEI has stockpiled some raw material inventory to against unexpected needs which also belongs to a part of the company asset. And when raw material prices fall, the inventory is faced with the value reduced risk which has a significant downside for HUAWEI. The inventory risk can be reduced or removed when the company realized the surplus inventory and handle that inventory. Thus, the inventory risk impact to HUAWEI is of low level. Chou (Logistics Manager, 14-04-2017) pointed out that the inventory risk did not occur in recent years and bears a low level of probability of occurrence.

5.2.2 Assess risk interactions

In this part, the potential interaction assessment of every supply side risks of HUAWEI will be discussed. A table is shown below to give readers a better overall understanding of the interaction impact of each risk. The table shows whether the risks on vertical side will have an impact on the risks on the horizontal. For example, the skill risk will influence the production and inventory risks, enhance and augment the overall impact by interfering with it.
In terms of skill risk, it can influence the production risk. As mentioned before, without enough skill capability and knowledge, HUAWEI cannot get the skill support to complete their new model products on time, which will obstruct their previous arrangement and the normal production process. Besides, if they cannot finish the production arranged before, on the one hand, this will lead to a long time out of stock in terms of their new model products. On the other hand, the other components they already prepared for the new model products will be piled up in the warehouse, which will increase the inventory cost.

As for quality risk, when HUAWEI received low-quality components from suppliers. Once they use those low-quality components continue their production, this will lead to low-quality production. Besides, even HUAWEI refuse to use those low-quality components, they choose to order high-quality components from other high reputation suppliers, and this will also cause some problems. Because HUAWEI needs more time to get those components, which will delay the inbound delivery time.

Regarding transportation risk, if the wrong selection of transportation method occurs, the transportation time will be affected. For example, if HUAWEI needs a batch of components urgently, but some mistakes about transportation mode selection occur, the inbound delivery time will be delayed and vice versa, early delivery is also possible. In addition, the natural environment factor (e.g., weather) can also lead to this kind of impact.

<table>
<thead>
<tr>
<th>Manufacturing risk</th>
<th>Logistics risk</th>
<th>Information risk</th>
<th>Inventory risk</th>
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<tbody>
<tr>
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<td>Quality risk</td>
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<td>Inbound delivery risk</td>
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<td>Lead time risk</td>
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Table 9: Supply side risks interaction map (own figure)
For inbound delivery risk, according to Anderson (2011), from the buyer’s’ perspective, the lack of on-time inbound delivery will affect the inventory holding and costs. If the delivery time is delayed, the inventory shortage may occur due to HUAWEI having not enough components to finish the products as they arranged before. Therefore, they do not have enough stock in their warehouse, which also can be considered as a production risk. Oppositely, if the delivery time is ahead of time, HUAWEI have to prepare more space to store these components, which may cause the bullwhip effect and the inventory cost also will increase.

Lead time risk influence the system of inbound delivery and inventory on HUAWEI. On the one hand, if the lead time that HUAWEI planned is short, then the inbound delivery time is limited for its suppliers. On the other hand, lead time directly can decide the level of inventory and inventory cost. The long lead time makes an overtop inventory level because the materials need to stay in the warehouse and to wait for assembling, however, the short lead time led to increase the volume of orders and increase the cost of the order.

Information transport risk affects the inbound delivery between suppliers and HUAWEI because of the delayed information transportation. When the order information changed and it cannot arrive at supplier side in time, then the inbound delivery time is longer than planned. The lead time is affected as well, incorrect information transportation causes the lead time be lengthened because the production time of suppliers’ need. Regarding supply side, HUAWEI has the first-hand demand information directly and if they don’t transport the information correctly to suppliers, the suppliers cannot coordinate synchronously with changes in the market. HUAWEI increases its inventory in order to avoid this kind of information risk (Shi, Channel manager, 04-05-2017), thereby the impact of this situation is that bullwhip effect appears in the whole channel. On the other hand, the illusion of product demand increasing makes the increase of raw material stock, these bring unnecessary occupation of funds on HUAWEI. Thus it can be seen that both channel’s information transportation and uncertainty will affect HUAWEI’s inventory.

