

Understanding Perceived Risks in a Lean Company for Supply Chain Risk Mitigation in the Automotive Sector of China

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Abstract

China's automotive sector has been undergoing rapid growth over the past two decades with significant increase of volume, technology upgrade and complexity of market environment. As a result, tier one suppliers have found themselves operating in an environment of fierce competition, compressed product development and launch lead time, and sophisticated supply chain vulnerable to disruptions, which is especially true for the companies which have deployed lean manufacturing practices.

The researcher has worked with several foreign invested automotive tier ones in China over the past two decades and has witnessed many supply chain risks and disruptions while personally leading multiple risk mitigation campaigns. It has been brought to attention that the occurrence of supply chain disruption has registered an increase in the course of recent years. The purpose of this research is to explore perceptions of practitioners in this field and develop a set of guidelines for the mitigation of supply chain risks.

The research has been undertaken by applying social constructionist ontology, interpretivist epistemology, using inductive qualitative research methodology, to draw an understanding of key issues perceived by ten practitioners within a single study organisation. Thematic analysis was utilised to explore the research data drawn upon the semi structured interviews.

The research has identified three main themes that are perceived by participants to be antecedents of perceived risks and risk mitigation enablers, namely: perceived risks mainly arise from mis-alignment; resilience plays a vital role in supply chain risk mitigation; and transformational leadership style and organisation development are necessary for supply chain risk mitigation. Analysis has further suggested that both

resilience and leadership styles can be synergised, and their aggregated synergy will support supply chain in risk mitigation. A framework is developed to outline these relations. Consequently, a set of guidelines is developed to assist practitioners in building their own risk mitigation strategies in their specific business circumstances. In light of this research and the findings thereof, contributions are made to knowledge and practice, which is also deemed as novel in risk management of supply chain.

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Last but not least, to my father, a professor and highly renowned medical expert has always been a role model in the hearts of your children. Your passion on academic perfection greatly inspires me on my academic choices. And to my mother, your wisdom and strong encouragement is inspiring throughout my life.

Declaration

The copyright of this thesis belongs to the author under the terms of the United Kingdom Copyright Acts as qualified by Regulations issued by Edinburgh Napier University. Due acknowledgement must always be made of the use of any material contained in or derived from this thesis.

I declare that this Doctorate of Business Administration thesis is my own work and that all critical and other sources (literary and electronic) have been properly acknowledged, as and when they occur in the body of the text.

Signed

Yuliang HUI

June 2019

Table of Contents

Abstract	i
Acknowledgements	iii
Declaration	iv
List of Figures	xi
List of Tables	xii
List of Acronyms	xiii
CHAPTER ONE: INTRODUCTION	1
1.1) Chapter introduction.....	1
1.2) Aims and objectives of the research.....	2
1.3) Broad approach to the research study.....	3
1.4) Motivation for this study.....	3
1.5) Contributions to knowledge and practice.....	4
1.5.1) Contributions to knowledge.....	4
1.5.2) Contributions practice.....	5
1.6) Thesis structure.....	5
CHAPTER TWO: CONTEXT	9
2.1) Chapter introduction	9
2.2) History of automotive sector development in China.....	9
2.3) Latest development of passenger vehicles in China market.....	11
2.4) Government policies and challenges.....	13
2.4.1) Emission standard.....	14
2.4.2) Vehicle recall.....	14
2.4.3) High fatality rate.....	15
2.4.4) Go West.....	15

2.5)	Challenges & implications of this research.....	18
2.6)	Context of research organisation.....	20
2.7)	Identification of issues for analysis.....	21
2.8)	Chapter conclusion.....	22
CHAPTER THREE: LITERATURE REVIEW.....		23
3.1)	Chapter introduction	23
3.2)	Scope and selection of contributions in literature review.....	25
3.3)	Importance of evaluating supply chain crisis.....	27
3.4)	Complexity of analysing supply chain crisis	29
3.4.1)	Perceived risks.....	33
3.5)	Lean firms can be more vulnerable to risks	34
3.5.1)	Lean definition	34
3.5.2)	Lean evolution	36
3.5.3)	Risk exposure of lean firms.....	39
3.6)	Commonly adopted approaches to mitigate supply chain crisis.....	42
3.7)	Human aspects on risk mitigation.....	46
3.8)	Limitation of existing researches.....	49
3.9)	Benefits of a set of guidelines for supply chain risk mitigation.....	51
3.10)	Chapter conclusion.....	52
CHAPTER FOUR: RESEARCH METHODOLOGY.....		54
4.1)	Chapter introduction	54
4.2)	Selection of research design model.....	55
4.3)	Author’s ontological and epistemological stance – Interpretivism.....	56
4.3.1)	Ontology.....	57
4.3.2)	Epistemology.....	58
4.3.3)	Axiology.....	60

4.4)	How could interpretivist approach apply on operations management research.....	60
4.5)	Critical discussion on the research design and approaches.....	63
4.5.1)	Methodology.....	63
4.5.2)	Methods and techniques.....	64
4.5.3)	Generalisability, repeatability and reliability.....	65
4.6)	Limitations and alternative approaches.....	67
4.7)	Ethical consideration.....	68
4.8)	Data collection and analysis methods.....	69
4.8.1)	Data collection method 1: Documentary analysis.....	70
4.8.2)	Data collection method 2: Semi-structured interview.....	72
4.8.3)	Sampling process.....	75
4.8.4)	Trailing the data collection methods: a pilot study.....	78
4.8.5)	Interview questions.....	79
4.8.6)	Thematic analysis.....	80
4.8.7)	Data saturation.....	83
4.9)	Chapter conclusion.....	85
CHAPTER FIVE: ANALYSIS AND FINDINGS.....		86
5.1)	Chapter introduction	86
5.2)	Theme 1 – Perceived supply chain risks mainly arise from mis-alignment.....	87
5.2.1)	Quality mis-alignment.....	87
5.2.2)	Capacity mis-alignment	89
5.2.3)	Forecast mis-alignment	91
5.2.4)	Decision mis-alignment.....	91
5.2.5)	KPI mis-alignment.....	93
5.2.6)	Functional mis-alignment.....	95

5.3)	Theme 2 – Resilience is a vital part in risk mitigation.....	95
5.3.1)	Backup development.....	96
5.3.2)	Collaboration across supply chain.....	98
5.3.3)	Quick response.....	100
5.3.4)	Flexibility.....	101
5.3.5)	Communication.....	102
5.3.6)	Contingency.....	103
5.4)	Theme 3 – Develop organisation and transformational leadership style for supply chain risk mitigation.....	107
5.4.1)	Authorisation.....	107
5.4.2)	Risk taking	108
5.4.3)	Drive for perfection.....	108
5.4.4)	Priority setting	109
5.4.5)	Tension management.....	110
5.4.6)	Hands on.....	110
5.4.7)	People engagement.....	110
5.4.8)	Emotion management.....	111
5.4.9)	Assertive.....	112
5.4.10)	People development.....	113
5.5)	Chapter conclusion.....	117
CHAPTER SIX: DISCUSSION.....		119
6.1)	Chapter introduction.....	119
6.2)	Purpose of the research.....	119
6.3)	Perceived supply chain risks mainly arise from mis-alignment.....	120
6.4)	Resilience is a vital part in risk mitigation.....	125
6.5)	Transformational leadership style for supply chain risk mitigation.....	130

6.6)	Issues anticipated in literature review that did not emerge through primary research.....	136
6.6.1)	Perceived risks.....	136
6.6.2)	Risk mitigation methods.....	137
6.7)	Interaction of findings.....	139
6.8)	Recommended guidelines.....	143
6.8.1)	Recommended guideline 1: Ensure internal management system well connected and aligned.....	143
6.8.2)	Recommended guideline 2: Build and strengthen resilience capability within the company.....	145
6.8.3)	Recommended guideline 3: Develop transformational leadership capability with the company across all functions at all levels.....	146
6.9)	Research question discussion.....	146
6.9.1)	Discussion on research question 1.....	147
6.9.2)	Discussion on research question 2.....	148
6.9.3)	Discussion on research question 3.....	149
6.10)	Chapter conclusion.....	149
CHAPTER SEVEN: CONCLUSION AND RECOMMENATIONS.....		151
7.1)	Chapter introduction.....	151
7.2)	Research objectives: Conclusion.....	152
7.2.1)	Research objective 1.....	152
7.2.2)	Research objective 2.....	153
7.2.3)	Research objective 3.....	153
7.2.4)	Research objective 4.....	154
7.2.5)	Reflection on research objectives.....	154
7.3)	Research questions answered.....	154
7.4)	Contribution to knowledge.....	156

7.5)	Implications for practice.....	157
7.6)	Limitations of study/recommendations for future research.....	159
	7.6.1) Methodological recommendations.....	159
	7.6.2) Research focus recommendations.....	160
7.7)	Concluding remarks.....	161
	References.....	162
	Appendices.....	181
	APPENDIX ONE: Company ethical consent.....	181
	APPENDIX TWO: Semi structured interview questions.....	183
	APPENDIX THREE: Themes and sub-themes.....	185

List of figures

Figure 1: Overview of the thesis structure.....	6
Figure 2: McKinsey China auto market forecast.....	12
Figure 3: Major issues caused by fast growth of vehicle volume.....	14
Figure 4: New OEM footprint 2013 & future plan.....	16
Figure 5: Research design map.....	56
Figure 6: Research methodology design building blocks.....	57
Figure 7: Perceived supply chain risks and mitigation enablers.....	141

List of tables

Table 1: Supply chain risk categories.....	32
Table 2: Lean production.....	36
Table 3: The development of a contingent evolved lean approach.....	38
Table 4: Methodological stances associated with qualitative research.....	66
Table 5: List of documents analysed.....	71
Table 6: Participant list.....	77
Table 7: Pilot study participants list.....	78
Table 8: Perceived sources of supply chain risks.....	121
Table 9: Elements of resilience for supply chain risk mitigation.....	126
Table 10: Transformational leadership style for supply chain risk mitigation.....	133

List of Acronyms

AQSIQ	Administration of Quality Supervision, Inspection and Quarantine
CAAM	China Association of Automobile Manufacturers
CAGR	Compound Annual Growth Rate
CEO	Chief Executive Officer
C-NCAP	China-New Car Assessment Programme
ERM	Enterprise Risk Management
GDP	Gross Domestic Product
JIT	Just in Time
KPI	Key Performance Indicator
JV	Joint Venture
LED	Light Emitting Diode
OEE	Overall Equipment Effectiveness
OEM	Original Equipment Manufacturer
SC	Supply Chain
SCM	Supply Chain Management
SCRM	Supply Chain Risk Management
SMED	Single Minute Exchange of Dies
SUV	Sport Utility Vehicle
TPS	Toyota Production System
USSR	Union of Soviet Socialist Republics

CHAPTER ONE: INTRODUCTION

1.1) Chapter introduction

China's automotive sector has been undergoing a soaring growth since the year of 2000. It is reported that from 2003 to 2013, the compound annual growth rate (CAGR) enjoyed an increase of 21% (Liu, 2017) and China alone accounted for three quarters of the automotive market in 2016 (IHS, 2017). Joint ventures (JVs) between multinational corporations and large Chinese state-owned enterprises spurred China automotive industry boom. By the early 2000s, all major global giants had JVs with Chinese state-owned automakers to manufacture and sell vehicles in China. These JVs have had a major impact on production – importing advanced machinery, technology, and global standards. In the wake of the 2008 global economic crisis, China emerged as the primary profit generator for multinationals such as General Motors, Volkswagen, Nissan, etc. (Zhang, 2014). Following this trend, international automotive parts suppliers have also penetrated into China market by establishing either wholly-owned or JVs in China market to provide components for car manufacturers. As such, the automotive supply chain has been evolving in more complexity, involving not only local Chinese suppliers, but also suppliers from the USA, Europe, Japan and India.

In the past few years, supply chains have become more vulnerable to disruptions (Christopher, 2004; Craighead, 2007; Kleindorfer, 2005; Simangungsong, 2012). This is supported by findings coming from organisational scientists (Perrow, 1984), which indicate that accidents become inevitable or even normal in complex and tightly coupled technological systems. Given this theory, it is not surprising that lengthy and complex supply chains, working with faster speeds, have become more prone to disruptions. In recent years, there have been issues such as 9/11 and tsunami in Japan in 2010 which have brought significant turmoil to the automotive supply chain.

While certain supply chain risks can be prevented, others can be mitigated, thus supply chain operations can be restored quickly after a disruption. Some of the more common strategies for mitigating supply chain risks include managing vulnerabilities through agility (Lee, 2004), flexibility (Tang, 2008) and resilience (Sheffi, 2005). In addition to major disruptions, supply chains also face disruptions caused by several sources of inherent uncertainties such as demand fluctuations, supply capacity changes, lead time variability and exchange rate volatility (Fahimnia, 2015). While disruptions in the supply chain are a realistic possibility that companies must address, most supply chain models fail to capture them sufficiently (Schmitt, 2012). In the increasing challenging context and this gap, supply chain practitioners and business leaders are seeking a new perspective to understand the cause of supply chain risks and possible effective risk mitigation methods.

1.2) Aims and objective of the research

The aim of the research outlined in this thesis is to “explore practitioners’ perceived supply chain risks and risk mitigation strategies within China’s automotive context”. The research, therefore, seeks to explore perceptions of management in China’s automotive context to develop an understanding of their views on issues related to supply chain risks and associated risk mitigation methods and to consider if these could be affected by or considered to be partially affected by human behaviours. Based upon the findings of this research, contribution to knowledge and the implications on the practices of supply chain practitioners explored are outlined.

In China’s dynamic automotive context, four objectives guided the study and delivered the aim of the research:

1. Examining critically existing literature regarding supply chain risks and risk mitigation strategies.

2. Identifying key elements influencing organisations using lean strategies within automotive industry from management perspective.
3. Identifying key influencing factors in risk mitigation strategies used by lean organisations within the automotive industry.
4. Identifying the key influencing factors impacting the outcome of the risk mitigation strategies to enhance future development.

1.3) Broad approach to the research study

The aim of this study is to explore practitioners' perceived supply chain risks and risk mitigation strategies within China's automotive context through four objectives, which are outlined in section 1.2. The research methodology and methods chosen for the research (considered fully in Chapter Four) were selected as being supportive and appropriate to the stated research aim. A single organisation was chosen as the location for the study wherein ten semi-structured interviews were conducted. Drawing upon a social constructionist ontological position and interpretivist epistemology, the research has placed emphasis on the value of perceptions of participants from a wide range of roles and internal organisational context.

As a result of the research methodology, it is recognised that as the research was undertaken within a single organisational setting, the research herein would perhaps lend itself to further and broader studies at a later date, perhaps within multi-organisational settings.

1.4) Motivation for this study

The researcher has worked for several foreign invested automotive tier one companies in China for almost twenty years, and in the course of which has witnessed, in the first-hand fashion, increasing occurrence of supply chain disruptions caused by either externally-driven or internally-driven factors. The

increasing complexity and technology intensity of the products have made the automotive supply chain more sophisticated. Whilst all the companies that the researcher has worked with have deployed lean manufacturing concept, the supply chain has become more vulnerable to disruptions since all the nodes became extremely compressed.

As a witness to these disruptions, the researcher has gained exposure either formally or informally to several supply chain disruption incidents, and also led in person in corresponding risk mitigation efforts. It has been observed that even in some companies where there are modern supply chain management systems in place, no one had stood up to address the tense situation until it was brought to the attention of top management while losses had already occurred; there were other companies on the other hand that were able to have managers lead the mitigation efforts almost simultaneously when the risk occurred whilst the recovery was swift. For an executive who has long been diving deeply in several automotive tier ones in China market, one of the primary motivations of the study was to explore perceived risks within the organisation and how people have responded to such perceived risks within such an automotive context. Through developing this understanding, it is the researcher's goal to contribute to both theory and practice.

1.5) Contributions to knowledge and practice

By delivering against the identified aims and research objectives, contributions are made to both knowledge and practice in the China's automotive context, which are considered as follows:

1.5.1) Contributions to knowledge

Drawing upon the themes identified throughout the study, a contribution to knowledge is made through a deep dive into relevant elements of resilience and

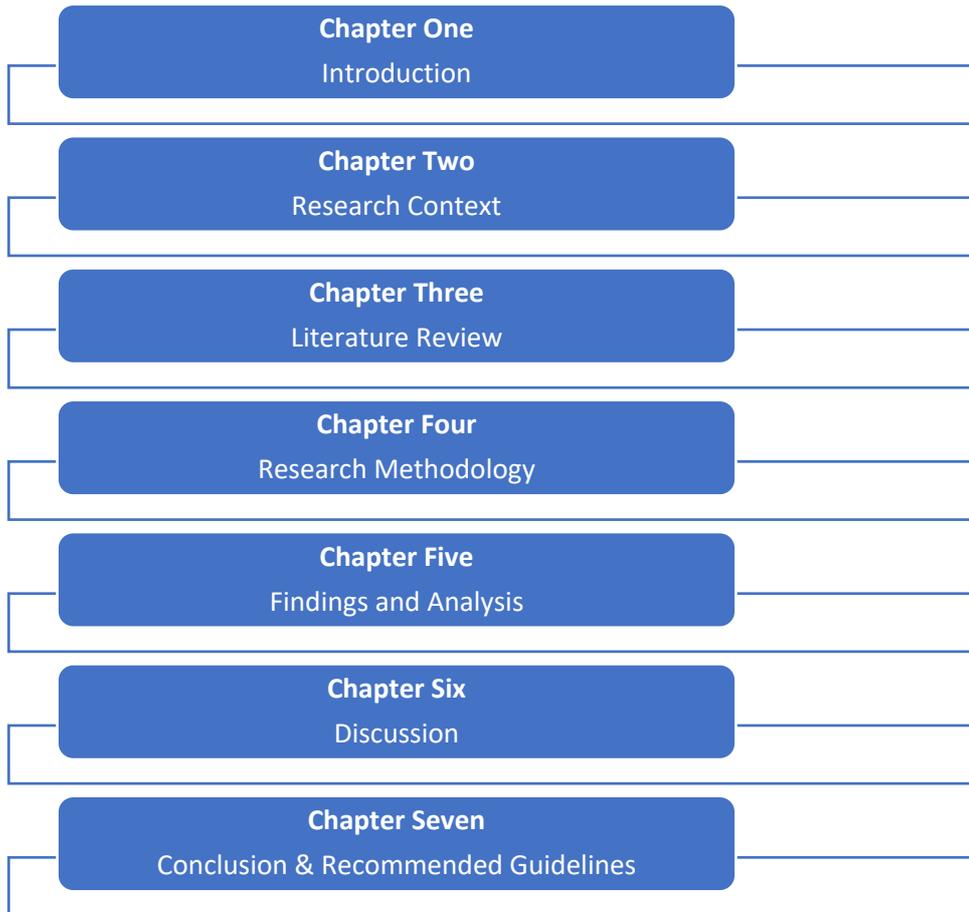
leadership styles and their relationship to perceived supply chain risks. The study has identified a number of antecedents of risk factors and mitigation methods as perceived by participants within China's automotive sector. It was further suggested that interactions may exist amongst some of the identified dimensions. The study of perceived supply chain risks and application of resilience and leadership styles for mitigation may be somewhat novel and therefore add a new light to research in this field. Furthermore, it has been established that the aggregated synergy of resilience and leadership styles together works towards mitigating supply chain risks.

1.5.2) Contributions to practice

The research contributes to practice through highlighting that aggregated synergy of leadership and resilience can support supply chain risk mitigation, whereby a set of guidelines are outlined. Firstly, it is suggested that internal alignment is essential starting from new project acquisition phase till final product delivery to customers. Secondly, companies shall cast more attention of developing and strengthening their resilience capability, especially focusing on quick response, flexibility, backups, collaboration and communication. Furthermore, guidelines on developing leadership styles associated with risk mitigations are outlined to support practitioners in formulating their risk mitigation strategies.

1.6) Thesis structure

This thesis is structured as outlined in Figure 1, in order to provide a logical and systematic presentation of the research that has been undertaken as planned, through to the conclusion and recommendations that may be drawn therefrom.



(Figure 1: Overview of the thesis structure)

Chapter One provides a short introduction to the topic of the research and states clearly the aim and objectives which the researcher has addressed. A broad overview for study approach and motivation is outlined. The contributions to knowledge and practice that may be made through the research are also highlighted.

Chapter Two provides a more detailed analysis of China automotive business environment context within which the research was undertaken. An overview of the research company in China's automotive context is presented, where issues and challenges arising therein are identified and considered critically.

Chapter Three presented literatures being reviewed in breadth and depth, whilst a critical reflection is presented upon the key literature relevant to the areas of the study. The chapter commences with an outline of the scope of research on supply chain risks and mitigation strategy with a particular focus on the antecedents thereof. A link amongst supply chain risks, lean, risk mitigation and human behaviour is reviewed, and the chapter is concluded with a summary of the gaps and issues arising from the review and key research questions raised for this study.

Chapter Four is aimed at critical examine and selection of appropriate research methodology to ensure the research aim and objectives are appropriately addressed. The philosophical research diagram informing the research is discussed, with reflection upon the ontological, epistemological and axiological position adopted by the researcher. The impact of these choices on determining the research methods is considered, with data collection and analysis methods outlined. Furthermore, considerations were given on generalisability and reliability of the study, whilst ethical issues pertaining to the research are also identified and addressed.

Chapter Five presents data collected and outlines key themes which emerged through data analysis. Following the presentation of the participants, the analysis and findings are presented clustering around three key themes.

Chapter Six is a natural flow based upon the key themes which emerged through thematic analysis. In-depth discussions are undertaken regarding themes which emerged and those anticipated through literature review but did not emerge. This chapter discusses the themes and interaction between previous research findings, as such the research questions identified through literature review are addressed and answered.

Chapter Seven presents the conclusion and recommended guidelines of the study, which is the final chapter. The research contributions to theory and practice are considered and a set of recommended guidelines is presented to help practitioners formulate their supply chain mitigation strategies. The limitations of the study are acknowledged, and future research areas are suggested.

CHAPTER TWO: CONTEXT

2.1) Chapter introduction

This chapter presents key information regarding the context within which the research was undertaken. An overview is provided on China's automotive sector, where China's history of automotive development, passenger vehicle development and government policy changes, and the implications thereof to the parts suppliers and supply chain management are considered. A brief outline is provided as of the organisation chosen as the study context before the chapter considers an identification of issues that warrant further exploration.

The aim of the DBA study is to explore practitioners' perceived supply chain risks and associated risk mitigation strategies to develop a set of guidelines for risk mitigation. In order to understand the research context, it is necessary to have a closer look into China's automotive industry, especially its recent development and key challenges.

Technology, quality, supply chain complexity and emerging risks are the main challenges identified that supply chain managers in China are encountering with.

2.2) History of automotive sector development in China

Until about 1975, there was virtually no passenger car production in China. Cars were the prerogative of a relatively small number of high-ranking officials, and most vehicle production comprised trucks, and to a lesser extent, motorcycles (Holweg, 2009).

Various research papers (Tang, 2012; Holweg, 2009) suggested that China's automotive history started from 1949 and can be fragmented into the following key phases:

- The central control and planning era (1949-1997)

In the early years of 1950s, China's main alliance was with the USSR, which provided assistance with many large projects during 1950 – 1960. One such project was the First Automobile Works (FAW).

As the relationship between China and the USSR worsened in the 1960s, China had to rely on its own resources for these developments. Consequently, all new automotive plants were designed, constructed and operated by personnel from existing auto plants. For example, personnel from FAW were involved in setting up the Second Automobile Works (Dongfeng). Ironically, Dongfeng became a competitor of FAW in the early 1980s, and now has JVs with Peugeot-Citroen, Nissan, Honda and Kia.

- The proliferation phase (1979 – 1994)

In 1978, China began to open up to the rest of the world, and as it did so the focus moved from political to economic issues. Most crucially, at this point the transition from a planned economy to the market economy began.

Existing facilities offered neither the quality nor the diversity of products to satisfy the growing market. The FAW and Dongfeng, controlled directly by the central government had the advantage of size but lacked flexibility. Small automotive factories began to develop under the direction of both provincial and municipal governments. Some machinery factories under the control of the ministries of the weapons industry and the aviation industry also began production of vehicles such as light trucks, mini vans and large passenger cars. The number of automobile factories increased from 55 in 1979 to 114 in 1985. (Holweg, 2009)

- The phase of concentration (1994 – 2004)

In 1994, the Chinese government designated a number of industries as ‘pillar industries’ intended to drive the national economy; the automotive industry was chosen as one of these industries.

- The most recent phase, since 2004

China joined WTO in 2002 and from this followed a number of steps to open up the market, including tariff reduction and elimination of local content requirements. The government continued to look to the automotive industry to drive growth throughout the entire economy, including a variety of basic and service-related sectors such as machinery, rubber, petrochemicals, electronics, textiles, auto financing, aftermarket distribution channels and automotive repair services.

The automotive boom started since China joining WTO. China took over the US in 2009 and became the largest single automotive market by volume (Thomson, 2009). An examination on China’s latest automotive market development will enable us to better understand the challenges and the impact on the research objectives.

2.3) Latest passenger vehicle market development

A McKinsey report (Wang, 2012) indicated that China’s automotive sector grew at a compound average rate of 24 per cent a year between 2005 and 2011. The report forecast the growth of China’s auto market will slow to an average of 8 per cent a year between 2011 and 2020 – still very fast by developed world standards. Sales are forecasted to reach 22 million vehicles in 2020, bigger than either the European or North American markets.

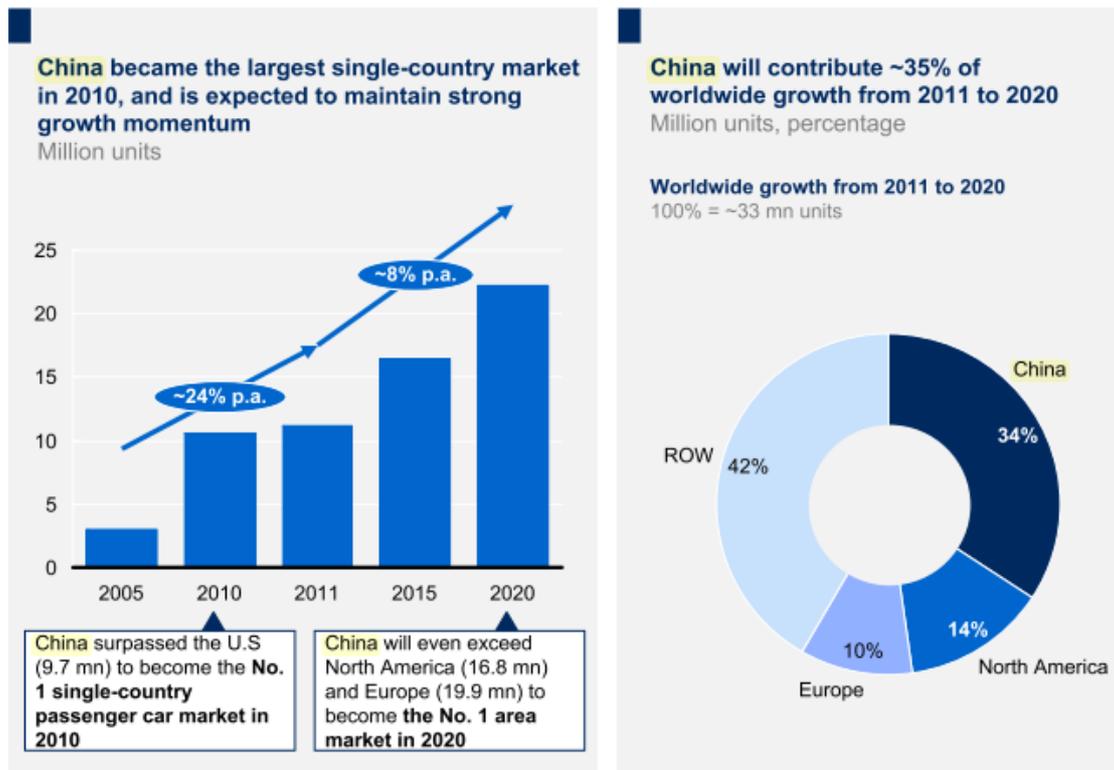


Figure 2: McKinsey China Auto Market Forecast (Wang, 2012)

A closer look into market review from China Association of Automobile Manufacturers (CAAM) re-confirmed the forecast made by PWC in 2012. China automotive market in 2013 can be summarised with the following main characteristics:

- 2013 full year GDP growth registered at 7.7% year over year, above the official target of 7.5%. The growth momentum is expected to be maintained onwards.
- Passenger vehicle production in 2013 reached 20.91 million with 15% growth over 2012, coupled with international OEMs with 21% growth and China OEMs with 8% growth. SUV still represents strong growth – 52% higher than 2012.
- International OEMs are still the major market players in China. Top 3 international players in China are VW, Ford and Hyundai; China's domestic

key players are Chang'an group, Shanghai General Motor, Wuling and Greatwall.

- Major car manufacturers are still located in east China, where economic development is well established; however there is the tendency to move car manufacturing to mid and west of China due to cost and government policy stimulations.

The rapid expansion of the Chinese automotive market not only was a boost to the national economy, but may also have led to a series of problems which the government are aiming to address in the next few years. (Tang, 2009)

The rapid increase in the number of vehicles on the road has already put China's road network and traffic system to test, causing severe traffic congestions and air pollution, especially in major cities such as Shanghai and Beijing. Parking has become another big headache for drivers in big cities. Since many residential communities were built before the boom in car ownership, parking spots are scarce. The construction of public parking lots as well as roadside parking spots has not kept up with the growth of cars on the road.

2.4) Government policies and challenges

Through the above discussion on the history of China's automotive market development, it can be found that government policy plays a significant role in the growth of automotive sector. The aforementioned fast automotive market growth in China has created problems and aroused government attentions mainly in the following areas:

Major Issues Caused by Fast Growth of Vehicle Volume

Policy maker focuses on resolution of these issues



Figure 3: Major Issues Caused by Fast Growth of Vehicle Volume (CAAM, 2014)

2.4.1) Emission standards

In February 2013, China's State Council called for nationwide desulfurization of gasoline and diesel fuel to a maximum sulphur content of 10PPM by the end of 2017 (Anon 2014). Over 2013, regulatory agencies in China translated the State Council's directive into formal regulatory language. Ultimately, three new standards were issued: China IV diesel (50PPM) in February 2013, China V diesel (10 PPM) in June 2013, and China V gasoline (10 PPM) in December 2013. Together these standards have laid out a roadmap for improving China's nationwide fuel quality to world-class. The improved fuel quality will reduce emissions from all motor vehicles while enabling advanced technologies to be deployed, yielding critical reductions in the air pollution impacts from China's vehicle fleet.

2.4.2) Vehicle recall

The Auto Recall Regulations 2012 (Zhao, 2013) overrode the *Provision of Recall of Defective Automotive Products (2004 Provisions)* which were jointly issued in 2004 by the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ), the National Development and Reform Commission, the Ministry of Commerce and the General Administration of Customs. Compared with the 2004 provisions, the *Auto Recall Regulations 2012* was promulgated at a higher level of legislation which reflects the clear aim of the Chinese government to reinforce the auto recall regime in China.

Now that the stricter new rules are in place, automotive OEMs will find themselves operating in a more regulated market. With China becoming the largest automotive market in the world, consumer protection, vehicle quality and safety are areas that the Chinese law further develops and improves.

2.4.3) High fatality rate

Traffic accidents are leading cause of death for people age 45 and younger in China (China Daily, 2011). The findings are important for China, where an increasing number of people are able to afford to buy cars, with many hitting the streets with little more than cursory training.

In order to reduce the road accidents, China is committed to improving safety regulations, tightening safety crash test, and strengthening penalties against the responsible party (State Administration of Work Safety, 2012). C-NCAP will be more concerned about the development of active safety technology.

2.4.4) Go West

that GM-SAIC-Wuling has created a new brand, Baojun, specifically for the lower tier market. The new brand has seen explosive growth and now enjoys an 8 percent share of its market segment. The Nissan/Dongfeng joint venture joined GM-SAIC-Wuling with the launch of its own budget brand, Venucia, to compete in the under \$10,000 price range. This diversification of in product line necessitates a parallel diversification in production lines.

- Logistics bottlenecks

China's expensive domestic logistics rates also harm the commercial viability of shipping cars inland from the coast. Operational and regulatory inefficiencies cause logistics expenses to constitute nearly 18% of China GDP, or more than double that in the European Union and United States (Pinsent Masons, 2013).

Wage hikes and worker shortages are also driving manufacturers of all sorts to move production inland. OEMs and parts manufacturers see opportunities to take advantage of labour supply and insulate themselves from high coastal production costs by moving inland.

- Government encouragement

Government policies and encouragement, both local and central, have played a significant role in the development of new inland manufacturing clusters. Hyper-competitive provinces and cities have long used incentives as a means of luring high visibility industries and companies. Doing so helps boost local GDP and jurisdictions' ability to hit ambitious targets. Perhaps most importantly, OEMs contributes significant income tax to local government coffers.

The central government's "Go West" policy also seems to be influencing OEM investment priorities. Volkswagen's investment in a \$225 million Urumqi factory stands out among other new production facilities as Xinjiang's population is too small to constitute a major market and logistics issue make shipping to the Chinese heartland sub optimal. While Volkswagen has not commented on this issue, their investment makes most sense when viewed in the context of government relations.

To summarise, the problems caused by fast growth also aroused Chinese government attention. The government recently issued policies aiming at introducing clean energy and reducing emission, improve safety and quality, and moving car manufacturers to the west China to further balance the environment and economic growth.

2.5) Challenges & implications of the research

China's automotive industry supply chain is very broad with many components such as import and export, manufacturing, environmental protection, technology upgrades and quality control (APCO Worldwide 2010).

China's fast automotive market growth and the recent government policies put the businesses operating in an ever-challenging environment. This can be reflected from the following aspects:

- Technology

The Blue Print for Industry Transformation and Upgrade 2011-2015 reiterates the central government's goal for automakers to consolidate operations and improve technology (<http://www.gov.cn/>).

The Chinese central government and all levels of local governments have been promoting production of alternative energy vehicles, such as pure electric and plug-in hybrid vehicles, since China became a major auto producer. They hope to adopt new technologies quickly, leapfrogging industrialised countries that are matured markets for mostly gasoline or diesel-fuel vehicles and become a major global player in this new field.

- Quality

In order to improve quality, automotive producers are required to adopt new technologies and take more selective criteria on supply base selection. This will involve upgrading existing suppliers' capability and/or introducing new suppliers from various regions depending on quality requirement.

- Supply Chain Complexity

The demand for higher technology, improved quality and migration of OEM assembly will convert into more components and their technology content. Introducing new technologies which is not available domestically will require more imports and hence extend the supply chain from existing east coastal area to west China. Consequently, it will then require advanced management on sourcing, planning, warehousing and transportation skills.

- Emerging Risks

China has always been prone to natural disasters, but a changing climate is causing more extreme weather (Reuters news, 2014). Data released by the National Statistics Bureau showed flooding and mudslides cost China 188 billion yuan in 2013, 20 billion more than in the previous year.

These risks will bring challenges to supply chain managers to operate in the demanding environment, including potential supply chain disruptions. Supply chain managers today need also to be change managers – not just managing change within the organisation but managing change in the way that relationships between organisations are structured. The trend towards the creation of the “virtual” organisation, whilst likely to help achieve agility (Goldman, 1995), also requires a high level of co-ordination and management.

2.6) Context of research organisation

In order to seek an understanding of the issues being researched, a single organisational context was identified for this study. It would be inappropriate to claim that the organisation chosen is entirely representative of China’s automotive sector, as the sector is heterogeneous in nature with a range of types, sizes, products and technologies. The chosen organisation should therefore be regarded as a singular China automotive context, the findings within which may be transferrable to other automotive contexts in China.

The study organisation chosen for this study is a leading European invested company in China producing high technology automotive lighting systems with products ranging from conventional halogen lighting, xenon lighting to full LED head lamps, rear lamps and fog lamps with almost all international OEMs as its major customers, including Volkswagen, Audi, Mercedes, Fiat Chrysler, Nissan, Honda, General Motor, Ford, etc. Following the OEMs’ new car model development, car lamps will have facelift every three to four years, and each facelift will introduce new technology content. From global perspective, this company is considered to be innovative, professional and with global reach. Due to the complex nature of the products, its parts and components are coming from suppliers worldwide.

Being a global company, its organisation setting is standard across each region. Within Asia, the headquarters is located in Shanghai, leading all key functions within Asia, including Sales & Marketing, R&D, Purchasing, Supply Chain, Finance, HR, Operation and IT. Main operational functions are located in each plant, including pre-production, assembly, industrial engineering, manufacturing engineering, quality, logistics, purchasing, finance and HR. Similar to most of international automotive suppliers, as a global best practice, lean manufacturing concept was also deployed in Asian manufacturing sites to eliminate waste and boost its efficiency.

2.7) Identification of issues for analysis

Having considered the challenges and opportunities for the sector identified in this analysis of China automotive context, the following paragraphs summarise key issues that may merit further analysis through this study. The issues identified herein provide important context for the literature review in Chapter Three, which considers key literature pertinent to the academic focus of the research.

The external environment is dynamic, challenging and contains a wide range of uncertainties which make it difficult for managers to plan with certainty for the future. In the meantime, most of its employees working in China are new hires coming from automotive background but with slightly differed experience. The expectations from customers vary no matter in terms of technology, quality, product development time frame and supply chain policies. In this context, how do supply chain managers ensure supply chain continuity under demanding business environment, especially when risks of supply chain disruptions occur? It has been reported the organisation also deployed lean concept in its manufacturing process, which squeezes every possible nodes to improve efficiency; meanwhile, its supply chain is more vulnerable to unexpected risks. With such challenges, it will be

interesting to have clarity on supply chain practitioners' perceptions of encountered supply chain risks. How do supply chain managers deem as important approaches to mitigate supply chain risks? What are the mitigation strategies which were not studied by previous researches?

2.8) Chapter conclusion

China automotive sector started booming since 2004 and in 2009 China took over United States and became the largest single market in the world (Thomson, 2009). The very fast development also created obvious issues, such as congestions, pollutions and high traffic accidents.

Chinese government issued new policies aiming at reducing emissions; improving car quality and safety; and encouraging car manufacturers to move to west China to balance the economic growth. Following this trend, many car manufacturers made the plan to establish manufacturing footprints in west China, as shown in Figure 4.

The company context for research undertaken is introduced. Following the fast pace of automotive market growth in China, the supply chain managers find themselves facing the challenges from technology, quality, supply chain complexity and emerging risks. Supply chain will be much longer, complex and vulnerable to crisis. A further study aiming at understanding perceived supply chain risk and mitigation strategies to develop a set of guidelines will be carried out and reported in the following chapters.

CHAPTER THREE: LITERATURE REVIEW

3.1) Chapter introduction

Supply chain uncertainty is an issue with which every practising manager wrestles, deriving from the increasing complexity of global supply networks (Simangunsong, 2012). In 2002, Christopher indicated that supply chain management was experiencing increasing exposure to risks. Shortly thereafter, Blackhurst (2005) confirmed that firms were being confronted by increasing supply chain risks and Zsidisin (2005) underscored the dramatic consequences of negative events on companies. Market globalisation, reduced product lifecycles, complex international networks of industrial partners, unpredictable demand, uncertain supply, cost pressures, the necessity to be lean and agile, increasing use of outsourcing and off-shoring, and reliance on suppliers make up some of the elements contributing to these difficult and ongoing situations. Natural disasters are one of disruptions to supply chains. They usually result in widespread damage to several firms and facilities at the same time. This has a severe impact on an industry and significant time is often required for recovery from natural disasters (Kuroda, 2015). Laframboise (2012) suggested the occurrence of disasters has increased in frequency across the globe over the past 50 years. Estimates of economic and financial losses from natural disasters have also risen.

It was argued by researchers (Kuroda, 2015) that some widely adopted supply chain management strategies also increase the risks of problems in situations of supply chain crisis. Examples include the “just-in-time” practice and lean supply chain management, which require more frequent deliveries of suppliers, minimising the non-value-added time and inventory. These efficiency maximisation models in business increase the level of interdependence between firms and correspondingly raise the chances of a supply chain disruption. Also the compression of

non-value-added time in inventory transfer and storage may remove the essential risk buffer between the production nodes and deepen the negative impact when various hazards occur in the global supply chain. For example, when a disaster hits a supplier or a distribution link and disrupts the supply chain, the focal firm that adopts “just-in-time” practices will suddenly encounter production suspension due to supply shortages and the negative effect will transmit quickly to the downstream supply chain.

Apparently, practitioners often encounter the challenge of maintaining lean during supply chain crisis. This is the paradox in many manufacturing organisations today especially due to the increasing occurrence of supply chain disruptions.

This section identifies and discusses key research issues in relation to supply chain risk mitigation in lean firms. The aim is to demonstrate that a gap exists in existing researches which are mainly focusing on mathematical methods but very limited on human behaviours (Nienhaus, 2006, Wee, 2009, Ellis, 2010, Tokar, 2010, Kulas, 2013, Sakar, 2015, Sax, 2015, and Asgari, 2016). It is original and significant as it is human who utilise tools/models for risk mitigation; but how humans behave was not deeply looked into. A set of recommended guidelines to maintain supply chain continuity during supply chain crisis in China automotive sector will bridge the gap.

This section is structured to demonstrate this gap by considering the following research issues:

- **Scope and selection of contributions in literature review** – Stating that the research is bounded within the supply chain management literature with main focus on leanness and supply chain disruption management and prevention.
- **Importance of evaluating supply chain crisis** – Discussing the importance of evaluating perceived supply chain crisis as an important way of improving

supply chain resilience.

- **Complexity of analysing supply chain crisis** – Demonstrating that supply chain crisis is extremely complex and can be varied, and course of actions are different.
- **Understanding lean theory (Lean firm characteristics and challenges)** – Demonstrating that lean theory has been widely applied in business today, whilst supply chain practitioners find it difficult to manage supply chain disruptions to well balance both risk mitigation and leanness. This suggests a gap of research exists.
- **Commonly adopted approaches to cope with supply chain crisis** – Assessing most frequent applied approaches and their impact to business performances.
- **Contemporary research on human elements on risk mitigation** – Assessing latest research on human behaviour's impact on risk mitigation, latest research trends, achievements, limitation and areas under researched.
- **Benefits of a set of guidelines for maintaining supply continuity during supply chain crisis** – Showing that a methodology would benefit to supply chain practitioners and business performances.

3.2) Scope and selection of contributions in literature review

“A literature review is a systematic, explicit, and reproducible design for identifying, evaluating, and interpreting the existing body of recorded documents” (Seuring, 2008). For literature review it is particularly important to define clear boundaries to delimitate the research (Seuring, 2008). In this context, the following important notes are made:

- This analysis is aimed at only papers in peer-reviewed scientific journals in English with a management focus. This excludes papers in other languages or non-peer reviewed papers.

- Publications on supply chain management for public sectors are not considered, as the research company is situated in private sector of China's automotive industry.
- Specific focus is given to literatures regarding leanness and supply chain disruption risk mitigation and human behaviours, especially on leadership styles. However, main researches were focused on mathematical approaches, but very few on assessing human behaviours, such as impact of culture and leadership.
- The majority literatures are mainly from supply chain management, lean best practices, risk mitigation and operations management and leadership.

The search for related publications was mainly conducted as a structured keyword search from major databases following a first quick content check, identifying which articles were included in and which were excluded from the analysis. Pre-defined key words which were used to scan the articles include: *disruption, risk mitigation, leanness, China automotive, resilience, agility, perception, human behaviour, leadership and decision making.*

In the evaluation stage, descriptive dimensions were used to classify the papers. The content of the papers was further assessed by means of a descriptive analysis:

- How is the description of publications across the time period?
- In which journals are such articles published?
- What research methodologies are applied?
- What are the main risks researched and discussed?
- What are the risk mitigation strategies?
- What are the human elements considered in risk mitigation?

For these classifications, each paper was assigned to one category. The selection of these categories is rather straightforward, as such descriptions are “normal” for literature reviews.

Having said that, it does not mean the literature review process goes without limitations. The structured process and systematic approach ensure the objectivity of the research process. Validity was aimed for by following the guidelines. But given the time-consuming process, it is somehow unrealistic to include more than this.

3.3) Importance of evaluating supply chain crisis

Uncertainty (generally termed “risk”) constitutes an inevitable part of supply chain management. Industrial companies depend on a range of up-stream resources that lie outside their control (Davarzani, 2011).

In a business environment characterised by high complexity and uncertainty, manufacturing companies are forced to manage their supply chains effectively in order to increase efficiency and reactivity (Thun, 2011). Recent years, catastrophes such as 9/11, Japan earthquake in 2010 and Thailand flood in 2012 have raised attention to this issue. There are also daily problems such as supplier losses or quality problems make supply chain risk management important (Thun, 2011). It aims at mitigating the negative impact of external disturbances and tries to manage certain risks within supply chains. It is also true for the automotive industry with a demanding requirement to improve its supply chain performance.

Kern (2012) argues that popular initiatives like outsourcing, reduction of inventories, just-in-time concepts, and increasing inter-firm cooperation created much leaner supply chains. In a world without supply chain risks, such initiatives lead to the most

cost-effective operation models with economic benefits for the entire supply chain. However leanness can also lead to more fragile supply chains (Kleindorfer, 2005).

The cost of supply chain disruption to a company can be of significance. Disruptions at any point in the supply chain have the potential to cause the entire network to fail. Riddalls (2002) noted that disruptions can be costly in supply chain systems and can cause a variety of problems such as long lead-times, stock-outs, inability to meet customer demand and increase in costs. Recent researches such as Tse (2018) started to evaluate quality risks along the supply chain and its devastating effects on overall business performance. When major disruptions occur, many supply chains tend to break down and take a long time to recover.

Gurnani (2012) stated that the effects of supply chain disruption are mainly in the following three folds:

- Shareholder value

Gurnani (2012) concluded that supply chain disruptions are viewed very negatively by the market. Supply chain disruptions result in significant short-term and long-term shareholder value losses. Thirty-three to forty per cent stock price underperformance over 3 years is both economically and statistically significant. Chen (2018) investigated how changes of supply chain risks affect firm financial performance. Firms that experience disruptions do not recover quickly from the stock price underperformance. Disruptions have a long-term devastating effect on shareholder value.