Inventory risk affects lead time when HUAWEI is missing the necessary components. According to Chou (Logistics Manager, 14-04-2017), the specific components are difficult to research & develop and produce in HUAWEI, so the necessary specific
components are out of stock. It leads to the uncertainty of lead time, therefore, the lead time risk appears.

5.2.3 Prioritize risks

In this part, authors use risk classification model to prioritize risks. Authors make impact and probability as coordinates and divide three different levels to distinguish the degree of these two coordinates (High-Medium-Low). According to the previous analysis, authors considers the impact and probability of each risk and based on their characteristics and actual situations of the target company to prioritize these risks. Meanwhile, in the risk classification model, authors use two ways to show each risk (with/without change). Risks without change are production risk, skills risk, quality risk and information risk; with change are transportation risk, inbound delivery risk, lead time risk and inventory risk. A sketch of risks prioritizing is given below.

Figure 15: Risk classification (own figure)
Production risk and skills risk belong to the High-High interval because in this research, authors suggest production as the final step in the supply side, which mean production risk will cause a significant impact for HUAWEI, and as the figure shows. There are three risks that will lead to production risk if probability is high as well. Skills risk is one of the very important factors for production because for companies like HUAWEI, is the core competitiveness, therefore, lack of skills will not only cause HUAWEI not to produce ideal products but also has a devastating impact on them. Meanwhile, skills risk will also cause inventory risk because production without skills support will lead to raw materials becoming useless and cause inventory backlog. Therefore, based on the previous analysis, the authors think that skills risk frequently occurs in daily production and operation. Both of these risks belong to critical risk category.

Quality risk and inbound delivery risk are placed in Medium- High and Low-Low category. Quality risk depends mainly on suppliers, if suppliers and their goods cannot meet the requirements of HUAWEI, the production and delivery will be affected. Inventory risk is not very serious for HUAWEI because HUAWEI can hack that shortly when they realize that they have surplus inventory. Additionally, the probability of these two risks belong to medium, they are unusual. Information risk is part of the Low-High interval, it almost does not occur. Unfortunately, it will be a tremendous impact to the company if it happens.

Transportation risk and lead time risk are changed, the separate estimate for these two risks belongs to Low-Low and Low-High interval, and they almost do not occur. However, transportation risk will cause inbound delivery risk (delivery delay) and affect other operations (production, inventory). Lead time risk will cause inbound delivery risk and inventory risk (e.g. delivery delay, production delay and inventory backlog, etc.). Therefore, authors adjust the interval of these two to Low-Medium and Low-High interval respectively. For information risk, without good information system, HUAWEI cannot maintain real-time communication with suppliers, then inbound delivery risk and lead time risk can appear. Therefore, authors consider that information risk has a negative impact on HUAWEI. Fortunately, Shi (Channel manager, 04-05-2017) described that, according to the statistics, the information risk might occur only once almost every five years. Therefore, authors put information risk into Low- High interval. The last one is an inbound delivery risk, authors put this risk in the Low-Medium
interval at the beginning of the analysis, however, when the risk happen, it will affect production and inventory in order to cause bad impacts such as raw materials and production delay, inventory backlog, increased management costs and so on. Meanwhile, as figure shown, there are four risks that will cause the inbound delivery risk, even the probability of these risks are low, authors still need to consider the increased probability level of inbound delivery risk. Therefore, after synthesized deliberation of above, authors transform this risk into the Medium-High interval.

5.3 Risk mitigation (Research question 3)

How can supply side risks of HUAWEI supply chain be mitigated?

The mitigation methods for different level risks will be discussed in this part. The figure 16 shown that all risks have different level of probability and impact for HUAWEI. As described by Aqlan et al. (2015), HUAWEI can mitigate these risks by classification using the following approach: risk avoidance, risk reduction, risk transfer, risk acceptance, ignoring risk or risk exploit. Based on the two steps, authors will give some specific suggestions to mitigate the critical risks, including production risk and skill risk. In terms of the rest of risks, the methods of risk reduction, risk transfer and risk acceptance will be suggested, and authors only give some general suggestions for these low and medium level risks. The below figure shows an overview of the different mitigation methods according to different level risks.

Figure 16: Supply side risk mitigation method (own figure)
5.3.1 Risk avoidance

As the figure 16 shown that production risk and skill risk belong to high probability and high impact, which can be considered as critical risk. In addition, according to Aqlan et al. (2015), when the risk has high probability and high impact it should be avoided. Thus, the mitigation method of risk avoidance should be used for these two critical risks. The production risk is mainly caused by production mode and skill issues, the problem of production mode is already improved by HUAWEI, and they are changing from mass production into customization production. Therefore, as for now, the major cause of production risk is skill risk, if skill risk can be mitigated the production risk also can be relieved to some extent, thus, authors will give some suggestions aiming skill risk.

Enhance risk awareness
Many risks of supply side in HUAWEI' supply chain are not being paid of enough attention, such as the importance of skill risk. Skill is essential for an electronics company like HUAWEI. If this kind of risk can get enough attention timely, many negative impacts can be avoided (Handfield & McCormack, 2008). Therefore, a specialized department can be established in HUAWEI to estimate the skill risk before making a plan for a new product. In this way, HUAWEI can anticipate the risks they may encounter in the manufacturing process and be prepared to respond positively to the production process, reduce the risk of adverse influence on the normal production.

Evaluate production feasibility and strength staff training
According to Wu and Zhao (2007), a company has to evaluate the feasibility of production before it is manufacturing, one of the major considerations is skill ability. In terms of HUAWEI, one of the biggest risks is skill. The major cause of their skill risk is that they want to produce new hi-tech products constantly, but they do not have enough skill support. Thus, it is necessary for HUAWEI to make an evaluation of skill ability before they make a production plan. For example, HUAWEI wants apply the curved screen to their new model mobile phone. But after they produced most components required for this kind of phone they found that only a few mature suppliers can provide curved screen skill support. If HUAWEI can make a comprehensive evaluation before they put into production, a large number of losses can be avoided. Such as the evaluation of their R&D department and production equipment and the staff skill ability.
HUAWEI can assess these factors by survey feedback and process consultation to evaluate whether the current condition of HUAWEI can support their hi-tech production arrangements. In addition, the training of staff is extremely important. HUAWEI can increase the training of staff, not only in the internal strengthening of training but also can send staff to study and visit other companies abroad, strengthen communication with the same industry.

**Analyze external environment in detail**

According to Song et al. (2017), HUAWEI should analyze Chinese or other country’s operating environment in detail which means it should understand the national laws, regulations and policies that closely relevant with innovation. Meanwhile, the culture, ethnicity, religion and mass psychology are also necessary to research in HUAWEI for a better understanding of demand requirements.

Overall, no matter how the technology level and objects are, HUAWEI could choose two different modes to organize its technology innovation activities: use its own capacities to develop technology exclusively, or jointly develop technology with external production and research institutes.

Independent R&D and joint R&D have different requirement to HUAWEI’s conditions and different level of effort, of course the benefits are different also. Independent R&D requires HUAWEI has enough technical staffs and assets which can be used in the research. If it will be success, HUAWEI will use new technology to produce a product monopoly over a period of time, and use this kind of competitive advantage to gain the huge profit. If the research and development don’t produce the desired results, HUAWEI will bear the consequence alone. With joint R&D, HUAWEI and its partners can gather more resources for R&D and share all R&D risks during the period. However, if the new technology is successful developed, HUAWEI should share the result with its partners.