- Share price volatility

Supply chain disruptions can create uncertainty about a firm's future prospects and can raise concerns about its management capability as disruptions indicate management inability to manage and control crucial

business processes. Disruptions may also lead to questions and concerns about a firm's business strategy. Disruptions could therefore increase the overall risk of the firm.

Gurnani (2012) studied the share price volatility before and after the disruption announcement date. The result indicated that after adjusting for other factors that could affect share price volatility there is still a significant increase in volatility that can be attributed to the disruption. Much of this increase happens after the disruption announcement. Furthermore, the share price volatility remains at this high level for at least the next year or two. Overall, disruptions increase the risk of the firm.

- Profitability

Gurnani (2012) further studied the long-term effects of disruptions on operating income, sales growth, cost growth as well as changes in the level of assets and inventories. The results indicate that supply chain disruptions have a devastating effect on profitability. The proportion of firms experiencing negative performance indicates that disruptions are bad news across the board.

In most cases, supply chain crisis brings severe negative impact to firm's financial performance. Those impact were mainly reflected on firm's shareholder value, share price volatility and profitability. It is more than necessary to deep assess supply chain crisis and identify necessary mitigation strategies with minimum impact to business performance.

3.4) Complexity of analysing supply chain crisis

Today's marketplace is characterised by intense competitive pressures as well as high levels of turbulence and uncertainty. Outsourcing and globalisation have created longer and more complex supply chains, which are more vulnerable to business disruptions.

Supply chain risks are anything that may disrupt or impede the information, material or product flows from original suppliers to the delivery of the final product to the ultimate end users (Peck, 2006). Based on the generic risk concept, supply chain risks also combine the two risk dimensions: the likelihood/probability of a loss with the impact/effect of that loss for the company or supply chain (Manuj, 2008).

Today there is no generally agreed definition of supply chain risk management (Ponomarov, 2009). Norrman (2004) suggested that supply chain risk management involves the collaborative application of risk management process tools for the purpose of dealing with uncertainties related to logistics activities. The definition introduces some important aspects, such as collaboration, a process based view and the importance of logistics elements into the domain of supply chain risk management. A more widely accepted definition was proposed by Juttner (2003). According to this definition, supply chain risk management is defined as "the identification of potential sources of risk and implementation of appropriate strategies through a coordinated approach among supply chain members, to reduce supply chain vulnerability".

Christopher (2004) classified supply chain risk into five categories:

- Process risks
- Control risks
- Demand risks
- Supply risks; and

- Environmental risks

The first two risk categories relate to factors internal to an organisation, the third and fourth relate to factors internal to the supply chain, but external to the organisation and the fifth category relates to factors external to the supply chain.

Olson (2010) divided supply chain risks into categories of internal (involving such issues as capacity variations, regulations, information delays, and organisational factors) and external (market prices, actions of competitors, manufacturing yield and costs, supplier quality, and political issues). Kleindorfer (2005) categorised these into risks arising from coordinating complex systems of supply and demand (internal), and disruptions (external). Specific supply chain risks considered by various studies as summarised by Olson (2010) in Table 1.

Table 1 Supply chain risk categories

Category	Risk	A	B	C	D	E	F
<i>External</i>							
Nature	Natural disaster: flood, earthquake	X	X		X		X
	Plant fire				X		
Political system	Diseases, epidemics		X				X
	War, terrorism	X			X		X
	Labor disputes	X	X		X		X
Competitor and market	Customs and regulations	X	X	X	X		X
	Price fluctuation			X			
	Economic downturn		X				
	Exchange rate risk	X			X		
	Consumer demand volatility		X	X		X	
	Customer payment	X					
	New technology		X	X			
	Changes in competitive advantage			X			
	Obsolescence	X			X		
	Substitution alternatives				X		
<i>Internal</i>							
Available capacity	Capacity cost	X	X				
	Financial capacity/insurance		X	X			
	Ability to increase production	X		X	X		
	Structural capacity		X	X	X		
	Supplier bankruptcy				X		
Internal operation	Forecast inaccuracy	X	X		X		
	Safety (worker accidents)		X				X
	Bullwhip effect	X		X			
	Agility/flexibility		X	X	X		
	Holding cost/order fulfillment tradeoff	X			X		
	On-time delivery		X		X		
Information system	Quality		X		X		
	IS breakdown	X					
	Distorted information				X		X
	Integration	X			X		X
	Viruses/bugs/hackers		X		X		X

A – Chopra and Sodhi (2004); B – Wu et al. (2006); C – Cucchiella and Gastaldi (2006); D – Blackhurst et al. (2008); E – Manuj and Mentzer (2008); F – Wagner and Bode (2008)

No matter how supply chain risks are categorised, it suggests that supply chain risks are embedded in many supply chain processes. Actually Christopher (2007) argued that supply chain disruptions are unavoidable and as a consequence, that all supply chains are inherently risky. The decision by a firm to pursue (i) supply base reduction

increases node criticality; (ii) global sourcing increases complexity, and (iii) sourcing from supply clusters increases density, which, in turn, elevates the firm's exposure to severe supply chain disruptions.

3.4.1) Perceived Risks

It has to be underlined that the supply chain risks as outlined above came from positivistic researches based on calculation. Renn (1998) investigated risk perceptions and argued that both a constructivist and the realist perspective on risk perceptions are amiss as risks are always mental representations of threats that are capable of claiming real losses. He claims that risk is a social construction rather than a representation of real hazards and argues that public perceptions of risk may be misguided by sensational press coverage and intuitive biases.

Caldwell (2013) argued that perceived seriousness of risks does not match expert-calculated risks and people tend to over-estimate highly publicised, large-scale technological risks and underestimate routine risks with low catastrophic potentials. Heckmann (2017) concluded that Heuristic forms of thinking guided supply chain practitioners and scientists to oversimplifications and mis-interpretations of the effects of risk. Understanding perceptions of risk is essential because appraisals of risk are subjective and actions regarding risks are based on perceptions (Yates, 1992b). Therefore, the perceptual measures of supply risk developed within this paper may serve as the basis for future research that simultaneously examines the environmental factors that drive supply risk, the behavioural factors that affect managers' perceptions of supply risk, and the multiple tactics that may be used to mitigate supply risk (Yates, 1992b).

Several researches underlined the significance of studying risk perceptions strongly linked with the choice of behaviours. March (1987) argued that managers do not

view risk as prescribed by classical decision theory; instead, behavioural research suggests that perceptual rather than objective assessments of risk guide decision-making. Mitchell (1999) asserts that “it is not objective risk which motivates behaviour, but the people’s impressions of it”. Even when objective data is available to support decision-making, issues related to interpretation may interject bias into the risk assessment process (Yates, 1994). As such, the view that perception of risk instead of objective measures is the key measure of managers’ choices and behaviours. Unfortunately, this is still an area that lack sufficient attention and has not been thoroughly studied.

3.5) Lean firms can be more vulnerable to risks

In recent years, lean has become widely applied across industries and sectors. Lean is rooted in the early work of Frederick W. Taylor’s *The Principles of Scientific Management* (Taylor, 1991; Spear, 1999; Emiliani, 2011) in which time and motion studies of specific work processes were used to find the most optimal way of optimising production. Science lean was introduced in 1998 (Krafcik, 1998) and popularised by the book *The Machine that Changed the World* by Womack (1990), which is based on cases from and reflections on the practice of Toyota (Schonberger, 2007), and subsequently many lean projects have also been implemented in industry.

3.5.1) Lean definition

There are many interpretations of lean that range from a focus on waste elimination, utilising operational tools and implementing specific production-related principles, to identifying conditions that are linked to the product and/or service and predictability of demand and stability. Arlbjørn (2013) noted that the lean concept springs from studies of the Japanese car industry (particularly Toyota). The practice deduced from Toyota’s production techniques is named in literature the “Toyota

Production System” (TPS). A central element in TPS is just-in-time (JIT) wherein specific production activities are initiated by a need further along in the chain (typically a warehouse that is to be stocked). Parry (2010) summarised below five “lean principles”:

- Specify value – Value can only be defined by the ultimate customer. It is specified in terms of satisfying customers’ needs by providing products and/or services with desired capabilities at a competitive price and lead time.
- Identify the value stream – The set of all the actions required to bring a product through problem-solving, information management, and physical transformation tasks. Here, value refers to the nature of activity being carried out. The value stream is the set of actions that transform a product or service.
- Make the value flow – By reducing cycle times and batch sizes to the absolute minimum, ensuring each operation is visible, defined, and has a visible status to eliminate possible stoppages in the production process.
- Let the customer pull – Processes or products are to be produced and delivered on-demand from the customers.
- Pursue perfection – Even if the other four lean principles are followed, if the mindset for pursuing perfection has not been developed across the enterprise, any improvement will only deliver a one-off benefit.

Karlsson (1996) enumerated the following building blocks of leanness – elimination of waste, continuous improvement, multifunctional teams, zero defects/JIT, vertical information systems, decentralise responsibilities/integrated functions, pull versus push (Table 2).

Table 2 – Lean production (Karlsson and Ahlstrom 1996)

Lean development	+	Lean procurement	+	Lean manufacturing	+	Lean distribution	=	Lean enterprise
		Supplier involvement		Elimination of waste		Lean buffers		Global
Cross-functional teams		Supplier hierarchies		Continuous improvement		Customer involvement		Network
Simultaneous engineering		Larger subsystems from fewer suppliers		Multifunctional teams		Aggressive marketing		Knowledge structures
Integration instead of Co-ordination		Zero defects/JIT						
Strategic management				Vertical Information Systems				
Black box engineering				Decentralized Responsibilities/ integrated functions				
				Pull instead of push				

A growing number of firms have adopted lean processes to promote continuous supply chain performance improvement (Mollenkopf, 2010). Konecka (2010) argued that supply chain management change and evolve mainly under the pressure of the competition. Generally, the existing activities of supply chain management aim at the cost reduction by using instruments for their leanness (lean management concept) or at higher service level by higher flexibility.

3.5.2) Lean evolution

Lean as a concept has evolved over time, and it will continue to do so. As a result of this development, significant confusion about what is lean, and what is not has arisen (Hines, 2004). Therefore it is important to make some key definitions so as to avoid ambiguity in the further discussion. Naylor (1999) defines that agility means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile market place; whilst leanness means developing a value stream to

eliminate all waste, including time and to ensure a level of schedule. Hines (2004) summarised four stages of lean concept development, as follows:

- Cells and assembly line – Turning firstly to the evolution from prescription to contingency, the awareness and quality stages of lean involves the highly prescriptive application of a set of tools and methods. These tools are well documented to include kanban, 5S (housekeeping), “single minute exchange of dies”(SMED – changeover time reduction) and cellular manufacturing.
- Shop-floor – At this stage, organisations are governed by a set of core values and management practices that are designed to clarify, communicate and reinforce the company’s culture. In this case, the lean quality stage has firms imbibed in a prescriptive best practice lean approach that is largely cantered on the manufacturing area.
- Value stream – Businesses started to re-position lean thinking as based on a set of five key principles that it was claimed could be applied across a wide range of industrial setting. Some firms tend to assume that improvements should be based solely on improvements in quality, cost and delivery in the belief that in improving these areas it will create customer value. According to Hines (2004), this works well in some parts of matured industries, such as the automotive supplier sector.
- Value system – Value system stage of lean thinking involves a much greater degree of contingency, as it moves past the rhetoric of customer value to include approaches to the active capture of customer needs. In addition, this is linked to the active use of contingent strategy deployment using policy deployment. The application of policy deployment takes into account the various contingent factors impinging on an organisation such as their size, industrial sector, industrial dynamics and technology employed. As such, using this fourth lean value system stage, a unique contingent approach is created using a range of tools drawn from diverse management approaches

such as the earlier lean manufacturing, six sigma, marketing, agile manufacturing, system dynamics, theory of constraints, and revenue management.

Phases	1980-1990 Awareness	1990-mid 1990 Quality	Mid 1990-2000 Quality, cost and delivery	2000+Value system
Literature Theme	Dissemination of Shop-floor practices	Best practice movement, Benchmarking leading to emulation	Value stream thinking, lean enterprise, collaboration in the supply chain	Capability at system level
Focus	JIT techniques, cost	Cost, training and promotion, TQM, process reengineering	Cost, process-based to support flow	Value and cost, tactical to strategic, integrated to supply chain
Key business process	Manufacturing Shop-floor only	Manufacturing and materials Management	Order fulfilment	Integrated processes, such order fulfillment and new product development
Industry sector	Automotive – vehicle assembly	Automotive – vehicle and Component assembly	Manufacturing in general – often focused on repetitive manufacturing	High and low volume manufacturing, extension into service sectors
Shingo (1981, 1988)	Shingo (1981, 1988) Schonberger(1982,1986) Monden (1983) Ohno (1988) Mather (1988)	Womack <i>et al.</i> (1990) Hammer (1990) Stalk and Hout (1990) Harrison (1992) Andersen Consulting(1993,1994)	Lamming (1993) MacBeth and Ferguson (1994) Womack and Jones (1994,1996) Rother and Shook (1998)	Bateman (2000) Hines and Taylor (2000) Holweg and Pil (2001) Abbas <i>et al.</i> (2001) Hines <i>et al.</i> (2002)

Table 3 – The development of a contingent evolved lean approach, (Hines 2004)

Lean is one of the most influential new paradigms in manufacturing, and has expanded beyond the original application on the shop floor of vehicle manufacturers and component suppliers in the auto industry, ranging from “heavy” industries to aerospace businesses (Hines, 2004). In particular, when applied to sectors outside the high-volume repetitive manufacturing environment, lean production has reached its limitation, and range of other approaches to counter variability, volatility and variety have been suggested. Here, the very often quoted lean-agile debate is applicable, discussing whether an agile or a lean strategy, or even a hybrid approach is most suitable (Naylor, 1999; Christopher, 2001).

Hoek (2001) argued that companies within the supply chain should work together to achieve a level of agility beyond the reach of the individual company. Companies as wide as raw material suppliers, manufacturers and retailers may need to be involved in the process of achieving an agile supply chain.

Goldman, (1995) defined four basic dimensions of agility:

- Enriching the customer;
- Cooperating to enhance competitiveness;
- Organising to master change and uncertainty;
- Leveraging the impact of people and information.

Christopher (2000) argued that as turbulent and volatile markets are becoming the norm as life cycles shorten and global economic and competitive forces create additional uncertainty. The risk attached to lengthy and slow-moving logistics “pipelines” has become unsustainable, forcing organisations to look again how their supply chains are structured and managed. It was concluded by Christopher (2000) that the key to survival in these changed conditions is through “agility”, in particular by the creation of responsive supply chains.

3.5.3) Risk exposure of lean firms

Manufacturing performance is related to a combination of practices. Several performance measures can be used efficiently. The most typical measures are rejects, scrap, labour and machine productivity, quality, inventory levels and turnover, unit manufacturing cost, manufacturing cycle time, delivery speed and reliability (Demeter, 2011).

Of all these measures, we can emphasise inventory turnover as a visible and concrete marketer of world-class performance and also as an indicator of efforts. Higher inventory turnover means that the company has to invest less capital in raw materials, work-in-process or finished goods. Certainly, reducing the amount of working capital frees up loans or makes additional investments possible. One of the fundamental goals of lean manufacturing is to eliminate excessive inventories as a form of waste. Other sources of waste also affect the level and turnover of

inventories. Overproduction, for example, means that the company produces more products than expected, which results in high inventories of finished goods that spend a long time in the warehouse or might never be sold. Faulty products can result in useless materials, waiting for processing leads to more work-in-process, and unnecessary transportation between working stations or plants also increase inventory. Thus, it seems obvious that eliminating wastes can result in higher inventory turnover, or in other words, a shorter time spent in the form of inventories.

Despite that both lean and agile are popular supply chain management philosophy, it cannot avoid criticism (Arlbjørn, 2013). The lean evolution is largely driven because of the shortcomings of lean that surfaced as organisations progressed on their learning curve, as well as the extension of lean thinking into new sectors with different settings and constraints. Hines (2004) argues that key aspects of this criticism are the lack of contingency and ability to cope with variability, the lack of consideration of human aspects, and the narrow operational focus on the shop-floor. Hines (2004) listed the main criticism as below:

- Lack of contingency – There is still a general misunderstanding of the contingent nature required to apply lean thinking. What is needed in the auto industry is an aligned supply that provides strategic value to the customer, by building cars to customer order (Holweg, 2001).
- Human aspects – Lean production system could be viewed through a Marxist lens as being exploitative and high pressure to the shop floor workers.
- Scope and lack of strategic perspective – Hines (2004) argues that almost complete lack of discussion of strategic level thinking in lean programmes as opposed to discussions of how to apply a series of different tools and techniques until quite recently. Earlier references to such strategic thinking are either consigned to isolated academic papers (such as Tennant, 2001) or

Japanese texts (such as Akao, 1991), neither of which reached a mainstream lean readership.

- Coping with variability – Another focal point of the criticism was the ability of lean production systems and supply chains to cope with variability, a key aspect of the lean approach. Indeed, in order to add value to the customer the lean approach seeks to find ways to manage variability and to create capacity by utilising assets more effectively than in traditional system. In the case of demand variability, these approaches have sought to flatten or control demand, as the original lean pioneers came from fairly stable demand industrial environments , such as supply chains of automotive sector (at least downstream of the assembler). This high-volume and repetitive demand character suits the application of kanban pull-scheduling. However, such kanban-style solutions can be inflexible and thus have attracted criticism.

It has been argued by many authors (Kleindorfer, 2005) that extreme leanness and efficiency may result in increasing the level of vulnerability, at both the individual firm level and across the supply chain. Very often lean firms strive for extreme optimum level of inventory, which is considered to increase risk for supply disruptions. Companies whose supply processes are affected by disruptions may experience delays in transportation and dysfunction in some of their facilities, which may result in inventory shortages. Gurnani (2012) suggested that the optimal management of inventory systems subject to supply disruptions. Hendricks (2005) warned that at a point in time when management strives to make supply chains as lean as possible, such disruptions may have serious impacts on company performance. This is especially true as automotive companies have widely adopted lean manufacturing system initiated by Toyota (Arlbjørn, 2013).

3.6) Commonly adopted approaches to mitigate supply chain crisis

Supply chain risks and disruptions are so costly and no doubt there have been many researches recently on supply chain risk mitigation. The majority of supply chain disruption research has concentrated primarily on countermeasures to mitigate the negative impact of supply chain disruptions (Marley, 2014). Such countermeasures include improving demand forecast accuracy, reducing the lead time between disruptions occurring and being discovered, and integrating planning and execution activities (Hendricks, 2003). In addition, other research has focused on the importance of developing and implementing a supply chain risk management program to manage risk (Christopher, 2011).

Fahimnia (2015) studied the main supply risk mitigation strategies, and it was interesting to find (1) A frequency analysis showed that quantitative, analytical and formal modelling of SCRM research output is growing rapidly especially since 2001; (2) Most formal modelling SCRM research is conducted by researchers at universities located in the United States and Asia (China, Hong Kong, India, Iran, Singapore, Taiwan); (3) Most quantitative SCRM research articles are published in three major journals, including International Journal of Production Economics, European Journal of Operational Research, and International Journal of Production Research; (4) Formal modelling SCRM research can be classified into eight different categories/streams from which we recognise “supply uncertainty” as a matured area, perhaps getting saturated, and “sustainability risk” as an emerging area; and (5) Generative research topics and areas show what additional possibilities exist for cross-fertilization of concepts, tools and theories for both mature and emergent areas of formal SCRM modelling research.

In order to understand contemporary supply chain risk mitigation methods, a review of literature suggested that most of mitigation research are focusing on quantitative

methods, such as Kern (2012), Azad (2014), MacKenzie (2014), Ho (2015), Mizgier (2015), Fahimnia (2015) etc. who are invariably suggesting a model to be applied for supply chain risk mitigation. Their researches are mainly focusing on assessing the relationship amongst demand, supply, inventory and dollar value which are quantifiable variables. Previous research has also looked at the ability of the company to recover from or adjust easily to supply chain disruptions. Researchers use the word resilience to characterise the ability of firms to react and quickly respond to supply chain disruptions. Christopher (2004) defined resilience as “the ability of a system to return to its original state or move to a new, more desirable state after being distributed”. In the most recent years, lean practices were also considered as a risk mitigation tool. Aqlan (2014), Mohammaddust (2017) argued that lean manufacturing techniques can be used to assess supply chain risks and failure mode and effect analysis is then utilised to identify the best mitigation strategies taking into consideration risk reduction, mitigation cost, ease of implementation, and possibility of success.

Sodhi (2012) noted that risk mitigation entails efforts to reduce the impact of risk incidents in case such incidents do occur. Broad risk mitigation strategies in this category are:

- Alignment of supply chain partners’ incentives to reduce the behavioural risks within the supply chain

Besides long-term partnership, there are other mechanisms to coordinate the interests of the different supply chain partners. Sodhi (2012) suggested to utilise different supply contracts to coordinate supply chain so that all parties will act in the interest of the entire supply chain when dealing with demand risks including wholesale price contracts, buyback contracts, and revenue sharing contracts.

- Flexibility to reduce not only demand risks but also supply and process risks

As summarised by Sodhi (2012) that there are at least five different types of flexibility strategies corresponding to multiple suppliers, flexible supply contracts, flexible manufacturing process, postponement and responsive pricing. The ability to shift order quantities across suppliers can be a powerful mechanism for the manufacturer to hedge against supply risks. Under flexibility supply contracts, the manufacturer is allowed to adjust the order quantities within a pre-specified range, say, a few percent of the order quantity. It was then argued by Sreedevi (2017) that while several industry practitioners underscore the importance of having flexible supply chain processes to cater to changing market requirements, many fail to invest in establishing a flexible supply chain. Two main reasons for this could be that flexibility is costly and it is difficult to see the immediate benefits of having such a capability.

- Building “buffers” or redundancies.

Building reserves for redundancy is useful for reducing the impact caused by disruptions and delays that can cause the affected organisation problems ranging from a minor to serious. A simple delay along the chain may create a temporary impact, whereas a sole supplier holding up a manufacturer to force a price increase represents a long-term risk. A machine breakdown may have a relatively minor impact for manufacturing companies with redundant capacity, whereas a war that disrupts shipping lanes can have a dramatic impact on a shipping company. Most companies develop plans to protect against the normal risks that are recurrent and low-impact in the supply chain; however, few companies develop plans to handle disruptions.

It is then crucial that managers identify the likelihood that disturbances will occur and then take the appropriate measures of response to each disturbance by developing mitigation plans/strategies or contingency plans/strategies, so as to limit the negative effects. The strategies can serve to reduce the likelihood that such a disturbance will occur or to reduce the negative effect of the disturbance. The adoption strategies suitable for the management supply chain disturbance will give the supply chain the ability to quickly return to its original state, or even a better state, and thereby demonstrate resilience (Barroso, 2010).

The concept of resilience is multidimensional and multidisciplinary (Ponomarov, 2009). On the one hand, resilience was a subject of scientific research for many years in such disciplines and developmental psychology and ecosystems. On the other hand, it is a subject of interest in relatively new emerging disciplines such as risk management and supply chain management. Ponomarov (2009) argued that even in well-developed disciplines, the existing definitions of resilience are often contradictory and confusing, and the unified theory of resilience is needed to have an operational definition of the phenomenon of resilience as well as an understanding of the key elements and capabilities that characterize it.