HUAWEI need to base the pros and cons to consider the best innovation mode which is perfect for HUAWEI’s conditions and strategy.
5.3.2 Risk reduction

The figure 16 shown that quality risk belongs to medium probability and high impact, lead time risk, delivery risk and information risk belong to low probability and high impact. According to Aqlan et al. (2015), when the risk has low or medium probability and the high impact it can be reduced rather than eliminating it, then the risk reduction can be used to mitigate that risk.

The major cause of quality risk and inbound delivery risk are the low reputation supplier. HUAWEI can evaluate its suppliers’ ability and delivery capacity especially its credit grade, and to do the performance measurement to suppliers in order to achieve the quantitative management in HUAWEI. Another cause of inbound delivery is the lack of delivery monitoring. To reduce that the supplier delivery process monitoring table can be used. HUAWEI buyer needs to check supply position which includes components’ type and quantity, an inspector need to check the inspection result which includes acceptance number and return number.

Lead time risk’s major cause is the wrong estimate with inventory, therefore, a suitable inventory management system is necessary in company. Authors suggest HUAWEI uses VMI (Vendor Managed Inventory), in that way HUAWEI’s replenishment system can be built on the basis of real sales market changes. The other two causes can be solved by mass customization. The customers will have the products of their want timely and with the required features. Mass customization can solve the issues arising from mass production and improper change management strategy. By adopting mass customization, the problems related to linear production system are also addressed because in mass customization, company has to make only customized products on priority basis, based on respective demand and build list/market data.

The main issue in information risk is that the communication channel between HUAWEI and suppliers is single, therefore to increase the information sharing level is the first step to reduce or eliminate the bullwhip effect. The second step is that HUAWEI need to develop its transportation of information flow by using the modern information technology.
5.3.3 Risk transfer

As presented in figure 16, the probability and impact level of the transportation risk are low and medium respectively. Aqlan et al. (2015) pointed out that when a risk has a low probability and high impact, the method of risk transfer can be applied appropriately to mitigate this kind of risk. As authors mentioned in risk assessment, the natural environment is one of the main causes of transportation risk, and the weather factors can affect it to a large extent. According to risk transfer strategy, risk can be transferred to another party (Aqlan et al., 2015), for HUAWEI they outsource transportation to third parties. HUAWEI can improve the detail of third party contracts and strengthen the monitoring of outsourcing procedures.

5.3.4 Risk acceptance

In figure 16, it shows the inventory risk belongs to medium probability and low impact. According to Aqlan et al. (2015), when the risk involves having low or medium probability and low impact, risk acceptance strategy can be adopted. Inventory risk Therefore, the inventory risk can be acceptance. On the one hand, the major cause of inventory risk is products’ lifecycle, it will increase the surplus inventory. But the surplus products are easy to deal with. On the other hand, as mentioned in risk interaction, the occurrence of inventory risk is influenced by skill risk, inbound delivery risk, lead time risk and information risk. Thus, if these risks can be solved, the occurrence probability of inventory will be decreased.
6. Conclusion

In this chapter, the research questions are answered in order to achieve the purpose of this study. Meanwhile, this chapter will also show the outcomes of the research as well as the suggestions and opinions for further research.

6.1 Answers to the research questions

**RQ 1 What kind of risks in the supply side of HUAWEI supply chain can be identified?**

In this case study, the four major risks identified for target company HUAWEI are manufacturing risk, logistics risk, information risk and inventory risk. For manufacturing risk and logistics risk, the authors transformed them into six sub-risks in order to analyze them in detail. Production risk, skill risk and quality risk belong to manufacturing; transportation risk, inbound delivery risk and lead time risk are part of logistics risk. Although these are sub-risks, but due to their strong impact on the case company, the authors still analyzed them in details as major risks. Therefore, in this thesis, there are actually eight risks that has been studied. Additionally, combined with real situations in HUAWEI to analyze these risks by interview, investigation, observation, theoretical framework and empirical data are gathered in order to ensure that the identified risks were subsistent.