Christopher (2011) critiqued resilience on its limitations which are mainly 2 folds:

- Firstly, resilience invariably causes additional cost, in the form of slack resources (e.g. inventory and capacity), as well as higher coordination cost (e.g. due to multiple sourcing). While conceptually sensible, under stable conditions, this will place any firm at a competitive disadvantage: if the supply chain is stable, the resources spent on creating that resilience are wasted.
- Second, what we are talking about the uncertainties that arise from all sorts of areas, some of which can be controlled, some others cannot. These are not isolated incidents (such as 9/11 or an earthquake), but fundamental shifts in

many key variables that determine our business environment.

Although it was argued by, such as, Marley (2013), Aqlan (2014) and Mohammaddust (2017) that lean manufacturing techniques can be used to assess supply chain risks and failure mode and effect analysis is then utilised to identify the best mitigation strategies taking into consideration risk reduction, mitigation cost, ease of implementation, and possibility of success. These approaches unavoidably associated with increasing inventories to mitigate risks. Gurnani (2012) and Namdar (2018) noted that the optimal management of inventory systems subject to supply disruptions may require an increase in inventory levels beyond those that would be required in a disruption free environment. This extra inventory incurs extra holding costs, and therefore it may not be desirable to managers, especially since disruptions are often considered rare events. On the other hand, the increase in cost from proactively stocking extra inventory is often dwarfed by the cost that would result from a disruption that strikes an unprotected system. Therefore, there is a trade-off between the cost resulting from disruptions and the cost resulting from the protection. Where a firm falls on this trade-off – i.e., whether it is beneficial for the firm to stock a lot of extra inventory or only a little to protect against disruptions – depends in large part on the “profile” of the disruptions. It has been shown that inventory is a more attractive disruption mitigation strategy if disruption tend to be frequent but short, while other strategies (such as supply redundancy) are more useful if disruptions tend to be rare but long.

3.7) Human aspects on risk mitigation

Leadership and organisational innovativeness have only received a modest amount of attention in supply chain research. For instance, Williams (2002) found that virtually no papers highlight the importance of effective supply chain leadership. Although a recent stream of supply chain leadership research provides the

conceptual framework to understand this still under-researched area (Defee, 2009), there remains a dearth of empirical research on leadership in the supply chain domain. Additionally, there is a recognised lack of empirical research regarding logistics innovation and the outcomes thereof (Grawe, 2009; Hazen, 2012). Most recently, Wang (2016) analysed case data in relation to the three characteristics of informality defined from the literature of organisation structure, communication method and leadership approach. The outcome of this analysis is a conceptualisation of informality using four dimensions relevant to the context of implementation of ERP in manufacturing companies.

Despite rare research and literature available on human aspects for supply chain risk management, a deep search on literature still can be discovered even though not applying an inductive research method. This is suggesting that supply chain risk management research have more elements to be considered and studied.

Van der Vorst (2002) suggested human behaviour is one of the supply chain uncertainties apart from supply chain configuration, infrastructure and facilities, order forecast horizon and information system. This already suggested needs to study human aspect. Nienhaus (2006) whilst studied bullwhip effect, criticised that extensive research has focused on identifying causes of the effect and on providing measures for reducing its impact, the role that human behaviour plays in the bullwhip effect is still overlooked. Likewise, Wee (2009) stressed importance in applying human approach in achieving sustainable lean supply chain management.

In the most recent decade, several researchers attempted to explore perception, decision-making and leadership in relation to supply chain risks. Ellis (2010) concluded that both the probability and the magnitude of supply disruption are important to buyers' overall perceptions of supply disruption risk. It was also found

that product and market situational factors impact perceptions of risk, but they are best understood through their impact on perceptions of probability and magnitude. Finally, it was found that decisions are based on assessments of overall risk.

Wang (2010) extended the knowledge of physical supply chain to knowledge supply networks by integrating a risk perspective, during which it was observed that experts in group decision-making processes do not give exact numbers to express their judgment but can only vaguely establish opinions and this is considered to be a risk factor. Tokar (2010) argued that previous research has focused on understanding the role and impact of different structures, systems and processes within the supply chain. As a result, the impact of the culture of the different organisations within the chain, the relationships and trust between them, and where power resides within a chain are not fully understood. Kulas (2013) experimentally investigated how risk attitudes mitigate leadership effectiveness in a collective setting with projects that exhibit both free riding and coordination problems. It was argued that the mere mention of risk attitude (whether risky or risk averse) undermines leadership effectiveness in mitigating free riding for the 420 experimental participants. Sarkar (2015) studied human behaviour and concluded that supply chain managers are unwilling to share risk information due to fear of damaging firm goodwill and reputation. It was suggested to build resilient supply chains by real-time sharing of disruption information. It was however a research based on deductive approach where limited view from supplier practitioners were gathered and considered. Sax (2015) brought this further and argued that not only do both enterprise risk management (ERM) and participative leadership style enhance risk performance but a positive interaction effect is also found. In addition, the findings suggest that a safe environment precede participative leadership style indicating this as a prerequisite for management to introduce participative leadership style. These findings underpin that an effective risk management system should include both a holistic, formalised

ERM system and organisational initiatives that enhance a strategic responsiveness through employee involvement. Asgari (2016) argued that the first important issue is how organisations should manage security, insourcing, sustainability, competition, risk/disruption and human behavioural issues within their supply chains. In addition, it is necessary to understand the particular practices, challenges and opportunities within newer applications of SCM such as healthcare, disaster and humanitarian and small and medium enterprises industries.

It has to be underlined that these researches revealed a subtle shift of supply chain risk management from pure mathematical reductionist research to understanding human perceptions, leadership, decision making and their relationship with risk management. This could be triggered by increasing occurrence of crisis in the recent two decades, whilst the explanation from traditional research can hardly address all those issues and a supply chain risk management need to look deeper and wider into human elements in relation to risk management.

3.8) Limitation of existing researches

As afore discussed, the major supply chain risk mitigation researches are mainly focusing on mathematical method while numerous models were developed. This finding was also endorsed by Tang (2011), who reviewed 112 risk mitigation articles which are all based on quantitative research. Ho (2015) concluded that most researches still piloted us to identify and classify the potential risk associated with different flows, namely material, cash and information flows. Asgari (2016) researched supply chain management from 1982 till 2015, and found that previous supply chain management literature reviews and surveys tend to look at just one aspect of SCM (such as information sharing, inventory management, network design, or SC integration) and a narrow range of academic journals. As a result, some topics

and industries have not been explored even though they become more relevant as different business environments, practices and challenges emerge.

Asgari (2016) also concluded that the following two aspects were under-researched to date:

- Risk and disruption management – Over the past decade, improvement in computational facilities and optimization techniques have enabled SC managers to deal with SC risk and disruptions via more sophisticated quantitative tools such as stochastic programming and robust optimizations. However, there is still a lot to do in this field as there are many new problems introduced due to considering new issues in SCM such as disasters, global SC, sustainability and competition.
- Human behaviour -- Previous research has focused on understanding the role and impact of different structures, systems and processes within an SC. As a result, the impact of the culture of the different organisations within the chain, the relationships and trust between them, and where power resides within a chain are not fully understood (Tokar, 2010). For example, it would be useful to better understand the factors that influence how supply chain managers think, make decisions and negotiate with other organisations in the chain (Carter, 2007). Although some research has started to be published in the last few years, this is still an area that requires further exploration.

In that regard, it is necessary for us to re-think despite numerous mathematical models in place, what are the missing areas for businesses to put in place in order to cope with supply chain risks. The literature assessed has provided mitigation strategies, however those strategies were invariably associated with increasing stock

and capacity, and these does not bring competitive advantage to the business especially it was considered that supply chain risks are rare and hard to predict.

3.9) Benefits of a set of guidelines for supply chain risk mitigation

The development of a set of guidelines with consideration of human elements for supply chain risk mitigation has significant benefit to both practitioners and researchers. The main benefits include but not limited to the following areas:

- Understanding human perceptions, behaviours and actions for risk mitigation – Former researches were mainly focusing on mathematical models with a reductionist approach, which did not put human elements into consideration. It has to be underlined that human beings are the key risk management agents, who decide and lead mitigation. With increasing occurrence of supply chain crisis, the conventional approach such as the traditional “buffer stock” approach (Gurnani, 2012) may subject to question. This research provides a new angle of research for supply chain disruption mitigation strategies.
- A new angle for supply chain practitioners – With interpretation of human perception, behaviour and actions for risk mitigation, it will enable practitioners to understand a broader spectrum of risk mitigation elements than mere mathematical approaches. This will allow businesses to operate with less hassle and improved supply chain performance.
- Flexibility – A set of guidelines are not as rigid as a model which offers both future researchers and practitioner to make choices and adapt to their specific needs under different crisis circumstances.

Given the justification of the relevance, originality and significance for the research, the major research questions are listed below:

- *What are participants perceived supply chain risks in China automotive sector?*

- *What do participants perceive to be the common and effective supply chain risk mitigation methods?*
- *What do participants perceive that human behaviours can influence supply chain risk mitigation?*

3.10) Chapter conclusion

Supply chain risks and disruptions are getting more frequent than before, no matter from business internal or external. Businesses spend huge efforts to mitigate supply chain disruptions, however this still brought damages to businesses on their financial standing, images and stock market performance.

This chapter mainly discusses the research issues on disruption mitigation methods especially for lean firms. Although leanness were very often considered as a main driver for supply chain disruption (Gurnani, 2012), it was widely applied by automotive companies. Lean approach seeks to find ways to manage variability and to create capacity by utilising assets more effectively than in traditional system and this will continue. In the case of demand variability, these approaches have sought to flatten or control demand, as the original lean pioneers came from fairly stable demand industrial environments, such as automotive sector supply chains (at least downstream of the assembler). This high-volume and repetitive demand character suits the application of kanban pull-scheduling. However, such kanban-style solutions can be inflexible and thus have attracted criticism. It was also argued that lean firm tend to lack of contingency, bring high pressure to staff and lack of strategic perspective (Hines, 2004).

Supply chain risk mitigation strategies are reviewed. It is especially necessary to mention that previous research on supply chain disruptions were mainly focusing on

building supply chain flexibility, agility and resiliency whilst numerous mathematical or computer aided tools/models were introduced.

It must be noted that all these approaches will eventually be utilised by human beings; however, this big portion of risk mitigation agents in lean firms are left under-researched. Some attempts were made recently (Nienhaus, 2006, Wee, 2009, Ellis, 2010, Tokar, 2010, Kulas, 2013, Sakar, 2015, Sax, 2015, Asgari, 2016), where either most considerations were given to regression analysis on companies located in the West, or unable to deep dive into single organisation. Such researches gave valuable suggestions on migrating focus to human elements, however the applicability in China's automotive companies are unknown. This was considered to be the main research gap and three research questions are naturally surfaced. A set of guidelines will eventually be developed as original contributions to academic and practitioners for lean firm risk mitigation.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.1) Chapter introduction

The Purpose of the study is to assess perceived risks within a China's tier one automotive company and develop a set of guidelines for perceived supply chain risk mitigation. This fits the needs for supply chain practitioners to assist their business operations.

Identifying the philosophical paradigm adopted for any research is of vital importance to the shaping of this study. Easterby-Smith (2008) highlighted that failure to think through philosophical issues can affect significantly the quality of research. A critical assessment on ontological and epistemological stance will underpin the research efforts.

Main efforts of this chapter will be on critiques of various philosophical choices and to argue the most appropriate option for this research. The philosophical paradigm adopted for the study may be seen to define "the basic belief system or world view that guides the investigation, not only in choice of method but in ontologically and epistemologically fundamental ways" (Guba, 1994). It has also been argued there is no single philosophical paradigm considered 'correct' or 'better' for any particular study, as this will depend on the research questions seeking to be answered (Saunders, 2012). Crotty (2006) reports that researchers can struggle to keep ontology and epistemology apart conceptually due to the confluence between the two notions. Whilst acknowledging this perceived difficulty, the following section attempts to do so.

It is expected the appropriate chosen research philosophy will lead to a credible methodology and research results with regard to the expected research outcome –

to develop a set of guidelines for supply chain risk mitigation in the context of China's automotive sector.

4.2) Selection of research design model

There are a number of research design models chosen by researchers. One of the most difficult things about understanding research design is that scholars have disagreements on the research stages. Disagreement was very clear between Crotty (1998) and Saunders (1997). Saunders (1997) classified research into six stages and labelled the model which presented them as 'the research onion'. Saunders (1997) divided the research to include: philosophies; approaches; strategies; choices; time horizons; techniques and procedures. On the other hand, Crotty (1998) narrowed them down to be: epistemology; theoretical perspective; methodology; methods.

There are large overlaps among management research methods therefore; choosing a research method or a mix of methods should really depend on favouring the most advantageous one and justifying the reasons why (Yin, 2003).

The Beech (2005) research design map as shown in Figure 5 can be considered as a robust basis for the researcher's design adapted to the relevant inquiry. Generally, the choice of a research paradigm and methodology brings along the methods suitable within that paradigm and epistemology as summarised in Figure 6. This can guide the choice processes that the researcher should go thorough for a credible and valid research.

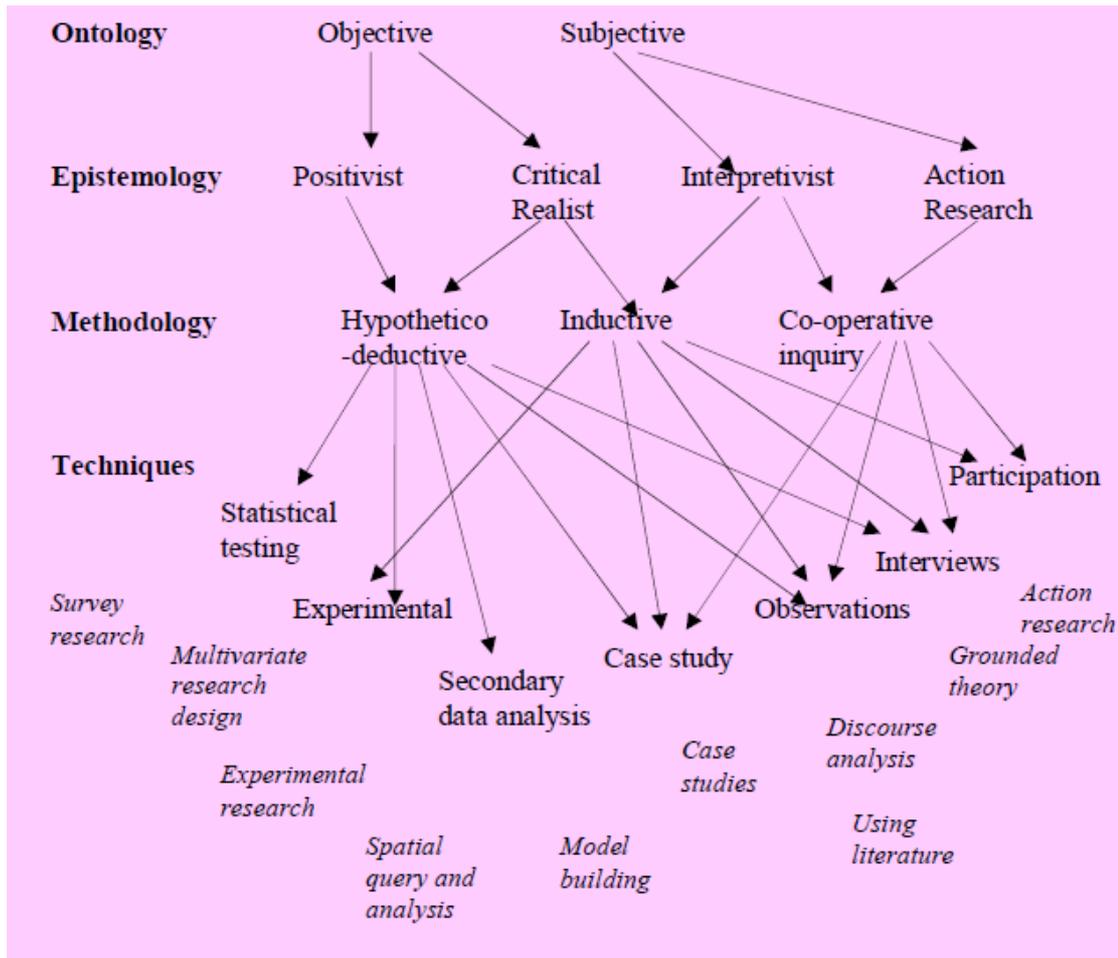


Figure 5: Research design map (Beech, 2005)

4.3) Author's ontological and epistemological stance – Interpretivism

Research methodology has a central role in any kind of management research if the research aims to demonstrate credibility. Ates (2008) further noted that a lack of consideration of the philosophical nature of the research might seriously affect the quality of the outcome of the research. The way the researchers understand and interpret the reality of the world will influence the research process followed and in consequence the results and findings. Hence, the philosophical assumptions will help the researcher to choose the right research strategies and techniques.

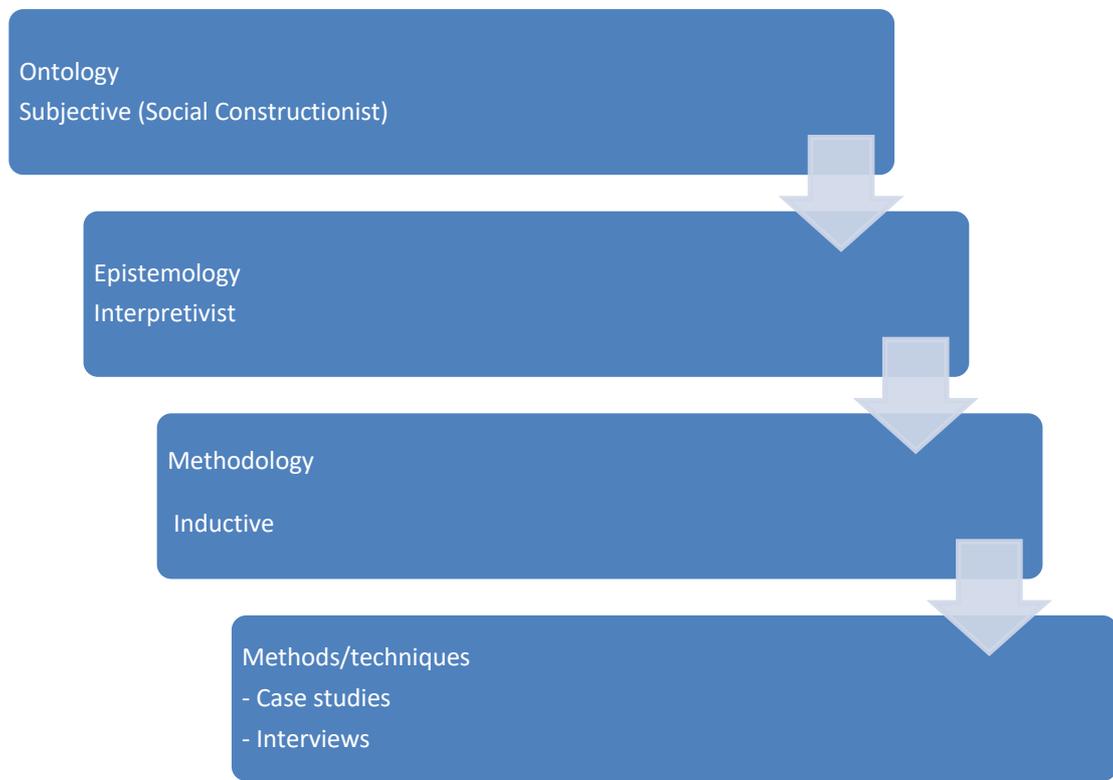


Figure 6: Research methodology design building blocks

4.3.1) Ontology

Ontology is related to the nature of truth. This can be subjective or objective and thus explained as “assumptions that we make the nature of reality” (Easterby-Smith, 2004). Main ontologies are (Easterby-Smith, 2004; Scholarios, 2005):

- **Objective ontology** – physical sciences approach; deals with facts, causality, fundamental laws, reductionism, measurement and objective reality; the truth holds regardless of who the observer is; aim is to discover what is there.
- **Subjective ontology** – constructed; the nature of what is there is not solid but shifting; truth depends on who establishes the facts are all human creations; aim is to understand people’s interpretations and perceptions.

The intended research aims at understanding perceived risks in China's automotive tier ones in order to develop a set of guidelines for risk mitigation. This requires the understanding of how supply chain practitioners interpret where the main risks are situated in the broad spectrum of risks. And as such the research will be subjective. It must on the other hand be noticed that the research will be narrowed into the company which the researcher was working with at the time, and supply chain participants will not always act and perform in the same manner, a pure objective ontology and its associated epistemology may not fit. Hoek (2002) noted that in the field of supply chain management, the human and social side of supply chains has not been entirely overlooked. It is therefore important to identify appropriate epistemological approaches.

4.3.2) Epistemology

The debate in supply chain management on most appropriate epistemology has been long. Beech (2005) suggested the following four key epistemologies mainly adopted in research:

- **Positivism** – Independence; value-free and scientific; hypothetical-deductive; large samples; empirical operationalization; principle of probability; reductionism; generalisation (Ates, 2008).
- **Interpretivist** – Interpretivist researchers engage with a deeper understanding of meanings in data analysis rather than aiming to generalise things. Interpretivist paradigm intends to deal with different contexts through sense making rather than objective real world out there. Interpretivist researchers generally employ methods such as ethnography, phenomenology, hermeneutics and discourse analysis in order to generate qualitative data. Data analysis involves observations, depth interviewing and analysis of text (Beech, 2005).
- **Critical realist** – Critical realist paradigm can be “seen as useful compromise

which can combine the strengths and avoid the limitations of positivist and interpretivist paradigms” although it has its own strengths and weakness, too. The major strong points are it recognises the value of using multiple sources of data and perspectives and the weak point is large samples might be required which might be costly (Easterby-Smith, 2004).

The philosophical debate around pure positivism and pure interpretivism is very distinctive. Ates (2008) argued that although management researchers are more passionate at the beginning into pursuing a particular philosophy, when they are conducting the fieldwork they might be using different research design at their convenience. According to Baker (2001), the distinction between the two approaches is based on the personal philosophy of each researcher on how to conduct the research. The positivists emphasise deductive or hypothetical-deductive procedures to establish and explain behaviour patterns; in other words, this involves establishing a hypothesis and a conclusion based on the hypothesis, the collection of appropriate data to test the conclusion, and the rejection or assertion of this conclusion. The point is to identify patterns or relationships. The interpretivists seek to establish the reasons and actions that lead to a given pattern of behaviour. The selection of a research strategy is strongly influenced by the researcher’s preference. The interpretivists argue that statistical patterns or correlations are not comprehensible in themselves. It is necessary to discover the meanings (reasons) that people give to the actions that lead to such patterns.

The purpose of the study is clearly highlighted to seek perceived risks from practitioners and find out practical mitigation methods for supply chain risk mitigation. It is therefore vital to deep dive into an organisation to understand participants’ messages and find out the pattern and their relations. As such, a hypothetical deductive approach based on hypothesis or a critical realist approach

applying multiple data sources will not be appropriate for this study. With applying of interpretivist approach, it allows the researcher to find out the pattern of the behaviour from which they will be able to comprehend themselves.