**RQ 2 How can supply side risks of HUAWEI supply chain be assessed?**

When authors identified the risks, the next step is to assess them. Due to the reason that each risk has its own impact level and according to the feedback by interview and observation as well as empirical data, the authors synthetically considered the actual situations and severity of each risk, and then assessed the impacts of these risks. Additionally, the assessment considered not only impacts but also analyzed the probability and intractability of these risks.

The probability determined that what kinds of response measures will be used for different risks by HUAWEI, meanwhile, it also decided upon the impact levels of risks for the company to some extent. Therefore, grounded on previous assessment, the
authors divided these risks into different intervals from low to high.

However, in the process of assessment, the authors found out that there were some connections among the risks and the assessment process of these connections was complicated. Authors needed to reassess the variables of impacts and probabilities for each risk, on the base of previous assessment. Because, when some risks interact with each other, the impacts and probabilities might also be changed, for instance, when authors did not consider the connections factors, the inbound delivery risk belong to the Low-Medium interval (low probability with medium impact), however, after the combination with connections, its impacts have increased to a high level because it affects both production and inventory and causes severity to these risks. Meanwhile, there are four factors (quality, transportation, lead time and information) which will affect this risk, therefore, its probability has increased to medium level and the authors have adjusted it to the Medium-High interval.

Additionally, based on assessment research and a comprehensive consideration, the authors divided production and skill risk into critical risks, and then comparatively detailed mitigation suggestions were given in RQ 3. The authors have built theoretical framework, separately, for the critical risks and its mitigation mechanism related to HUAWEI’s current situation, and the severity of these risks in terms of HUAWEI’s analysis.

**RQ 3 How can supply side risks of HUAWEI supply chain be mitigated?**

In the thesis, the authors mainly pointed out four measures to mitigate supply side risks in HUAWEI’s supply chain which are risk avoidance, reduction, transfer and risk acceptance. However, although all the measures are important, there are also the primary and secondary points. The Risk Avoidance Strategy has been selected to respond to critical risks (production and skill risk). For this purpose, the authors suggested that HUAWEI could avoid these risks by enhancing risk awareness, evaluating production feasibility, strengthening staff training and analyzing the external environment in detail.

The risk reduction is also a necessary measure to undertake. The major cause of quality risk is the low reputation suppliers and therefore, HUAWEI has to develop and adjust
the requirement of their supplier evaluation strategy. At the same time, for the fear of inbound delivery risk, HUAWEI should make a reasonable supplier evaluation strategy while monitors delivery processes in real time. For lead time and information risk, the authors suggested that HUAWEI can use VMI system and mass customization mode to mitigate the former and reduce the latter by increasing the information sharing level based on the modern information technology.

HUAWEI could transfer transportation risk to the intermediaries by purchasing insurance policies and signing effective third party contracts in order to minimize the loss of risk when irreversible situations happened (e.g. unfavorable weather conditions). HUAWEI has not many serious problems about their inventory because their inventory risk was mainly caused by other risks (e.g. skill, inbound delivery, lead time and information), therefore, the strategy of risk acceptance has been suggested for this kind of risks.

In fact, these mitigations are not only for HUAWEI but also for other high-tech or semi-finished products processing companies, such as Apple and Samsung. In these types of large international companies, although their operations are very mature, there are still supply chain risks. Meanwhile, these mitigations also apply to small and medium enterprises, because these enterprises will likely have more possibility of risk. Therefore, these mitigations may help enterprises to seek better cooperation with their suppliers and reduce the possibility of supply chain risk.