4.3.3) Axiology

Saunders (1997) argues that our values are the guiding reason for our actions; therefore, it is important to consider how the researcher's values may impact in each stage of the research process.

The researcher is coming from an industrial sector in senior management position which is required to cope with changing circumstances, make decisions and drive changes. With such a job nature, it is important to understand key stakeholders' perceptions and identify and motivate right change agent within the organisation to lead change initiatives. Although it is often required to utilise numbers to convince the executive team, a successful change also depends largely on understanding of human behaviours and change agent. These are the motives that drive the researcher to consider beyond the pure positivist approach and consider it to be wise to deploy an interpretivist approach to understand the many variables impacting the supply chain.

4.4) How could interpretivist approach apply on operations management research

It has to be admitted that positivist philosophical basis has been widely accepted by the supply chain and logistics management research community presumably because its adoption facilitates the production of guidelines for "optimised" configurations/designs and improvement interventions, which are easily commoditised and applied in an a-contextual fashion. Nevertheless, it fails to provide insights and explanations (answers to hows and whys (Sachan, 2005)) for

supply chain phenomena which are seemingly products of the inherent complexity that supply chains as socio-material systems have and which are not immediately recognisable, neither can be analysed by reduction to their parts (burgess, 2006). Hence, it is not strange that a call for the adoption of new philosophy of science perspectives in supply chain and logistics research has always been open.

The overarching question driving this research is “How do supply chain practitioners actively perceive, interpret and react to the supply chain risks?” Johnson (2008) argued that the current state of supply chain research does not address this transition from the minds of managers, nor does it address the anger, frustration, exhaustion, cynicism and anxiety that can erupt during times of change. Recognising the value of practitioners’ experiences to achieve more understanding of mitigating perceived risks lead to the utilisation of an interpretivist research method that seeks to comprehend complex social phenomena that are problematic for the people involved (Mello, 2009).

Social constructionist and interpretive philosophy of science approaches maintain that the notion of supply chain is actually a social construction with interpretation flexibility (Naslund, 2002). Interpretivist approach generally takes an open-minded approach and starts from data rather than a literature-based theory or hypotheses to be tested out. Interpretivist researchers look at organisations in depth and generally appoint to extensive conversations, observations and secondary data analysis such as company documents and reports in order to overcome generalisability critiques (Easterby-Smith, 2004). In the supply chain research context, it maintains that the behaviour of a supply chain is the emergent result of the behaviour of organisations participating in supply chain, which, in turn is caused by the behaviour of individuals in organisations, which again is the emergent result of

their personality characteristics influenced by the geo-historical context of the individual and so on.

Isabella (1990) argued that in creating philosophical underpinnings required for the supply chain orientation, it is imperative that supply chain managers, defined broadly to include purchasing, production, and logistics managers involved in supply chain activities, undergo an alternation in their cognitive thinking that facilitates and supports the need to change, the process of changing and the maintenance of what has been changed. The supply chain managers are the lynchpins of organisational change, acting as intermediaries between top management and the front line (Huy, 2002). Many supply chain failures may occur if top management does not understand the challenge involved as supply chain managers try to grasp a change they did not design and to coordinate the details with others equally removed from the strategic decision making (Balogun, 2004).

To summarise, the interpretivist philosophy rests on the contrasting belief that supply chain knowledge is not discovered, rather constructed and transmitted through social situations. Human beings create mental constructions whereby meaning is assigned through interaction and interpretation, leading to the assumption that many possible realities exist, each of which is relative to a specific context or frame of reference (Hudson, 1988). These realities must be comprehended holistically, and if they are separated or fragmented, then the meanings change. While theory building has been advancing in the supply chain discipline, the interpretivist research paradigm has largely been missing from supply chain research (Mello, 2009). Because of the focus on collaborative relationships and elements of human behaviour, such as commitment, cooperation, etc. necessary for supply chain management, it was contended that the use of interpretivist approach

can lead to valuable insights as it has complex social elements inherent in its very nature.

4.5) Critical discussion on the research design and approaches

The interpretivists seek to establish the reasons and actions that lead to a given pattern of behaviour. The selection of a research strategy is strongly influenced by the researcher's preference. The interpretivists argue that statistical patterns or correlations are not comprehensible in themselves. It is necessary to discover the meanings (reasons) that people give to the actions that lead to such patterns (Baker, 2001). Supply chain and logistics management research based on the assumption of interpretivist ontology requires to find out the pattern amongst the sample set.

4.5.1) Methodology

The Beech (2005) research design map can suggest that interpretivist ontology can lead to the following methodologies and research techniques:

- Inductive -- Inductive methodology often starts with data rather than literature and finally co-operative inquiry is seen in action type of research in which there are high levels of involvement of the researcher. Saunders (1997) mentioned that inductive researchers will seek to build up a theory which is adequately grounded in a number of relevant cases.
- Co-operative Inquiry – Co-operative inquiry is seen in action type of research in which there are high levels of involvement of the researcher.

The overarching approach planned for this study is inductive. It may be observed that a primary inductive study approach aligns well with the interpretivist epistemology adopted for the research in that it is concerned with building understanding of an issue or problem within a particular context to allow the formulation of a theory or new insights (Saunders, 1997).

The research methodology used to demonstrate the application of interpretivism in supply chain research by understanding practitioners' perceptions on supply chain risks and mitigation strategies. The research is then to follow an inductive approach as the theory building process. This will involve a case study to be developed by employing different data collection and research methods to describe and analyse the situation. A social practice perspective that concentrates on the identification and analysis of practitioners, praxes and practices as well as on their interactions (Whittington, 2006) is used. The adoption of this perspective facilitated the structuring of both the field work carried out by many individuals, as well as the development of a case study by gathering and representing information in an organised manner. Following the deconstruction and analysis of the case, different theories were considered as the basis of mechanisms responsible for the generation of events.

4.5.2) Methods and techniques

The Beech (2005) research design map can be used to indicate the research methods and techniques associated with the chosen research ontology, epistemology and methodology. As listed in Figure 6, the research will be guided by a subjective ontology, interpretivist epistemology, and an inductive methodology. The research techniques will then fall into the following categories:

- **Case Study** – Case study method allows researchers to keep the holistic, rich and significant characteristics of real-life events. Case studies are applied to topics such as “decisions, individuals, organisations, processes, programs, institutions and events. (Yin, 2003)
- **Interview** – Research interview is a conversation with a purpose and the qualitative research interview seeks to describe the meanings of central themes in the life world of the subjects. The main task interviewing is to

understand the meaning of what the interviewees say. There are three types of interviews which are structured, semi-structured and unstructured interviews (McMaster, 2005).

- **Observation** – includes direct observation, participant observation and action research.
- **Action research** – The aims of action research according to (Huxham, 2003) are to create tools and methods, to build up theory that relates to the implementation of policy and to develop practice-oriented theory related to management process. However the researcher's involvement and high levels of subjectivity bring along critiques to action type of research. Credibility and robustness are debatable in action research according to different authors influenced by interpretivist or positivist paradigms (Huxham, 2003; Tranfield, 1998).

As stated in the beginning of this chapter, the objective of the research is to explore practitioners' perceived supply chain risks and risk mitigation strategies within China's automotive context. The target is to go beyond building mathematical model but to lobby executive team for implementation. It is therefore essential to avoid the reductionist approach and consider a wider set of influences.

4.5.3) Generalisability, repeatability and reliability

Interpretivist research does not make claims that research outcomes are generalisable or predictive in nature. Similarly, there are no claims the results and conclusion from this study would be applicable directly within another organisational setting. The findings are not intended to be developed as 'a single truth' but rather intended solely as an accurate reflection and understanding of a set of actors' perceptions within the single study organisation.

While qualitative research is not given to mathematical abstractions, it is, nonetheless, systematic in its approach to data collection and analysis: in analysing data generated in this format, responses are not grouped according to predefined categories; rather, salient categories of meaning and relationships between categories are derived from the data itself through a process of inductive reasoning.

Perspective of the researcher and the researched
<ul style="list-style-type: none"> • Taking an open-minded approach and starts from data rather than theory • Supply chain is a social construction with interpretation flexibility (Naslund, 2002) • The behaviour of supply chain is the emergent result of the behaviour of organisations participating in supply chain, which in turn is caused by the behaviour of individuals in organisations, which again is the emergent result of their personal characteristics influenced by the geo-historical context of the individual and so on (Easterby-Smith, 2004).
Nature of research design
<ul style="list-style-type: none"> • Adopting a flexible research strategy • Conducting naturalistic inquiry in real-world rather than experimental or manipulated settings
Nature of data generation
<ul style="list-style-type: none"> • Main qualitative methods include: documentary analysis, observation, in-depth individual interviews, and analysis of documents and texts
Nature of analysis/interpretation
<ul style="list-style-type: none"> • Based on methods of analysis and explanation building which reflects the complexity, detail and context of the data • Identifying emergent categories and theories from the data rather than imposing a priori categories and ideas • Developing explanations at the level of meaning rather than cause
Nature of outputs
<ul style="list-style-type: none"> • Producing detailed descriptions and ‘rounded understandings’ which are based on, or offer an interpretation of, the perspectives of the participants in the supply chain setting • Mapping meanings, processes and contexts • Answering ‘what is’, ‘how’ and ‘why’ questions • Consideration of the influences and the researcher’s perspectives

Table 4: Methodological stances associated with qualitative research (Adapted from Ritchie and Lewis, 2003)

Table 4 above provided a structured summary on the methodological choices made in conducting the study. The methodology adopted by this study is in the realm of qualitative research, based on an interpretivism position; it does not commence with a prior hypothesis to be tested and proved but with an inductive approach to data analysis, where research outcomes are not broad generalisations but contextual findings: 'words are the way that most people come to understand their situations; we create our world with words; we explain ourselves with words; we defend and hide ourselves with words' (Maykut, 1994).

4.6) Limitation and alternative approaches

The research design has a number of limitations, which are associated with author's ontological and epistemological stance and hence the methodology and research techniques. These issues/limitations will be the further area of work need to be carried out in the future. The main limitations are below:

- Case selection – Cases will be mainly selected from industrial settings. It has to be acknowledged that supply chain risks may be varied from business to business and their magnitude and impact to business will also differ.
- Future testing is required – As supply chain risks may not always appear to be the same and is not a frequent occurring phenomenon, the author may not be able to test the practical effect of the guideline. It is necessary to track the effectiveness of the guideline in the future so as to verify its effectiveness.
- Methodology – Sachan (2005) noted that hypothetical-deductive approaches, as well as predictive mathematical modelling and other related management science methods and tools are the most common methods used. This positivist philosophical basis has been widely accepted by the supply chain and logistics management, while interpretivism approach or inductive approach were only recently applied on supply chain research due to rapid

evolution of operations technologies and managerial methods (Lewis, 1998). As noted above, once the research results were tested, it will help validate the research methodology adopted and/or improve future research methodology.

With the acknowledgement of clear awareness of the selected research method limitations, further data collection and analysis will consider avoiding its limitations and stretching the methodological advantages.

4.7) Ethical consideration

Ethical considerations are a vital part of the research and presenting the research. Ethical approval was sought from the Edinburgh Napier University Business School's Research Integrity Committee. This process ensured that a wide range of ethical issues was considered prior to the research being undertaken.

With careful consideration, a variety of issues were identified that requires thoughts and actions, including negotiating appropriate access within the study organisation; ensuring appropriately informed consent of participants throughout the study; obtaining approval of interview transcripts; confidentiality of participant data; and ensuring no harm would come to participants through their engaged study. With the support of the regional CEO to align with the headquarters, approval for appropriate access to conduct a research study within the company was granted.

Following Patton's ethics checklist (1990), before each interview session, the participants were briefed of the research purpose and were advised they could choose not to participate or not to answer some of the questions. Confidentiality was highlighted in advance, so that participants were able to understand if they could be named or could be identifiable in the research output. Participants were

also asked if recording was permitted in advance. With all such briefing made with participants, the Research Consent Form (Appendix 1) was dually signed by participants and researcher.

One of the key issues recognised is that the researcher is either a peer or the supervisor of some of the participants. Care was therefore required not to lead participants to provide responses that may potentially lead them to company politics, or to assume prior knowledge of issues that may not have been there. It was also recognised that positioning power or relationship could be an issue if this were not managed with due care during the interview.

4.8) Data collection and analysis methods

Silverman (2016) proposes there is no right method to use in research design, suggesting instead the approach must be considered in light of the data required to address the research questions. In selecting appropriate methods for capturing the research data for this study, considerable thoughts were given to choosing those that would address the research questions in a manner consistent with the research philosophy.

The philosophical stance places considerable emphasis on the researcher being an embedded and active participant in the data collection process, with a value placed on discussion and the flexible exploration of issues to develop a deep understanding. Such an approach also places an importance on the gathering of participant viewpoints and perceptions, rather than seeking what may be considered to be a single truth or universally generalisable findings. Quantitative collection methods from the positivist tradition were therefore discounted from consideration as they would not have aligned with the adopted research paradigm and would not have

provided the information required in order to build an understanding around research questions.

4.8.1) Data collection method 1: Documentary analysis

Trautrim (2012) suggested that the documentary method has value for logistics research because it can offer insights into how human perceptions and actions influence the implementation and effectiveness of logistics processes. A broad definition of a document is a written text. Document must be studied as socially situated products (Nock, 1991). It is defined as any written material other than a record that was not prepared specifically in response to some requests from the investigator (Eraut, 1982). Ahmed (2010) indicated that document research is a reflective process in which we confront what researcher call the moral underpinning of social inquiry.

Ahmed (2010) argued that document research is particularly useful when the researcher is faced with the task of analysing a variety of documents which have no common format and which appear to be being developed without sufficient empirical evidence. Documentary evidence can provide the researcher with a wealth of rich and detailed information which is unbiased by the data collection process. It is even argued that even original research can be done with using old data.

As a step to refine research questions and understand the existing lean practices in place during supply chain disruptions, the following document will be assessed:

- Purchasing and supply chain control procedures
- Business continuity plan
- Meeting minutes during supply chain disruptions
- Financial control policy

It is not the intention to answer the research questions based on the documentary analysis, rather it is expected to be a means of providing insights in the organisation where the research was undertaken. As such the following documents were selected and analysed.

Table 5: List of documents analysed

List of Documents Analysed
Customer order handling
Raw material and components purchasing
Supplier delivery performance assessment
Warehouse material flow control procedure
Stock taking procedure
Warehouse management procedure
The third-party logistics management procedure
The import and export operation procedure
Logistics management of new projects
Extraordinary freight control procedure

The main findings out of documentary analysis through internal control procedures did not give a direct answer to the research questions. The documents analysed only defined supply chain and purchasing process management under ordinary circumstance and it was realised that there appears not having an official process to describe type of supply chain risks and mitigation procedure. Although somehow frustrated, it was then considered a necessary step in forming the questions for the subsequent semi structured interviews. With such, it further suggests that an inductive approach for the study to be necessary and a focus on perception would bring significant value to this research.

4.8.2) Data collection method 2: Semi-structured interview

Gorman (2005) said that the interview case study uses data collected from the individual interviews linking the research and the subjects in general. Additionally, Denscombe (1998) pointed out that the interview does not need to collect much technical information, but the basic technical skills are required for researchers who already have the ability to conduct a conversation. During the research interview, the researcher can record the conversation and save it, and then listen to it to write their research report. Without doubt, conversational skills are very significant between researchers and interviewees. The researcher has to describe very clearly the questions to let the interviewee answer them, leading to more accurate responses.

In addition to this, the conversation is not a general and relaxed interview; it is a part of the research process to express the social phenomena and present the respondent's knowledge and produce findings that can contribute to both the academic and practice areas. Therefore, the interview must be very careful and serious. It is of considerable importance when choosing to use interview surveys that the researcher thinks of his or her research purpose, especially when they want to know more details and gain in-depth answers to analyse from the interviewee. Gorman (2005) referred to the benefits of an interview survey in qualitative research; the interviewees can be encouraged to answer open-ended questions face-to-face and it also can let the interviewees better understand the research topic and context. The interview can also produce very in-depth and directly sympathetic research questions and can prove a very direct method of qualitative research.

Fontana (2005) declared that an interview includes broad selection methods and a variety of types; the methods include individual, face-to-face vocal transactions, but the interviewing involves face-to-face group exchanges and telephone surveys.

Denscombe (1998) stated the different interview types: structured interviews, semi-structured interviews or unstructured interviews, one-to-one interviews, group interviews, and focus groups, as outlined below:

- Structured interviews: the researcher asks the same questions to the limited response group. In other words, the respondents are given the same questions; there is very little flexibility about which questions are asked or answered in the structured interview (Fontana, 2005). Denscombe (1998) pointed out that structured interviews provide the collection of quantitative data. The reason for this is that the researcher prearranges the questions and answers which allow more control over the wording and the same questions are asked of every interviewee, making it easier to analyse the data. The structured interviews are used with a broad number of respondents to collect the data.
- Semi-structured interviews: the semi-structured interviews are open-ended answers that let the interviewee be more flexible and develop their ideas and speak more widely. But the researcher using the same structured interview processes, has to prepare a clear list of questions to be answered.
- Unstructured interviews: unstructured interviews are more encouraging to allow the interviewees to extend their thoughts. The main difference from the semi structured interviews is they do not really need a list of questions in advance and allow more in-depth investigation to explore the interviewee's experiences and feelings. The same aim of semi-structured and unstructured interviews is to "discover" their interviewees' thoughts rather than "check" them (Denscombe, 1998).
- One-to-one interviews: the ordinary way to conduct semi-structured or unstructured interviews is one-to-one. It is easy to arrange a meeting for the researcher and interviewee. The benefit is to catch very direct thoughts

during the interview. In addition, one-to-one interviews can get more detailed ideas from a few people.

- Group interviews: some researchers need more numbers to collect their data. The numbers research, such as group interviewing, engages four to six people to do the survey. Nevertheless, it is difficult to gather the people to argue about one topic and collect the different voices at the same time during the interview. Some opinions may influence the other people in the group interview and one cannot get the original voices from the other people.
- Focus groups: Denscombe (1998) said that focus groups interviews have become more popular. The focus groups contain between six and nine people. They are brought together with the researcher acting as a mediator to discover the manner, comprehension and judgment in relation to the research topic. The main point is that they only focus on one subject to discuss. It is more the contribution of the interviewees.

Ultimately, from the above interview types' investigation, the research that focuses on the interview case study has a more flexible process, but this still has to be planned. Gorman (2005) suggested that the researcher has to get ready a list of questions before the interview but that extra questions are allowed during the interview to reply to the research subjects. When the questions go forward to the interviewing process, if some answers are not very clear, it is necessary to go back to the earlier interviewees to ask the questions. It is very significant to draw out more information for the research subjects to expand the research topic. Nevertheless, the interviewing case study is a structured process to allow the researcher to ask about their research questions to support what cannot be observed. The interview case study more deeply explores the research questions from face-to-face interviews and can also discover other related resources for the research subjects. When the questions are more formal, the responses will be more correct and effective. The

interview case study is based on the two conversations, and the researcher's role is to encourage the interviewee to speak out more about their experience and events. Thus, the interview case study can produce high-quality research to develop the research findings.

4.8.3) Sampling process

Given (2008) stated that sampling is the process of choosing actual data sources from a larger set of possibilities. This overall process actually consists of two related elements: (1) defining the full set of possible data sources—which is generally termed the population, and (2) selecting a specific sample of data sources from that population. Note that this definition is stated in general terms that apply to both qualitative and quantitative research, because it is nearly always necessary to work with a sample of data sources rather than attempting to collect data from the entire population. Beyond that similarity, however, the very different goals of qualitative and quantitative research lead to equally different procedures for selecting data sources from a larger population. It is thus important to understand the differences between the logic of purposively selecting a small number of sources for intense analysis in qualitative research, as opposed to the emphasis on randomly selecting large samples for statistical analysis in quantitative research.

Given (2008) argued that there is no one best sampling strategy because which is best will depend on the context in which researchers are working and the nature of their research objectives. As outlined in Chapter One, the research objective is to explore practitioners' perceived supply chain risks and associated mitigation methods, an adoption of interpretivism epistemology, the researcher intends to deep dive into the organisation by understanding their perceptions from different organisational levels associated with supply chain activities.

Miles (1994) suggest the approach which is usually accepted when undertaking qualitative research relies on a smaller sample of people to understand the context of the phenomena in more detail. They consider the natural approach for qualitative sampling tends to be purposive rather than random as samples are selected to suit the requirements of the specific phenomena being considered. Silverman (2016) stated the purposive sampling choice is not an easy selection as it 'demands that we think critically about the parameters of the population we are studying and choose our sample case carefully on this basis'. Blaikie (2009) clarifies the selection process further by suggesting it is a 'matter of judgement' for the researcher to determine the sample from the most appropriate pool. Qualitative research is dependent on the quality of the information derived from the survey participants, their subject knowledge and their ability to share information in an unfettered way. The initial determination of the subjects who will be part of the project is therefore vital to a successful outcome. This accords with the approach being undertaken as samples were chosen for their differing management roles and positions and the individuals' knowledge and understanding of the thesis subject i.e. their involvement and perception on supply chain risks mitigation. It is therefore considered the number of samples chosen for this research is sufficient, as the participants well covers all levels of the management involving in supply chain risk management and their perceptions on SC risk mitigation will offer their understanding on the research topic.

As such, purposive sampling process was selected for this study. Purposive sampling is virtually synonymous with qualitative research (Given, 2008). It was further argued that there are many objectives that qualitative researchers might have, the list of purposive strategies that may be followed is virtually endless, and any given list will reflect only the range of situations the author of that list has considered.

With the understanding of the merit of purposive sampling, the study selected five sample groups coming from the headquarters, regional level and operational level. The five sample groups consist of several leaders working as general business leaders, operation function, supply chain function, finance function, and purchasing function.

Table 6: Participants list

Participants	Length of service in current role (Years)	Position	Position Level
1	7	Asia CEO	Regional
2	8	Malaysia General Manager	Regional
3	2	Global Supply Chain Director	Global
4	15	Asia Supply Chain Director	Regional
5	3	Plant Supply Chain Director	Operational
6	14	Asia Operation Director	Regional
7	5	Plant Manager	Operational
8	6	Asia Finance Director	Regional
9	7.5	Plant Finance Manager	Operational
10	5.5	Regional Purchasing Manager	Regional

This will allow the interview to gain insights from a wider scope of input, so as to avoid getting biased opinion. Most importantly, the samples selected are mainly coming from the staff who had served company for a considerable period of time and all had experienced or directly led supply chain disruption mitigations. It is expected that their direct experience will help address the interview questions.

Ates (2008) noted that research interviews have a number of strengths such as being more personal form of research, enabling access to views and opinions, being flexible and responsive and being able to follow up information, access detail and depth quickly, providing comparative information on complex issues and building contacts. This approach fits the research purpose well as the main objective is to

understand the perception and decision-making process. This allows participants to give their own opinion in a more free and casual manner.

4.8.4) Trailing the data collection methods: a pilot study

Before undertaking the full study, a pilot study was undertaken. Yin (2009) suggested that a pilot case study would help to refine research data collection plans with respect to both the content of the data and the procedures to be followed. The pilot case study can be so important that more resources may be devoted to this phase of the research than to the collection of data from any of the actual cases. In undertaking the pilot study an objective was to reduce the probability of participants experiencing difficulty responding to questions or problems being experienced in the recording of interview data (Saunders, 1997).