6.2 Societal implications

An impeccable supply chain risk management could make upstream and downstream firms develop to a more efficient strategic alliance, the social competition moves from corporate competition to supply chain competition. Because the competition leads to improvement and advancement of organizations and management measures, the supply chain can be a company’s competitive advantage when the company mitigates its supply chain risks. After the supply chain is improved, companies the same industry could consider mutual cooperation as a sustainable development to share resources. This will lead to improving the industry development.
6.3 Own reflections

In terms of this study, at the beginning, authors might have not been fully aware of the complexity of the supply chain and just thought that inadequate coordination was the main causes of supply side risks for HUAWEI supply chain. But this is not true. According to interviews, detailed investigation and observations, the authors came to know that coordination is only part of the causes, not even major cause. There were many risks will lead to supply chain issues. Therefore, the authors shifted focus to these risks instead of focusing on coordination by the processes of identification, assessment and mitigation to the underlying issues.

Various research and data could help authors to achieve a more in-depth understanding of supply chain, especially for the supply side. As globalization expands, corporate cooperation is more demanding, and thus, the optimization of the supply chain is the goal of every company. According to this research, the authors hope that there can be some workable suggestions from this research to help HUAWEI and other companies in the same industry.

6.4 Further research and limitation

The authors conceived a new research direction for future research, that is, to study the application of the risk management decision-making framework which is on the basis of risk identification and risk assessment. The firms need to analyze the internal/external environment and condition in order to help enterprises to find out the best solution to mitigate the risk.

Due to the fact that this research is focused on the supply side, the authors relatively neglected to research the variety and complexity of demand side. Meanwhile, in this thesis, the research target is for HUAWEI only, which means that although supply side is the major research area, but the study is still not comprehensive enough for all the supply chain risks and their mitigation planning. Therefore, managers in the companies and further researchers should to transfer attentions into demand side and combine with related risks in other typical companies to analyze the impacts of demand side for the whole supply chain risks. It will cumulatively a better research direction for further
6.5 Critical review

In the end, the authors deemed it necessary to mention that there are uncertain external factors may affect the results of the research. The limited two months time was a critical issue to highlight all the factors, study organization and the industry in detail for making this study more accurate and effective. This has affected the research scope and depth to some extent. Moreover, the empirical data about supply side risks of HUAWEI supply chain are not perfect as it includes the managers’ opinions and the authors could not go in depth industry studies to be able to assess the manager’s knowledge and have a better hermeneutic review of the information provided. Another reasons is that there exist time equation due to the case company is in China. Besides, authors had limited access to the managers in HUAWEI. The effective data collection cannot be gained by limited access, or through a one time interview, which needed to be determined according to the time of the interviewees.

Alexandra Harney (9 December 2004). 'HUAWEI wins 3G contract from Telfort'. *Financial Times*.


Bushuev, M., (2013), *Supply Chain Delivery Performance: Points of View of a Supplier and a Buyer*.


XIII


Interviews

Chou, D., (03-04-2017), Logistics Manager: HUAWEI Headquarters Shenzhen Guangdong China, Interviewed regarding background in HUAWEI supply chain

Chou, D., (14-04-2017), Logistics Manager: HUAWEI Headquarters Shenzhen Guangdong China, Interviewed regarding general supply chain process of HUAWEI.


Shi, Y., (04-05-2017), Channel Manager: HUAWEI Headquarters Shenzhen Guangdong China, Interviewed regarding information system in HUAWEI supply side.
Appendix A - Interview guide for background of HUAWEI supply chain

Interviewee: Di Chou (Logistics Manager)
Date: 03-04-2017

1. Can you give a brief introduction about HUAWEI Company?

2. Can you briefly talk about the current operation model?

3. Can you give more details about operation of supply chain and primary focus on supply side?

4. Can you give a general overview of the logistics operation between the suppliers and manufacturer?

5. Do you think the current operation model for supply side of your company is good enough?

6. What kinds of risks exist in supply side of HUAWEI supply chain?

7. Do you think these risks have a greater impact on HUAWEI? And some measures should be taken to fix them?

8. Does HUAWEI have any plans to mitigate these risks?

9. If HUAWEI already has some measures, do you think whether these measures are available to cope with the risks?
Appendix B - Interview guide for risks relate to logistics and inventory perspectives of supply side in HUAWEI supply chain

Interviewee: Di Chou (Logistics Manager)
Date: 14-04-2017

1. How is the warehouse work?

2. Can you tell us the inventory amount of inventory recent years?

3. How much does HUAWEI cost on inventory?

4. What is the inventory structure? And what method do you take to manage the inventory?

5. How does HUAWEI classify the raw materials with different value? And how to manage the inventory of these different type raw materials?