Based upon the purposive sample the pilot study was conducted on two participants, with care being taken to ensure the roles selected provide an appropriate cross section of likely participants in the full study. This deliberate choice of roles allowed the researcher to gain insights into whether a range of function owners with different levels of seniority, knowledge and experience would be able to understand and engage with the data collection method being used in the full study.

Table 7: Pilot study participants list

Pilot Study	Participants role
Pilot role 1	A Logistics Manager
Pilot role 2	A Finance Manager

Although only a limited number of participants (two) were included in the pilot study (Table 7), it was considered to be sufficient to be sure that the participants would be able to understand the questions, follow the flow of questions and most importantly,

provide information that would help to address the study's research objectives. When reflection on the pilot study was complete, a few changes were identified for the full study – changed the interview into a casual dialogue instead of formal question and answer to allow participants to better relax and express their perceptions and feelings. All other aspects of the study, including the planning the administration and analysis were left unchanged.

The interpretivist philosophical approach adopted for the study emphasises that the researcher should be embedded within the study organisation, in order to more fully understand the context of an issue being explored (Holstein, 2008). Therefore all pilot interviews were conducted at locations convenient for the participants. Interviews were conducted in the participants' own office or small meeting rooms as chosen by the participants, with no attempt made by the researcher to control the chosen data collection environment.

4.8.5) Interview process

After the pilot interview, the interview process is better understood. The resulting interview process is outlined in this section. The process of the interviews includes the following steps (Dick, 1990):

- Deciding how many people to interview and who to interview
- Arranging for the interview with the respondent
- Determining the time and setting of the interview
- Determining the opening questions
- Determining special questions for the specific information required

The fieldwork involved face-to-face semi structured interviews in Shanghai office of the research company. The only interview conducted via telepresence was with the global supply chain director. With the high audio and video quality, the telepresence

works well like sitting face-to-face. Interviews were conducted with 10 participants as listed in Table 6, taking approximately 50-100 minutes to answer the semi structured questionnaire. As aforementioned, with strong support from the regional CEO, the access to participants was very smooth. Prior to official interview appointments being set, participants were already aware of the upcoming interview. Even though, official outlook invitation were sent to fix the appointment to allow a comfort and relaxing time slot and meeting rooms selected.

The purpose of the semi structured interview is the main part of the data collection process in order to fulfil the research questions as outlined in Chapter Three, which are:

- *What are participants perceived supply chain risks in China automotive sector?*
- *What do participants perceive to be the common and effective supply chain risk mitigation methods?*
- *What do participants perceive human behaviours can influence supply chain risk mitigation?*

Surrounding the research questions listed above, 15 interview questions were pre-defined as listed in Appendix 2. Between colleagues, the interviews went quite smoothly and talks were open. The pre-defined interview questions served as an interview guideline to make sure all necessary points were covered; however during the interview process, questions were not asked in a sequential manner.

4.8.6) Thematic analysis

Braun (2006) said that thematic analysis is a method for identifying, analysing and reporting patterns (themes) within some data. In this study context, data is a set of interview transcripts. Thematic analysis is used within formal approaches such as

grounded theory but it is increasingly becoming a qualitative research methodology in its own right. By itself, it offers flexibility without being tied to any theory, which is useful in our case as seeking to identify themes covered by supply chain practitioners' perceptions and feelings.

In general, analysis of qualitative data can be outlined in five steps: compiling, disassembling, reassembling, interpreting and concluding (Yin, 2011). The data were analysed following these five steps for this study:

- **Compiling**

Compiling the data into a useable form is the first step to finding meaningful answers to the research questions. Compiling might mean transcribing so that the researchers can easily see the data. For this study, data were collected using digital recorder and then transcribed by researcher, which helped researcher to familiarise with the data in general to ensure it could be fully understood and analysed appropriately. Even though, to ensure immersion in the data, the transcripts were read and re-read at least five times and in between the recording were re-played to fully understand the between-the-line meaning or just a simple laugh. During this intense period, areas of potential interests were highlighted.

- **Disassembling**

After compiling and organising the data, it must be separated. Disassembling the data involves taking the data apart and creating meaningful groupings. This process is often done through coding. Coding, in the realm of qualitative research, is defined as "the process by which raw data are gradually converted into usable data through the identification of themes, concepts, or ideas that have some connection with each other" (Austin, 2014). This stage can be time consuming but very interesting. Through continuous reading and

listening, the researcher is able to read the between-the-line meaning, and honesty behind their words. For a former employee of the research organisation, there is an advantage for the researcher to fully understand the terminology used by participants. The connected details were marked with coloured pen and then put into a spreadsheet including the original transcribed answers from the participants, whilst the thoughts and questions identified can be added into the spreadsheet for further analysis.

- Reassembling

The codes, or categories to which each concept is mapped, are then put into context with each other to create themes. A theme “captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set” (Braun, 2006). At this stage, each transcript was assigned with alphabetical number and the highlighted text data were assigned with alphabetical number. They were put into post-it and stick onto a white board to be able to visualize and compare and contrast the data. This worked well as the themes began to emerge from the board. In the meantime, the codes were put into a spreadsheet (Appendix 3) by cluster based on the output from the comparison and contrast.

- Interpreting

Yin (2011) said it was unfortunate that data do not speak for themselves. This critical stage in the research process involves the researcher making analytical conclusions from the data presented as codes and then themes. Even though the steps of data analysis are listed in linear sequence, interpretation does not have to wait until the end of the analysis process. In fact, the interpretation for this study was associated with each data analysis

stages – compiling, disassembling and reassembling. It has to be admitted this was a challenging process for the researcher being relatively new to research, and expecting to be assured that the themes identified were appropriate and significant to provide a level of trustworthiness of the outcomes of the research undertaken. By constant revisiting research questions, the researcher was able to identify thematic patterns across data. It is also important to underline here that the importance of theme is not dependent upon how often it appears or how much data is contained within the theme; rather the importance is related to whether it captures something important in relation to the overall research questions (Castleberry, 2018).

- **Concluding**

Conclusions are the response to the research questions or purpose of the study (Yin, 2011). All research should start with a plausible research question and analysis should always answer a question (Braun, 2006). Bearing that in mind, the conclusion appears to be a natural flow based on the former four stages as significant emphasis were placed on interpreting process which leads to a clear-cut answer to the three research questions and hence a set of recommended guidelines were given.

4.8.7) Data saturation

Failure to reach data saturation has an impact on the quality of the research conducted and hampers content validity (Bowen, 2008; Kerr, 2010). Given (2008) noted although there is some confusion and controversy about what it means to achieve saturation, a variety of strategies for reaching saturation have been established.

- First, saturation may be achieved more quickly if the sample is cohesive (e.g., if all participants are members of a particular demographic group). In this

case, one is not trying to make the theory transferable to the general population, where great variability is likely to exist and more sustained data collection may be needed.

- Second, theoretical sampling is key to achieving saturation quickly. Here research participants are selected so that the resulting data help to build and validate the emerging theory. Researchers are cautioned against using a random sample because it is possible to randomly select individuals who simply repeat what everyone else has said or who simply have no relationship to the emerging theory (e.g., if one is building a theory about nurses, one does not necessarily want data from nursing assistants).
- Third, engaging in sustained field research can help to achieve theoretical saturation. Researchers who have been in the field for some time will better understand the nuances of the research setting, so it is more likely that they will develop a thorough understanding of the themes and their interrelationships.
- Finally, negative cases provide salient evidence of where gaps may exist in the developing theory, illustrating whether saturation has or has not been achieved.

It is believed the sample in the study to be 'saturated' as regards to the purpose of understanding practitioners' perceived supply chain risks and associated risk mitigation strategy. The sample selected covers a wide span within the organisation covering all functions from different organisational levels related to supply chain activities and data analysis produced necessary patterns and themes capable of answering the research questions, therefore adding more samples would not result in more themes. Marshall (1996) asserted that qualitative sampling should be flexible and pragmatic, where the appropriate sample size is that which adequately answers the research question. This is operationalised with reaching data saturation.

Data saturation is deemed to be concerned with the degree to which any new knowledge does not provide new insights, with excess data being the problem for reaching conclusions (Strauss, 1998).

4.9) Chapter conclusion

The aim of this chapter is attempting to identify author's ontological and epistemological stance. Ates (2008) noted that research methodology has a central role in any kind of management research if the research aims to demonstrate credibility. A lack of consideration of the philosophical nature of the research might seriously affect the quality of the outcome of the research. The way the researchers understand and interpret the reality of the world will influence the research process followed and in consequence the results and findings. Hence the philosophical assumptions will help the researcher to choose the right research strategies and techniques.

It was recognised that the author is an interpretivist, based on which the research design and associated methods were outlined. Ethical considerations for the researcher were identified and discussed together with the sampling methods used, the selection process for the participants and background detail of the organisations involved. The chapter concluded by providing a review of the analysis method used to ensure the data was represented in a fair and consistent manner.

The findings chapter which follows provides a detailed description of the findings derived from the interviews with the participants. Direct quotes have been used extensively throughout the chapter to provide a rich understanding of the interviews, before moving on to the next chapter which discusses the findings in relation to the literature considered in order to develop a set of guidelines for supply chain risk mitigation.

CHAPTER FIVE: ANALYSIS AND FINDINGS

5.1) Chapter introduction

This chapter is focused on presenting the analysis findings of the research undertaken in the study. The findings will be presented in three sections associated with the main themes identified.

- Theme 1: Perceived supply chain risks mainly arise from mis-alignment;
- Theme 2: Resilience is a vital part for risk mitigation;
- Theme 3: Leadership style and organisation development are necessary for supply chain risk mitigation

Within each of these themes, consideration is also given to sub-themes that were surfaced with participants through the research process. The findings are subsequently discussed in the following sections. Theme 2 were initially discounted as this is in line with the established literature as outlined in Chapter Three; with analysis going deeper, it was discovered that Theme 2 and Theme 3 share a joint contribution towards SC risk mitigation (discussed in Chapter 7).

It is necessary to underline that management perception towards contingency plan is the only inconsistency discovered. This is mainly due to the level of understanding of each of the participants in relation to their functions and also due to the corporate functional frictions. While a great number of quotes have been acquired from the global supply chain director and Asia supply chain director, the Asia CEO contributed less quotes and was rather prudent in giving answers to a researcher who is an employee of his company, which could attribute to the sensitivity arising from his position. The lack of balance of opinion initially reduced the overall data, however, where the discussion was focused on the opinion of different functions, the golden chain of data surfaced. As explained in the previous chapter, the

advantage of conducting semi-structured interviews provides the opportunity to guide discussion to specific topics to ensure the views of the participants could be used to achieve data blended in opinion and practical experience.

5.2) Theme 1 – Perceived supply chain risks mainly arise from mis-alignment

As a global automotive tier one supplier, it supplies parts to customers with varied technical and quality requirements. Customers are mainly European, American and Japanese car makers based in China, and therefore the product specifications, quality standards and ordering behaviours vary from one another depending on different customer origins and car platforms. This resulted in varied internal production processes and suppliers' requirements. All these needs have to be well established and embedded within the tier one supplier in order to be flexible to meet customers' needs.

5.2.1) Quality mis-alignment

The first sub-theme emerged during the thematic analysis was quality mis-alignment within the organisation which led to several rounds of supply chain crisis. The study shows that the participants, such as the Malaysian general manager, Asian operation director and the plant manager described quality incidents occurred at different levels within the company, which eventually led to supply chain crisis.

When traced to a few years back, it could attribute to the fact that the management from the headquarters believed that the quality requirements in Asia were less stringent and so European quality criteria can be easily accepted by Asian customers. As such it was decided by the headquarters to export aesthetical parts to Asia. Unfortunately, due to the sophisticated manufacturing processes and lack of awareness of Asian customers' quality standards, failure rate registered at a fairly

high level and thus ended up with supply chain disruption. As the general managers said:

“... we used to buy from supplier in Germany – they mould the parts after that they moved parts to almost 600 kilometres to do hard coating. They did the hard coating with another company. Then after hard coating, these parts are back, they then send to Malaysia. ... we started with this supplier – the supplier moulding and after going 600 kilometres and they have a hard coating problem and both suppliers blaming each other and then we don’t get parts and finally we have to fly parts every day; and I think at that time is almost 5 to 6 million Ringgit for airfreight from Germany to Malaysia... Maybe that, the understanding is Malaysian customer the quality standard is lower, so we can manage this – so this could be the mentality not to give approval for Malaysia to have hard coating.” [Participant 2 – Malaysia general manager]

This kind of lack of awareness and mis-alignment of quality requirements of customers also happens within the manufacturing plant. The Asia supply chain director clearly memorised a very recent case:

“We had the problem I think we just finished a few weeks ago with Honda in Japan. Why we had the problem with Honda Japan? Because Malaysia you know is producing pieces, then they are delivering pieces to Japan and then Japan they are shipping to customer. Malaysia, they are producing in pre-production lenses, bezel, whatever. So they are checking. Then they assemble the head lamp for example. They are checking again. Then they ship to Japan and this should be the normal flow. But in reality, they are again before to ship 100% checking and then in Japan, we are 100% checking again... So because here they are scraping I don’t know say 10% in pre-production, then I don’t know, 5% in assembly ... You can

understand how much capacity and components we are losing during the process.” [Participant 4 – Asia SCM director]

The study revealed that quality mis-alignment occurs between any stages of the supply chain. It likewise happens between the manufacturing company and its supply base. This was strongly manifested by the plant manager:

“The main supply chain risks which I see are mainly linked with quality. Normally it was driven by quality to have an impact on supply chain. This key is the components quality level. Normally the risk directly associated with logistics are rare, mainly are from quality. I would say quality impacting the supply chain operation.” [Participant 7 – Plant manager]

Participants reported that quality standards are mis-aligned across the supply chain on many occasions – inspection criteria not aligned internally with customers resulting in capacity and parts loss may well bring the company into supply chain crisis mode.

5.2.2) Capacity mis-alignment

The second interesting finding occurs very often, where capacity was mis-aligned across the supply chain, thereby resulting in supply chain disruption, as the Asia CEO subtly noted:

“Take one example, one of the issues we had in one part of the world was linked with the capacity lacking, right? What happens is that we didn’t anticipate enough the volume increase, we didn’t check enough the impact on the capacity of the machine, we probably didn’t anticipate some scrap level. Let’s say inefficiency impact directly the capacity of the machine, and all in all we end up in a situation where we stop the

customer due to lack of capacity that is something happening today, but should have been checked six months before.” [Participant 1 – Asia CEO]

It is also relevant to identify that both the Asian operation director and plant supply chain manager gave the same example on capacity mis-alignment. As a common market behaviour, customer demand in quarter four reaches peak. This was realised only lately by the plant and then the management decided to transport a moulding machine from its sister plant to hedge the peak capacity demand. The machine accidentally fell from the truck and thus immediately switched the plant into capacity shortage:

“Wuhu plant recently had a big issue since the 2K machine falling down from the truck. It brought huge pressure to our plant, because just at this very moment, our machine utilisation rate reached peak; in the meantime, customer is increasing demand in fourth quarter especially in China market.” [Participant 5 – Plant supply chain manager]

“If you talk about the 2K machine, in fact the problem happened because of combination of 3 factors – Frist factor is you have a tight capacity, because organisation is pushing us to saturate maximum the machines. So we saturate, OK? ... Then you have 2 machines, then you have the 3rd machine which fell down from the truck. So you arrive when you are saturating your machines and you are missing one. So you are missing 50% more of capacity, and at the same time you have all the tooling coming for new test. Then you have all the tools, the project and of course everyone shouting because operation is in the middle.” [Participant 6 – Asia operation director]

Capacity mis-alignment happened in many plants due to sudden customer volume increase, or late awareness of the market volume trend, and poor management on equipment transfer had been cross confirmed by participants that this it well represents another root cause of supply chain disruption.

5.2.3) Forecast mis-alignment

It was also emphasised by Malaysian general manager that customer forecasts tend to variate frequently and unexpectedly. Hence such variations turned out to be difficulties for the manufacturing company to adjust its internal production and material planning:

“Depend on the customer, also how is the customer performing in the market like Honda. Honda is really fluctuating very high. So the problem is always how the customer is giving us more visibility on the numbers, then based on that we are planning our pre-production and also the assembly line production. For pre-production, even you have a lot of SMED and we do a lot of activity, but still create a lot of risks.”

[Participant 2 – Malaysia general manager]

The participants emphasised that as a tier one supplier, customer volume increase is always welcome. When customer volume increases, sales team hesitates to refuse but tends to assure customers of being capable of delivery and brings the pressure back to the company. Although there were internal capacity reviews when customer volume increased, such exercises were normally conducted under extremely tight time windows and thereby several factors were unable to be fully assessed. The forecast mis-alignment highly stressed the supply chain with disruption incidents.

5.2.4) Decision mis-alignment

It came to the researcher's attention during the thematic analysis that there is disconnection especially between the headquarters and plants on investment decisions. Inside a centralised company, key decisions were often made in a top-down approach, whilst regional situations were not fully brought to consideration. The general manager from Malaysia noted one supply chain disruption due to the top-down decision making approach – The headquarters believed that the quality of European suppliers can satisfy Asian customer requirements so that investment can be avoided in Asia, which unfortunately ended up with supply chain crisis and tremendous premium airfreight cost:

“Yes, we foresee this problem. There was a big argument and discussion. Finally, there was decision made to go for German supplier. Because that supplier, the idea was Germany will support this supplier. That means they will support the development, but actually it did not happen that way. Then finally we were responsible to go there. Even we get some support from engineer for coating process, but because of transportation from moulding to coating 600 kilometres you have a lot of issues, dust and inspection, a lot of issue came up.” [Participant 2 – Malaysia general manager]

When the Asian operation director talked about decision making, he turned emotional and commented that people either fear or unable to argue with the headquarters even when they believe themselves to be right. He noted:

“In fact, why you or me are sometimes taking the commitment of risk because we are focusing on delivery and in the end you see some decision taken by some other people, higher level people not to invest and you end up in a situation like Pulaski. In the end it is the decision from the CEO to refuse some investment because below my counterpart are not capable to argue, to justify the investment, not capable to justify the headcount

needed for the right competency on time. Because of afraid of conflict or argumentation, they just shut up and lead to a mess.” [Participant 2 – Malaysia general manager]

The severity and magnitude of crisis due to decision mis-alignment between headquarters and plants are significant. The decision of no investment and headcount reduction resulted in about 18 months of inability to fully deliver to customers. The company had to subcontract some of the process and fly operators and experts from all over the world to support through the crisis, ending up with significant cost and damage to the business relations with its customers.

5.2.5) KPI mis-alignment

Many participants pointed out that performance measurement led to disconnected actions on the part of employees, hence resulted in discrepancies in internal reports. Functions operate surrounding their own KPIs, which sometimes goes to extreme. In order to achieve OEE targets, production department put supply chain planning aside but produced parts actually not required by customers. The Asian supply chain director noted:

“Since I arrived here in April last year, I insisted a lot to change the role of logistics. Why because logistics is okay a department inside production for sure; but we don’t want to leave production to manage resources in terms man and machine. Because we leave them to do this, they have different point of view. So I mean that for example if this is a machine A, they run tool number 1, they run this tool good. So due to the fact that this tool is running well, with this machine they prefer to produce big batches. Because they are good, OEE is good, labour losses good. But logistics know that after you produce 1,000 sets, you should change from 1 to 2 ... Because otherwise if we leave that people to manage the

planning, they will for example, in that line I have to produce product A and product B. But if they run product A, they would like to produce 2 or 3 days always product A. In that way, they can do better labour losses and OEE.” [Participant 4 – Asia supply chain director]

The study discovered that reports may not always be reliable. With tight KPI control, people may even report wrong numbers just to meet their KPIs. An example of reporting very low scrap rate, SCM could not have clarity of the good parts available. When it was discovered, the supply chain was already under crisis. The Asia operation director criticised:

“... Then you discover the reality of scrap. When everybody is telling you it is 5-7%, I discover this was too wrong because I checked the material consumption which is not the reality. But when someone left, you discover the real numbers. So when you discover the real number you have 40%.” [Participant 6 – Asia operation director]

Even the Asia finance director criticised that over focusing on individual KPIs is dangerous, where a holistic view on KPIs is required:

“Let’s say if you have some good KPI, with a bad strategy behind, from finance point of view, this means nothing. For example, if you have a good KPI, but you decide to import from Europe a component, you have stock of 25 days; or you have the worst KPI, but you buy from suppliers in China, from finance point of view, it is much better to have this kind of worst KPI.” [Participant 8 – Asia finance director]

It is very obvious that participants have strong opinion and criticism on existing over focusing on KPIs but lack of understanding what is behind the performance numbers. More importantly the coordination across functions appears weak.

5.2.6) Functional mis-alignment

Following KPI mis-alignment, the Asian chief financial officer underlined the mis-alignment between functions:

“...One of the reasons is the link between different departments of the company. So I mean the sales department probably is not well connected with logistics or with finance or with purchasing.” [Participant 8 – Asia finance director]

As the researcher himself is also in the executive position in the company, the participants tend to indicate internal frictions in a subtle way so as not to bring themselves into company politics. It is only the Asian Finance Director who was straightforward pointing out the mis-alignment between sales and other functions. This may due to finance tend to be in a stronger position over all the other functions.

In a nutshell, although there are six types of perceived risks reported hereinabove, it must be underscored that 1) quality mis-alignment, 2) decision mis-alignment, and 3) functional mis-alignment are deemed as the major risks. As a matter of fact, it is not as challenging to come to the enlightenment that although KPI mis-alignment was iterated by the participants, the series of mis-alignments eventually ended up with mis-alignment in quality and decision-making. Likewise, capacity mis-alignment appeared initially to be a key issue, yet eventually evolved into the mis-alignment of production and purchasing decision, and hence is rooted in decision mis-alignment. Last but not the least, forecast mis-alignment derived from the lack of coordination amongst different functions, since the latter were mis-aligned and consequently constituted the root cause of forecast mis-alignment.

5.3) Theme 2 – Resilience is a vital part in risk mitigation

This section endeavours to elaborate supply chain risk mitigation strategies applied by participants, which are effective from the management perspective. Although there were no pre-assumptions during the thematic analysis, it was still attempted to discover the discussions on the application of numerical methods. Contrary to the expectation, none of the participants discussed numerical methods, the discussions were rather surrounding resilience elements.

A set of sub-themes emerged during the thematic analysis, such as back-up development, collaboration, and contingency, etc., which are all parts of methods in support of supply chain risk mitigation. These findings are in line with those from literatures but were not contemplated initially. With further data analysis, especially when Theme 3 emerged as described in section 5.4, it was then recognised as an important theme given the joint contribution of Theme 2 and Theme 3 to supply chain risk mitigation, and thereby in-depth discussion hereon is undertaken in Chapter Six (Discussion).