6. How does HUAWEI cope with low-turnover materials?

7. Do you think there are any problems of inventory in HUAWEI? Do you think there is any influence for HUAWEI?

8. How long is the delivery time? How to reduce the delivery time?

9. Shipping method? (Time, average cost)

10. How do you arrange the transportation?

11. How to minimize the delivery cost but do not influence the delivery time (no delay)?

12. Do you have an efficient information sharing system?

13. Can you know the stock and demand information in the first time?

14. What do you think of your company's advantage over other companies of the same type? And what is the challenge?
15. What are the major guidelines HUAWEI follows to for procurement?

16. What are the major issues related to lead times HUAWEI?

17. Which processes takes the key lead times in HUAWEI supply side?

18. How does HUAWEI management take the inbound delivery and lead time risks?

19. What are the major delivery related risks in HUAWEI?

20. What are the key steps taken by HUAWEI to reduce lead times? Key issues still prevailing?

21. What are key the common aspects related to suppliers and manufacturing coordination related to delivery and aspects of the risky deliveries and delays?

22. Which part do you think can be improved in HUAWEI supply side?

23. Does these kind of risks occur frequently? Can you give some suggestions about mitigation from your view?
Appendix C - Interview guide for the risks relate to manufacturing perspectives of supply side in HUAWEI supply chain

Interviewee: Bo Li (Production Manager)
Date: 28-04-2017

1. How much does HUAWEI spend on technology research and development each year? Does HUAWEI have enough cost to support the R&D?

2. Compared to other electronic company, do you think HUAWEI has any advantages of technical skills?

3. In recent years, what is the achievement of HUAWEI in technology research and development field? Can you give a brief introduction about this?

4. Who is HUAWEI’s biggest competitor from your point of view?

5. What are HUAWEI’s strengths and weaknesses compared to its competitors?

6. What are the quality standards of HUAWEI?

7. How does your company control the quality issues?

8. How does HUAWEI choose its suppliers?

9. Do you have any measures to control the quality of the suppliers? Can they always provide high quality components for HUAWEI?

10. Do you think there is any need to improve the quality control?

11. What kind of production mode does HUAWEI use now? And how is going with this production mode?

12. Does HUAWEI try to change another production mode? Can you give a brief introduction about the new production mode?
13. Do all components produced by HUAWEI itself? If not, how does HUAWEI guarantee the components which supplied by suppliers can meet the requirements of HUAWEI?

14. How does HUAWEI make the producing and purchasing plan?

15. How does HUAWEI supervise all factors during production process?

16. How does HUAWEI keep the market sharing?

17. Does HUAWEI have any training system for employees? And what about the high-tech development system?

18. Does manufacturing risk happened often? Can you give some mitigation advices about this risk personally?
Appendix D - Interview guide for the risks relate to information system perspective of supply side in HUAWEI supply chain

Interviewee: Yuyong Shi (Channel Manager)
Date: 04-05-2017

1. Which department of HUAWEI communicate with their suppliers?

2. What is the structure of the department that communicate with suppliers?

3. How does HUAWEI communicate to its suppliers and when company order components from its suppliers?

4. How to transfer information among each department? Does HUAWEI has information department to control and transfer the information?

5. Do you see any risks on information system?

6. What information risk exist today?

7. What effects from information risks on HUAWEI currently?

8. Does information risk occurred constantly? Do you have some mitigation suggestions from your side?