This section details the findings, as follows:

5.3.1) Backup development

Backups were often mentioned by participants as the first option when supply chain risks were encountered. Two levels of backups were mentioned – backups between manufacturing companies and suppliers' backups. The Malaysia general manager shared his opinion as he said,

“Then we need to on what you called regionally for the in-house parts. If Foshan or Wuhu has capacity, and if we have a critical issue here, we can ask for their help.” [Participant 2 – Malaysia general manager]

This point was resonated by the plant supply chain manager that backups represents a systematic approach embedded in his daily operation, as he said,

“Very fortunately, we found out that there are suppliers capable of producing our product with simple tooling modification. Also we have similar or same products produced in Czech and Germany. Actually, this kind of management are not conducted until crisis, we do the same when each project goes into serial production.” [Participant 5 – Plant supply chain manager]

“As logistics, the first reaction is to check with Europe if any backups available. Then purchasing will check with local suppliers. Our first reaction at the time is to check with Europe to secure the capacity for China.” [Participant 5 – Plant supply chain manager]

The regional purchasing manager holds the same opinion:

“The latest one is one of our bulb suppliers on strike. So this brought some risk to our production, but at the end, the company solved the issue also with backup solution. So our line has not been impacted.” [Participant 10 – Regional purchasing manager]

“In some cases, we should have only one supplier because of the volume is not enough to make two tools. So we have to maybe focus on only one supplier. In that case, the best way is to have another supplier standby, but maybe he doesn’t have the tooling. If one of our suppliers is having some crisis, because tooling is our property, we can move the tooling to the backup supplier immediately. That could be a balanced way to limit this kind of risk.” [Participant 10 – Regional purchasing manager]

The management deems it necessary to develop backup resources for SC risk mitigation. The study discovered that the management perceives intercompany backup within the region, worldwide and backup suppliers as essential for risk mitigation. Backups are the first thing that the management looks into when supply chain disruption occurs.

5.3.2) Collaboration across supply chain

It was understood by participants that collaboration within the company and across the supply chain, including customers and suppliers, plays a vital role in risk mitigation. To make collaboration happen, it was recognised by the management to establish and maintain contact interfaces amongst other functions, which can play critical roles when disruption occur. The global supply chain director shared his experience:

“I define the main contacts criticality I could have during this. Based on this kind of splitting criticality, I tried to identify the right people that will help me not only to the crisis but also preventing the crisis. And then for me is important having a list of this kind of person and I try to simulate when identify who could that mean and who could that be for the company; not only inside the supply chain team, but also having the right link in other functions, because supply chain is a cross-functional organisation. That is very important to have some reference person in purchasing team, in product development, in manufacturing, sales organisation and so on. I prepare a very short map of the list of person that I need if I will have or if we will be in the middle of the crisis.”

[Participant 3 – Global supply chain director]

At the plant level, collaboration was also perceived as critical for SC risk mitigation. The plant manager held that collaboration should go above and beyond mere the

plant, but rather embrace the whole organisation and suppliers. He then commented:

“Under such circumstance, this cannot be solved by only one plant. This requires the whole team – from top management to the plant level. We must execute how to do all the job, including the supplier. How fast we can react.” [Participant 7 – Plant manager]

Moreover, the plant finance manager expressed that collaboration also includes both customers and suppliers sides:

“When such incident happens, we need to try to minimise impact. This should not only be the effort from us, but also from OEM that they need to adjust their plan. I think the impact is more than just on our company, but also on other tier ones. I still recall that we helped Yusei to import some overseas components and bear some additional expenses.”
[Participant 9 – Plant fiancé manager]

The study unveils that task force represents a common approach to re-enforce collaboration in event of SC crisis. With selected staff members from all related functions, the task force accorded with clear objectives, is put in a good position to quickly make decisions and implement action plans. The Asia Finance Director noted:

“For me in the special situation, the management should be what I saw in the past when I was in Bolonia when the crisis happened in Japan. There was a point of special management to manage the crisis. That was supporting for example purchasing or logistics which are not the same department. And this one was let’s say setup the best strategy at that moment.” [Participant 8 – Asia finance director]

The regional purchasing manager described once the task force from purchasing helped its supplier during the crisis:

“I think in the plastics moulding supplier, we have sent the whole team. From purchasing side, there are around six persons. There are three plants in the supplier side. We sent people to each of their plant to manage the situation. Internally after we tell them the situation, they understand if they don’t help us we will stop our customers. So for them, they also cannot accept this happen. They then sent their resources to help us.” [Participant 10 – Regional purchasing manager]

It is obvious from the participants’ feedback that collaboration is well perceived as essential for SC risk mitigation. Participants exemplified collaboration across supply chain including internal cross-functions, suppliers and customers. What is more important, task force is an important approach commonly applied when SC disruptions occur, so to ensure clearcut objective setting and necessary support can be offered by each internal function.

5.3.3) Quick response

As expected in Chapter Three (literature review), nearly all participants indicated that quick response is critical in risk mitigation. Indeed, in the event of SC disruption, every second becomes so precious and must be fully utilised with effective actions.

The plant manager said:

“If we did not pay attention to system and if we were not proactive in such situation, for sure risk will happen. We are fast in response.”

[Participant 7 – Plant manager]

Similarly, the regional purchasing manager remembered:

“So we arranged our human resource to take out the tooling and transfer to another supplier and start production immediately and also get approval from customer for the temporary solution to go ahead. So at the end we have succeeded without impacting customer line.” [Participant 10 – Regional purchasing manager]

5.3.4) Flexibility

In spite of rigid rules and procedures well established in automotive industry which require major changes be well validated and documented, and be informed to customers for approval, participants still have figured out practical ways of necessary flexibility without prejudice to established rules and procedures. Flexibility emerged especially in relation to product design and processes, in view to components interchangeability and dual validation at product development stage. The Asian Operation Director explained:

“I have changed some components, some suppliers. I changed some components which maybe low performing, but informed customer because based on the short time and because of the risk. Design flexibility is important here.” [Participant 6 – Asian Operation Manager]

It was further highlighted by the Regional Purchasing Manager that flexibility should be seated in the mindset. Each SC disruption can be different and there is no readily available procedure to educate people of everything. When the procedure cannot tell what to do, it has to rely on brainstorming together with the team to figure out solutions. He then commented:

“I think first you don’t try to understand when the crisis happens, please don’t try to understand if it belongs to 80% or 20%. You do the essential procedure, then you will find if you can solve the problem very smoothly, it should already have been covered by the procedure; if you meet some

very big problems which you cannot solve even you follow everything in your procedure, that should belong to the 20%. Then you need to use your own resource your own brainstorming to understand what is the root cause and how you will solve it. No people can forecast everything. People are the most intelligent creature and you need to manage yourself.” [Participant 10 – Regional purchasing manager]

5.3.5) Communication

Communication was perceived as important to provide people with correct information so to avoid public panic. It is also a significant approach to collect and verify very chaotic information in support of developing right actions. The Global Supply Chain Director said:

“The same thing was done also in the previous experience when I joined the other plant and we had some union relationship. It was very important also in having a clear communication with the mass media. We have several televisions out of our plant. They were asking what had to do, do we close, do we continue and so on.” [Participant 3 – Global supply chain director]

He further noted,

“I don’t like to say you must do it. I don’t like to say ‘make it happen’ – it is wrong. Because the people they will do but they will only understand maybe one hour later. It must be based on concrete and communicated in a very kind way inside also the organisation. Outside of course, always trying to collect all this issue we have and promoting to them in one shot, for avoiding that today I give you a piece of the problem, tomorrow I had another piece of the problem. So the customer says,

guys you are in the disaster, you have done nothing and you don't know which is the situation." [Participant 3 – Global Supply Chain Director]

The Regional Purchasing Manager deemed communication as important for correct decision making at the point of risk:

"... but there are several different kinds of feedback from supplier side, from our purchasing side, from other moulding competitors. Also from our supplier side – the information is different with different channels. So for us is first to understand which is the real one. So we send immediately our people to supplier side to check what is the real situation. This is giving us the right information to make sure we will make the right decision in the first minute. I think this is the first priority for us." [Participant 10 – Regional Purchasing Manager]

5.3.6) Contingency

Interestingly, there was a high frequency for participants to mention contingency but with different opinions. The Asia CEO and Asia Finance Director both clearly stated that there was no readily available contingency plan in the company as they believed it is unlikely to have a contingency plan to cover all types of risks. Furthermore, the cost to maintain such a plan could be extremely high. Part of their statement may be attributable to their pressure of financial performance avoidance of the cost for rare cases. The Asia CEO stated:

"To be honest, I think we don't have a structured contingency plan. It relied very much on the individual. We know that we have different situation in different part of the world. The root causes are somehow well-known. There's nothing like a tsunami or earthquake that happen, right? What happen is just you didn't anticipate enough some potential

problem to come in our business that are usual business.” [Participant 1 – Asia CEO]

And the Asia Finance Director made similar statement:

“I think the cost for prevention action I never evaluate it. But can be too high compares with the risk. But probably should be better evaluated the trade-off between the risk and the cost for the preventative actions.”

[Participant 8 – Asia Finance Director]

Contrary to the Asia CEO and Asia Finance Director, participants who are directly dealing with supply chain risk management shared different opinion. These participants invariably stated that they believed contingency plan be quite essential for SC risk mitigation. Although there is no companywide contingency plan in place, some of them are applying the concept either based on their experiences or the practices they acquired from their former employer. The Global Supply Chain Director stated:

“I defined a team for preventing this kind of crisis, engaging my purchasing manager in the plant, the purchasing manager worldwide and engineering and financial controller. I defined some specific competencies, skills in my team. So we start spending one hour once a week for three to four weeks we worked in this way, defining what will happen if the supplier will have the financial criticality. And then we defined what had to do, the action plan, who will be in contact with the supplier for understand what is happening. In the meantime, we define the list on the tooling location, the volume we need. We classify the volume we need in terms of A,B,C – importance in terms of turnover, quantity we need. So we created a very wide picture about the situation in this case for this kind of supplier.” [Participant 3 – Global Supply Chain Director]

“Sometimes we don’t consider the crisis and contingency plan like something that could support the continuous improvement. Instead this is very important. Very important in the sense that the continuous improvement is not only related to cost reduction, inventory reduction and so on. One of the most important thing for sustaining in the business is also having an understanding the risk we can run in the daily execution. Not only when we run into a big disaster, but also having an approach on this. There are some other cases pushing us to have contingency plan. That is very important to have these. So I prefer to work for preventing the crisis.” [Participant 3 – Global Supply Chain Director]

The Global Supply Chain Director further explained that in case the crisis mode was not covered by the contingency plan, it can still help with forming basic steps when SC disruptions occur:

“But even if the crisis is moving in a completely different direction, having a completely different reaction in the environment, but having a plan help a lot because you have for example a clear step of what you have to do in terms of people engagement, skill, competency you need, reference person you have to contact. ... We cannot avoid the crisis, but we must have the right team, the right people, the right plan for managing and solving the issue. ... Because at the end, we don’t have a crystal ball for having all the answers to several situations, but having the right mind-set, the right approach, the right plan and the right engagement, you have a good and very high possibility to solve the crisis.” [Participant 3 – Global Supply Chain Director]

The Regional Purchasing Manager provided very similar opinion as that of the Global Supply Chain Director:

“Of course if I have a procedure, which is in writing that when we have this kind of strike, what is step one and step two, for sure it will be more helpful. Maybe I don’t need two hours to discuss with team, to generate ideas. I can react faster.” [Participant 10 – Regional Purchasing Manager]

“Sometimes we want to have something in advance. We don’t need to waste time to understand and to react. This is our wish, but on the other hand with what you said is how we can define a procedure which can be applied for everything. I think for most of the crisis, we can manage as 80% of the crisis should be similar. So for our procedure, if we can cover the 80% of the crisis, for me is already a good success.” [Participant 10 – Regional Purchasing Manager]

Contingency plan was also discussed by Plant Supply Chain Manager, Asia Operation Director and Plant Manager. Due to the length of the conversations, all the quotes are not listed here. What is important to note is that participants who directly manage crisis deemed it more necessary to have contingency plan as opposed to the Asia CEO and Asia Finance Director.

It is worth noting that though Ponomarov (2009) and Christopher (2011) criticised that resiliency can cause additional cost in terms of inventory and capacity, yet none of the participants reported excessive inventory or capacity increase attributable to the six resilience elements as hereinabove explored. As a matter of fact, participants claimed that the stock level went low during the disruption, whilst the

abovementioned resilience elements helped the supply chain back to normal operation.

5.4) Theme 3 – Transformational Leadership style and organisation development are necessary supply chain risk mitigation

The most eye-opening finding emerged out of the thematic analysis is that organisation development and transformational leadership styles were deemed as a method of supply chain risk mitigation. A set of sub-themes include authorisation, risk taking, drive for perfection, priority setting, tension management, hands on, people engagement, emotion management, assertiveness, and people development.

5.4.1) Authorisation

The Plant Supply Chain Manager believes that authorisation from his management can help with risk mitigation. The Plant Supply Chain Manager explained that he was in a better position to make tough decisions when he was fully authorised by the management.

“For example, those lower level staff who are unwilling to make decision and push this to his line managers. As supply chain head, I have been fully authorised by Plant Manager and Asia Operation Director. I will even pressure them to dispatch goods even there are some quality uncertainties, but with clear mark on the product.” [Participant 5 – Plant Supply Chain Manager]

The Plant Supply Chain Manager’s superior, Asia Operation Director shared similar opinion. He believes it efficient to bring the right people and fully authorise them to execute.

“I will really bring upfront the expert with me. And the expert to take leadership to make it happen. And also, to associate the right guy from

the plant to take leadership with the expert. And I will say guys this is your commitment and your action plan. I don't follow and then I just manager the guys." [Participant 6 – Asia Operation Director]

5.4.2) Risk taking

The participant who claimed to have successful experience of managing big crisis demonstrated strong willingness of taking risks despite knowing that potential company politics may go against him. The Asia Operation Director said,

"The risk, who is taking the risk? Myself, because I was managing directly. ... This you can only do with experience and someone will take the decision, but you'd better avoid taking the wrong decisions. And whatever people say you are wrong, you don't care." [Participant 6 – Asia operation director]

5.4.3) Drive for perfection

Participants in the management position also think it necessary to push for the best possible results in their daily operation. The Asia CEO said,

"For me since I am here, I developed with the team a way to check it. Not always satisfactory by the say, so that's why I am pushing and pushing and asking to review again, again and again. But this is for me something that is not written anywhere in a handbook but that is extremely clear that as one of the major risk we can have." [Participant 1 – Asia CEO]

The CEO further briefed on how he uses the analysis prepared by his people. He will not just trust the analysis submitted by his staff, but checks and pressure tests them to be sure the analysis is flawless:

"Because personally I don't do the analysis, but I check the way they do the analysis and I check the result of the analysis and I challenge the

result to make sure that they have double checked two times, three times and so on.” [Participant 1 – Asia CEO]

Apart from that, he also challenges and questions himself very often.

“I reflected a lot on this topic because I was thinking ‘Oh by the way, in China I remember I struggled a lot on quality of people, not quantity.’ Quantity is not an issue in China.” [Participant 1 – Asia CEO]

Push for perfection can be found not only from the senior management, but also from the Regional Purchasing Manager:

“...but there are several different kinds of feedback from supplier side, from our purchasing side, from other moulding competitors, also our supplier side – the information is different with different channel. So for us is first to understand which is the real one. So we send immediately our people to supplier side to check what is the real situation. This is to make sure we will take the right decision in the first minute.” [Participant 10 – Regional Purchasing Manager]

5.4.4) Priority setting

It was also discovered that the management team makes a lot of effort on priority setting even in complex situations. The Asia Operation Director recalled:

“So the only thing you have to do is take your shirt like this and you go. And then you go to priorities. Priority one, back to basic condition in hard coating and then anti-fog. I want myself to be sure why the filter were not done, why cleaning were not done, what was the dust level here and what was the reason of the scrap level, top one, top two, top three.” [Participant 6 – Asia Operation Director]

5.4.5) Tension management

It is also a familiar scenario that certain team members may attempt to shirk their responsibilities when encountering frustrating pressures, which does not at all add value to solving problems. The Global Supply Chain Director specifically noted that,

“Avoiding any kind of conflict inside the function sometimes logistics against supply chain, against purchasing, against quality, against manufacturing – everybody is trying to say OK that is my job, this is not my job. Guys that is the job for everybody. We had to work together in the middle of crisis. Because the problem is the company problem, not quality problem, not logistics problem, not supplier problem. It is the company problem.” [Participant 3 – Global Supply Chain Director]

To eliminate internal tension arising from taking responsibilities as a team member is critical to enable the team to collaborate closely so to solve the problem.

5.4.6) Hands on

Participants emphasised the necessity to be hands on and to lead people by example. The Global Supply Chain Director shared,

“You have to learn to meet the people for achieving this kind of reliability. Otherwise you can pass some message and people can look at you with open eyes and say I will do, but nobody will do. You have to jump with them and step by step spend yourself doing very simple and basic things. That is the approach.” [Participant 3 – Global supply chain director]

5.4.7) People engagement

The Global Supply Chain Director puts a lot of attention on people. Apart from top-down decisions, engaging people from all functional areas can gear the entire teamwork towards the same direction. He said,

“In a crisis, the solution from top-down you can decide the plan, the priority and take decision; but the solution will arrive only if the people are engaged from the bottom. And in very short time you have to engage a lot of people – the logistics, the planning, the production leader or the people who are working on the injection machine, the team leader and everybody must be aware and at the same time engage for understanding we are working together for solving the crisis.”

[Participant 3 – Global Supply Chain Director]

5.4.8) Emotion management

Encountering crisis, people may very often feel under enormous pressure and tend to be emotional as a natural reaction. Several participants mentioned that their experiences in managing and control emotion are important for risk mitigation.

The Asia CEO recalled,

“So my first reaction was not to panic, but to spend time before the first meeting with the customer to understand what was the situation.”

[Participant 1 – Asia CEO]

The Asia CEO further concluded that emotion management is the key to a successful SC risk mitigation, as only by keeping calm will he be able to focus on analysing the situation and build robust action plans:

“The success was linked to the panic, self-control, cold head to analyse the situation and work on the plan and make sure it was robust. When the plan is defined, you control it very closely until each step is achieved.”

[Participant 1 – Asia CEO]

The Global Supply Chain Director shared his experience:

“And then another important topic I had to manage is the stress. Because in the middle of the crisis the stress is very, very, very high. You have to provide the answer immediately and have to justify too many things. People ask you what I had to do, and then it is most important having steps or approach managing the crisis.” [Participant 3 – Global Supply Chain Director]

The Plant Supply Chain Manager feels that his management team is well in control of the emotion during the crisis:

“I think it was coming from the top management. They were all calm.”
[Participant 5 – Plant Supply Chain Manager]

Starting from the top management to the frontline managers, emotion control was well managed to enable everybody to focus on finding solutions even under significant pressures.

5.4.9) Assertive

Participants mentioned that being decisive and even being assertive is necessary under crisis situations – not just follow others, but to have other people follow themselves.

Normally when there are international visitors coming to China, most local Chinese staff are very friendly and even refrain from challenging the international visitors. The Asia CEO, however, commented:

“Personally, if I was in this position, I would reject this approach. And I always pay attention in China that we don’t end up in this situation. For example, when some people come over to support us, I was always very attentive to make sure that if someone comes, I want this person to be

integrated in the work and provide solution. Not someone that remains outside of the working team, make some advice more or less good and then leave and talk about the good advice they made and why the team is really bad and they cannot make it. For me, in the task force, you need to be an actor, you need to be solving the problem.” [Participant 1 – Asia CEO]

The Global Supply Chain Director took the same position:

“No forget whatever happened. Stop! We will see after what happened.”

[Participant 3 – Global Supply Chain Director]

The Asia Operation Director even commented that he may even not follow his boss:

“I have two bosses, but I don’t listen to them. I don’t care because I know what I have done. I know what I am capable.” [Participant 6 – Asia operation director]

[Participant 6 – Asia operation director]

5.4.10) People development

People development is a topic that half of the participants actively discussed and commented on. It appears that leadership at different levels of the company took similar opinion. The Asia CEO commented on the importance of training people in a fast developing country:

“You know like the growth of a factory with a lot hiring that maybe you are not able to hire all these people. Being fresh employee they don’t have the experience so you need to train them and maybe didn’t have time to train them; or maybe you didn’t train them at all. So I think the contingency plan is not really structured in our company, it relies on people and the person leading this company for this region is to anticipate the risk. But I don’t do it with specific methodology, I do it

with my personal knowledge, experience. Of course, using the experience of the team of many people.” [Participant 1 – Asia CEO]

“If you don’t have the right team, you are going to live like hell. The crisis task force was unbelievably experienced. I knew I already had in my DNA the team work and leadership was important to win some very difficult battle, but in this I really took a new degree. That’s my first team building, by the way, I had a very great leader for the team building, an American psychologist that was advised by top people. We created a team from nothing, I mean one day I arrived in US, the week after, I have completed my team, and then the week after I am in team building, because we have six months to fix it. So when you are in this kind of crisis or urgency, if you go the normal way to know each other, maybe after six months you start to work as a team. I couldn’t afford that. I have to build up the team in the accelerated way. And this team building was a great success.” [Participant 1 – Asia CEO]

This view is shared also in different levels within the company. The general manager commented that people development is part of his company procedure:

“Normally it is automatically coming to your daily life when you see the people, definitely you have to have. Because for me, people that means if plan to leave when we will do – that is already have in our people development plan; which is for me the contingency more on surprise or sudden things happen ... So people is already in our normal working activity – there we have routine on people development and also in our successor and you are looking at the complete team evaluation.”
[Participant 2 – Malaysia general manager]

The Global Supply Chain Director holds that it is essential to develop a strong team from the very beginning of the crisis:

“The most important thing and always in my experience not only during the crisis is the team. The team is the centre, the core topic we have to implement.” [Participant 3 – Global Supply Chain Director]

“I define the main criticality I could have during this. Based on this kind of splitting criticality, I tried to identify the right people that will help me not only to the crisis but also for preventing the crisis.” [Participant 3 – Global Supply Chain Director]

“So we have to start from our people and understanding our people and finding and working with our people and looking at the solution working with our people for improving and giving the possibility for growing up.”
“Then also this case if most important having the right people on board.”
[Participant 3 – Global Supply Chain Director]

The Asia Supply Chain Director gave examples of failure to attain key staff resulting in supply chain crisis, especially in light of the high employee turnover rate in China:

“Now I think you know what is happening in Wuhu – 2K machines. You know we lost a guy, a good technician. All people told me he is a good technician, and then suddenly with three machines we are not able to cover customer demand that is strange, because normally with 2 machines maybe we can do this.” [Participant 4 – Asia Supply Chain Director]

“Because here in China, we have a lot of turnover, so people changing a lot. Every time that one guy is coming in our company, this is a good

opportunity in the same time because maybe he brings some new experience, but on the other hand, this is a high risk that you detect not immediately, maybe one year after.” [Participant 4 – Asia Supply Chain Director]

The Asia Operation Director commented that he was very careful in screening the right people to be part of his crisis management team based on their competency:

“Then you need to organise every function with short term, midterm and long term. And in fact, you cannot ask the people from long term to solve the problem short term and short term to think too much in the long term.” [Participant 6 – Asia Operation Director]

The Asia Operation Director also gave an example of taking care of his plant manager to avoid over stressing his people:

“I was learning the people, then you say you need to do something here because you cannot spend your whole life here. I even send my plant manager on holiday for 2 weeks. I said you need to take a rest, why because he has some difficulties to manage such crisis, so I did. And also, by not having him here, I helped also to be sure he doesn’t feel the frustration. So he can take a rest and manage, then he come back and he take over.” [Participant 6 – Asia Operation Director]

The Plant Manager commented:

“If quality is weak, I will set the direction for them and tell them to bring up the capability. Short term, they may be able to survive; but long term I don’t want to wait until the risk came. I will tell them where they are weak. R&D need to develop lessons learned, if design itself already have many problems, then we should not repeat the same problem in the

future. Again, people are very important.” [Participant 7 – Plant Manager]

To summarise this section, participants invariably discussed and exemplified certain transformational leadership styles and organisation development. This company puts great emphasis on developing transformational leadership capability at all organisational levels and includes leadership in annual employee performance appraisal. This could be the reason that participant all talk the same leadership language and applied those into their daily business operations. The relationship between transformational leadership styles and supply chain risk mitigation is discussed in next chapter (Discussion).

5.5) Chapter conclusion

This chapter has set out the analysis and initial findings of the research study undertaken. The findings of three broad themes have been identified and analysed. The first main theme is mis-alignment which is perceived as the root cause of supply chain risks. Mis-alignment happens at different levels both inside the company and throughout the supply chain. With this finding of perceived risks, it is important to define supply chain risk mitigation strategies. The second main theme is resilience which is applied in risk mitigation. A set of sub-themes emerged such as backup development, collaboration across supply chain, quick response, flexibility, communication, and contingency. These are already embedded in the organisation for risk mitigation. The most striking finding is Theme Three – transformational leadership and people development being key supply chain risk mitigation factors. A set of sub-themes including important transformational leadership characteristics and people development are important risk mitigation factors.

The findings elaborated in this chapter are discussed in further detail in Chapter Six (Discussion), which weighs the importance of the findings and navigates towards the answers to the research questions identified at the end of the Literature Review in Chapter Three.

CHAPTER SIX: DISCUSSION

6.1) Chapter introduction

The analysis and initial findings of the primary data collection process is elaborated in last chapter. This chapter aims to develop the key elements of risk mitigation enablers on the basis of research findings and emergent themes in order to explore the key issues associated with perceived supply chain risks and risk mitigation strategies. Within the discussion, reflections are provided on findings that were anticipated or identified a priori, subsequent to initial literature review and prior to primary research being undertaken. It should be underlined that the literature review was an iterative process, with appropriate journals being identified and reviewed throughout the entire study process.

In the current chapter, contemplation is also given to emergent findings, i.e., those findings that were not anticipated but newly revealed in the study. An overview is provided of those issues that were anticipated through the review of study context and the literature review, but which did not subsequently arise in the study. In this chapter, the interactions between different dimensions of the study are considered and possible explanations explored where appropriate.

6.2) Purpose of the research

This research was undertaken in a critical period where China's automotive sector has undertaken rapid expansion with supply chain growing into complexity accordingly, which tends to be more fragile in event of unexpected crisis, especially for lean firms. Supply chain interruption has become one of the major challenges for China's automotive supply chain practitioners. Correspondingly, foreign invested automotive suppliers are more exposed to supply chain risks due to their established international supply chain network and higher risks arising from the market. The

research, through adopting thematic analysis, aims to explore and understand supply chain practitioners' perception on supply chain risks and associated risk mitigation methods.

6.3) Perceived supply chain risks mainly arise from mis-alignment

The research unveiled that mis-alignments across supply chain are deemed as main risk factors. All participants gave examples of mis-alignment in different forms. Interestingly, none of the participants criticised mis-alignment in his/her own functional area while most blames were directed to other functions. It is acknowledged, however, that external risks do bring risks to the supply chain, which is perceived as rare and impact thereof on business be less than internal mis-alignment. This finding is partially aligned with authors such as Christopher (2004), who classified supply chain risks into five categories – process risks, control risks, demand risks, supply risks and environmental risks. Olson (2010) gave classifications of supply chain risks as internal and external. While a lot of researches are focused on addressing the risks associated with external risks or environmental risks, the risks that participants put most emphasis on are internal mis-alignments which brought significant risks into the supply chain operations. The research demonstrates that the main risks (Table 8) perceived by practitioners were partially addressed by previous researches, including process risks and control risks. This study, nonetheless, brings a rather more in-depth exploration on those risks, i.e. various types of mis-alignment within the supply chain.

Perceived Risks	Impact	Literature
Quality mis-alignment	<ul style="list-style-type: none"> - Customer quality expectations were mis-interpreted, product rejected by customers and then repeated sorting, which lead to supply chain disruption - Forecast and capacity mis-alignment - Tight investment control - supply chain disruption 	<p>Sun (2012), Tse (2011, 2018) and Tapiero (2007) consider quality to be a supply chain risk factor</p> <p>Chopra (2004); Taylor (2008) consider forecast and demand mismatch and strategic decisions will impact supply chain risks.</p>
Decision mis-alignment		Olson (2014); Taylor (2008); Ahmed (1996) criticised operations management silo thinking and lack of internal coordination can lead to supply chain risks, whilst performance management is essential in supporting this alignment.
Functional mis-alignment	<ul style="list-style-type: none"> - Silo thinking - Focus on OEE only - Parts produced are not customers' needs 	

Table 8: Perceived sources of supply chain risks (Source: author)

Although there are six types of perceived risks reported in Chapter 5, it must be underscored that 1) quality mis-alignment, 2) decision mis-alignment, and 3) functional mis-alignment are deemed as the major risks. It is necessary to elaborate how these three mis-alignment were deemed as the most significant ones.

- Quality mis-alignment

In fact, it is not as challenging to come to the enlightenment that although KPI mis-alignment was iterated by the participants, the series of mis-alignments eventually ended up with mis-alignment in quality and decision-making. As a matter of fact, quality mis-alignment was the most immediate perceived risk exposed to the organisation.

- Decision mis-alignment

Likewise, capacity mis-alignment appeared initially to be a key issue, yet eventually evolved into the mis-alignment of production and purchasing decision, and hence is rooted in decision mis-alignment.

- Functional mis-alignment

Finally, forecast mis-alignment derived from the lack of coordination amongst different functions, since the latter were mis-aligned and consequently constituted the root cause of forecast mis-alignment.

Quality mis-alignment is happening at different levels – ranging from mis-alignment between manufacturing companies and customers, internal mis-alignment and mis-alignment with suppliers.

The research company is a manufacturer of high technology lighting aesthetical components. Very often customers' quality expectations were misinterpreted which

led to entire shipping lot reject. Repeated internal parts sorting, as a knee-jerk reaction in such circumstances, further worsened components shortage. Likewise, similar challenges occurred to its suppliers. All the knee-jerk reactions unfortunately ended up with an immediate supply chain disruption. Sun (2012), Tse (2011, 2018) and Tapiero (2007) studied quality impact on supply chain performance and consequently quality risks were identified as a risk factor. In recent years, it has also been realised that establishing alignment amongst internal functions of the company can be more challenging than building external alliances (Skipworth, 2015). It must be brought to attention that although quality failure has been considered as a risk factor and alignment herein is important to improve supply chain performance, yet none of the former researches appeared to embrace quality mis-alignment as a critical supply chain disruption factor as argued in the current research.

The next finding in terms of mis-alignment within the organisation is decision mis-alignment, which is strongly criticised by senior management to their headquarters. A most notable scenario is that forecast and capacity were very often mis-aligned thus leading to devastating supply chain disruptions. Chopra (2004) pointed out that mismatching between the actual demand of the market and a firm's prediction leads to forecast risk. The senior management expressed their negative feelings against the headquarters on ignoring regional business needs or underestimating the challenges from the local market. Due to very tight control from headquarters on capital investment, equipment investments were often replaced by outsourcing without adequately bearing in mind of extended transportation routes or the complexity in managing suppliers' quality. Consequently, the company had to pay more airfreight cost than otherwise the investment itself to fulfil deliveries to customers. Taylor (2008) suggested that company's strategic decisions shaped critical events in company's history. It was further argued that management unit

frequently operating under conditions of resource scarcity may well lead to company collapse. This also applies to the crisis of supply chain.

The last finding on mis-alignment is functional mis-alignment. Olson (2014) argued that supply chain risk management is interested in coordination and collaboration of processes and activities across functions within a network of organisations. One of the typical examples is that each function has their key performance indicators (KPIs), yet their KPIs are not well aligned. KPIs are supposed to be the main approach measuring employee and functional performance. Taylor (2008) criticised that some observers were blinded by their operations management mind-set of functional separation and silo mentality. Due to lack of alignment amongst each key performance indicator (KPI), each function tends to fight for only itself in ignorance of coordination. It was criticised by participants that sales was not aligned with logistics and operation focused on merely overall equipment effectiveness (OEE), while on the other hand a lot of parts were produced in ignorance of real customer demand, hence not surprisingly resulting in supply chain crisis. This is exactly as commented by Ahmed (1996) that performance management is crucial in supporting supply chain alignment, as it provides the governance mechanism by which the organisation can evaluate if the cascade of strategy is effective.

Although it was studied by several researchers, such as Faisal (2007) Adamides (2012), Skipworth (2015), etc. that internal alignment is a key supply chain enabler to enhance supply chain performance and improve customer satisfaction, it is unveiled by this study that internal mis-alignment is perceived by practitioners ranging from headquarters to operation frontline managers as a key source of supply chain risks which can even bring devastating impact to the business. Mis-alignment can happen at several levels within and beyond the manufacturing company – headquarters to

regional operations, across different functions, and through to the shop floor and customers and suppliers.

6.4) Resilience is a vital part in risk mitigation

The second main theme that emerged through the study is that resilience plays a pivotal role in risk mitigation. Marley (2013) termed resilience as a supply chain that is able to react to supply chain disruptions and respond quickly. Sheffi (2005) stated the essence of resilience is the containment of disruption and recovery from it and suggested there are two approaches to create resilience – flexibility and redundancy. Flexibility refers to developing capabilities within the firm to respond to disruptions such as standardized processes, postponement, strong supply chain partners and a flexibility-oriented culture. Redundancy involves maintaining excess resources such as inventory, capacity, or suppliers in the event a disruption. The study findings as shown in Table 9 are in line with those of Marley (2013) and Sheffi (2005).

Resilience	Examples of Actions	Literature
Quick response	<ul style="list-style-type: none"> - Quickly setup special task force team - Flexible mid-set - Flexibe in putting resources together - Design flexibility 	Konecka (2010) and Wu (2008) suggest the ability of fast reaction to supply chain disruptions is a critical organisational capability for risk mitigation.
Flexibility	<ul style="list-style-type: none"> - Regional operation backup - Global operation backup - Supplier backup 	Knemeyer (2009) and Munoz (2015) commented similarly that flexibility initiatives can increase the speed of crisis recovery.
Backup	<ul style="list-style-type: none"> - Task forces to tie up internal resources - Closer collaboration with suppliers and customers motivate crisis manaeement and optimise planning. 	Trkman (2009); Heckmann (2014); Ma (2014) suggested that dual/multiple sourcing and backup suppliers can improve the elasticity of the supply chain network.
Collaboration	<ul style="list-style-type: none"> - Communication to customer, supplier, internal employees and public depending on the level of disruption 	Sun (2012); Westbrook (1991); Kleindorfer (2005); Birkie (2016) suggested that role of external collaboration with suppliers, customers and other partners, internal coordination, and cross-functional integration are recognised to provide companies with better agility in mitigating and
Communication	<ul style="list-style-type: none"> - Frontline managers believe contingency plan can eliminate internal cross-functional barriers and quick access to desired resources - Senior executives consider contingency plan to be too costly 	Christopher (2011); Wong (2012); Closs (2004); Gurnani (2012); Jia (2010) argued that effective communication is critical for supply chain risk mitigation. Communication failure can even lead to supply chain crisis. Cultural barrier should also be considered in communication effectiveness.
Contingency plan	<ul style="list-style-type: none"> - Blackhurst (2011), Tummala (2011), Knemeyer (2009) and Kern (2012), etc. argues that contingency plan can help reduce mistakes and developing self-executing plans enable firms to deploy mitigation strategies quickly, thereby increasing supply resiliency. Zolkos (2003b) and Ellis (2010) further concluded that companies that will be successful are those that can identify and develop contingency plans for the various risks that exist internally and externally to the organization. 	Blackhurst (2011), Tummala (2011), Knemeyer (2009) and Kern (2012), etc. argues that contingency plan can help reduce mistakes and developing self-executing plans enable firms to deploy mitigation strategies quickly, thereby increasing supply resiliency. Zolkos (2003b) and Ellis (2010) further concluded that companies that will be successful are those that can identify and develop contingency plans for the various risks that exist internally and externally to the organization.

Table 9: Elements of resilience for supply chain risk mitigation (Source: author)

The insight of participants is that quick response is always key in any risk situation. It is believed that regardless of the type of risk situation, it is always desirable to have a task force established in a short notice to cope with the situation. Participants' reflected that their line managers and employees are able to work in a task force, in the event of a crisis, to quickly set up clear objectives, resource plan and course of actions, in spite of existing mis-alignments across functions. The ability of fast reaction to supply chain disruptions is echoed by Konecka (2010) and Wu (2008) as critical organisational capability for risk mitigation.

The second issue addressed in risk mitigation is to keep flexibility. The commonly perceived view is that supply chain disruption can happen unexpectedly and no risks are the same. Even there is a generic procedure in place, it cannot cover all risk scenarios. It is therefore important for the organisation to have the mindset of being flexible in figuring out the root causes and identifying right resources to solve the crisis. Knemeyer (2009) and Munoz (2015) commented similarly that flexibility initiatives can increase the speed of crisis recovery. Apart from developing flexible mindset, it was also highlighted by one of the participants from his operational point of view that flexibility also extends to design flexibility. Flexible design allows manufacturing companies to quickly switch from one component to another when they run into a crisis situation. This is especially helpful for automotive businesses where there are rigid procedures in place for change of components status. Should critical components be designed in several grades or standards and be tested and validated in the design phase, much greater flexibility would be reserved for manufacturers to switch to the alternative components to secure supply continuity in the event of a crisis.

Similar to flexibility, backup is perceived by many participants as a common approach for risk mitigation. The research shows that backup embraces several

dimensions, including regional operation backup, global operation backup and backup suppliers. This approach was endorsed by several previous researches. Trkman (2009) mentioned that dual/multiple sourcing strategies may be a preferable choice, especially where the main supplier is a bouncer. Heckmann (2014) gave the example where Ericsson and Nokia both had to deal with the same direct consequences of an unexpected incident. Ericsson suffered deeply from a supplier shortfall which nearly provoked them to leave the mobile phone market, while Nokia managed to acquire backup suppliers and alternative production capacities. Likewise, Ma (2014) noted that in order to improve the elasticity of the supply chain network, there should be at least one backup supplier to maintain a reasonable level of stock. Based on the previous researches, this is a common practice not only for automotive sector, but equally for other business sectors including mobile phone industry.

Next perceived critical risk mitigation factor is collaboration. Sun (2012) noted that based on the definition of supply chain risk management, it appears that one can mitigate risks by adopting appropriate policies of the 3C (coordination, collaboration, and cooperation). This was well confirmed by the research participants' perception.

The research has discovered that collaboration includes three main dimensions – collaboration within the company, collaboration with suppliers, and collaboration with customers. This includes setting up special task forces, in event of a crisis, to better aggregate internal resources to eliminate mis-alignment for quick action.

Supply chain management team of the company worked closely with suppliers on adjusting production planning, delivering and sending the expert to suppliers to support quick improvement of production output. In order to make full use of effective capacity, planners were also dispatched to suppliers to jointly work on suppliers' production planning. For downstream side, sales team approached

customers to request for car manufacturers to adjust their production planning so that supply can continue and earn the time for recovery. Such endeavours also earned financial benefit to both car makers and the company – the car maker can switch to other models for production and the company can avoid high penalty due to the customer's line stoppage. This was also echoed by Westbrook (1991) that closer collaboration with suppliers increases supply chain integration and performance. It was suggested by Kleindorfer (2005) that disruption management must endeavour to provide incentive alignment and collaboration for risk avoidance and reduction amongst all supply chain partners. Birkie (2016) concluded that the role of external collaboration with suppliers, customers and other partners, internal coordination, and cross-functional integration are recognised to provide companies with better agility in mitigating and responding to risks.

The research again unveiled management attention on human side. It was perceived that communication is an important risk mitigation factor. Some researchers such as Christopher (2011) even asserted that poor communication can be a main risk for supply disruption. It was highlighted by participants that there is extremely limited time, in a crisis mode, for employees to handle many objectives and confusions. Open communication, therefore, should be encouraged to help align employee behaviours as identified by Wong (2012). It was discovered that communication used to be interpreted as communication to customers, suppliers, internal employees and the public, depending on the level of disruption. The capability to exchange information across internal functional barriers in a timely, responsive and usable format (Closs, 2004) enables the manufacturer to quickly respond towards the same direction and avoid internal confusions. In the same vein, Gurnani (2012) argued that leading indicators need to be tracked, control limits need to be set to determine out-of-control conditions, two-way communication with suppliers and customers must be done on a continuous basis and visibility system must be in place. Adding to

that Jia (2010) cautioned that there are authors argue that cultural distance between supply chain partners negatively influence the building of mutual trust, which will subsequently impede long-term coordination. Hence the cultural differences between China and the West should be considered as a potential source of risk. It has to be admitted this is not covered in the scope of this research.

The most interesting issue is contingency plan where there appears to have differed views between senior management and frontline managers. The frontline managers argued for the necessity of having a contingency plan which can help quickly mitigate disruption risks, especially in the fronts of eliminating internal cross-functional barriers and quick access to desired resources. With no surprise, this was also argued and advocated by researchers such as Blackhurst (2011), Tummala (2011), Knemeyer (2009) and Kern (2012), etc. who argued that contingency plan can help reduce mistakes and develop self-executing plans which enable firms to deploy mitigation strategies quickly, thereby increasing supply chain resiliency. Zolkos (2003b) and Ellis (2010) further concluded that companies that will be successful are those that can identify and develop contingency plans for the various risks that exist internally and externally to the organisation. Ironically the senior leadership may perceive contingency plan in a different perspective. It was argued by senior executives that the cost to develop and update a contingency covering all risks can be extremely costly due to duplicated tooling and equipment. Since many disruptions are unforeseeable, it will be wise to put the right resources for mitigation than contingency. This debate may be attributable to the realities that senior management usually work with demanding financial targets on the one hand, and frontline managers are prone to consider more on their daily operational tasks on the other.

6.5) Transformational Leadership style for supply chain risk mitigation

Greater attention is now being accorded to crafting appropriate leadership styles that are accountable for the sustainability of supply chains and, managing their performance and improvement (Li, 2006; Robinson, 2005; Mentzer, 2001). Others accentuate that leadership drives the overall system of the supply chain that results in improved financial results and customer satisfaction (Ou, 2010; Kuei, 2001). These arguments are supported by several other researchers who reported effective leadership as a significant impetus for directing and managing while achieving impactful supply chain management performance (van Hoek, 2002; Kuei, 2001). Leadership and organisational innovativeness have received only a modest amount of attention in supply chain researches. For instance, Williams (2002) identified that virtually no paper had highlighted the importance of effective supply chain leadership. Although a recent stream of supply chain leadership researches provided the conceptual framework of comprehension that this is still an under-researched area (Defee, 2009), there remains a dearth of empirical research on leadership in the supply chain domain. Additionally, there is a recognised lack of empirical research regarding logistics innovation and the outcomes thereof (Grawe, 2009; Hazen, 2012).

It was identified in the data analysis of last chapter that a set of transformational leadership styles appear closely associated with successful endeavours of supply chain risk mitigation. Sheaffer (2011) reported that key leadership style, primarily those associated with transformational and transactional types, decision-making styles and risk-taking propensities constitute conspicuous antecedents of perceived crisis proneness or preparedness. Unlike the perception towards contingency plan, it was widely acknowledged by participants that strong transformational leadership is vital in their experience of mitigating supply chain disruptions. Cilliers (2008) argued that a leader who shows dedication, a strong sense of purpose and perseverance, and confidence in the purpose and the actions of the group helps to ensure the success of the group and gives followers a sense of empowerment and ownership.

Typical transformational leadership styles as shown in Table 10 also emerged during the crisis management, which is key to influence their colleagues and employees in delivering desired objectives. Bass (1985) suggested that leaders who succeed in affecting their followers to transcend self-interests for the benefit of the group or organisation to achieve extraordinary goals would be characterized as transformational. Contrastingly, managers who solely induce the most basic exchanges with their followers embody transactional leadership (Bass, 2006).

Leadership Styles	Benefit to Risk Mitigation	Literature
Assertive Risk taking	<ul style="list-style-type: none"> - Quick decisions - Volunteer to be task force leader 	Eagly (2007) argued decision making is argued to be centralised during crises because of the need to take fast and decisive actions.
Hands on Priority setting Drive for perfection Engage people Authorisation People development	<ul style="list-style-type: none"> - Employees were given freedom and flexibility to voice opinions to the management - Constant status review from management - Challenge the status and set new objectives 	<p>Misha (1996) argued that participative decision making is encouraged during harsh times primarily because this enhances the flow of additional and creative insights emanating from underlings.</p> <p>Sheaffer (2011) suggested that over assertive and risk-taking willingness organisation are more prone to crisis, however participative leadership style during the crisis are beneficial for risk avoidance.</p> <p>Emiliani (1998) suggest the subconscious emotional memories can lead to systemic difficulty in controlling one's response in stressful business settings.</p>
Emotin and tension management	<ul style="list-style-type: none"> - Leadership self management on their fear, anger, stress, frustration, etc. to set good examples to influence the whole team. 	Goleman (1995) argued that one's emotional intelligence is a significant factor in determining one's ability to more regularly achieve flow in threatening environments.

Table 10: Transformational Leadership styles for supply chain risk mitigation (Source: author)

As listed in Table 10, the first set of transformational leadership attributes belong to those leaders who tend to be assertive and willing to take risks as appeared in successful experiences. It is not surprising that in a crisis mode when time is precious, any delay in making decisions will render additional loss to the organisation. Decision making is argued to be centralised during crises because of the need to take fast and decisive actions (Eagly, 2007). This is especially true in an organisation where there are already many mis-alignments as presented in the previous chapter -- without a strong and decisive leader who is willing to take risks despite of the known potential company politics which may go against him/her afterwards, things may well go into diversified directions and chances for a successful mitigation be missing. This is typically embodied in volunteering him/herself to be the task force leader, convincing management team for necessary resources and pushing for the results.

More importantly, being assertive and risk taking does not preclude from being hands on, priority setting, driving for perfection, engaging people, authorisation and people development, which are the second main cluster of transformational leadership styles for crisis mitigation. Mishra (1996) argued that participative decision making is encouraged during harsh times primarily because this enhances the flow of additional and creative insights emanating from underlings. Top management team in turn may benefit from and build on the diversity of views, attitudes and experiences, all of which have the potential to improve the quality of critical decisions made at higher echelons. Sheaffer (2011) suggested that over assertive and risk-taking willingness organisations are more prone to crisis, however participative leadership styles during the crisis are beneficial for risk avoidance.

The current research demonstrates that the research organisation has a good combination of being assertive and risk-taking in terms forming a special task force. Upon the task force being established, considerable authorisation, freedom and

flexibility are accorded to the team to allow opinions from different perspectives and to make swift, calculated and well-informed decisions. The task force is nonetheless not left alone. The leadership team constantly reviews the priority setting to ensure the overall direction does not deviate from the ultimate objective and to ensure support with additional resources when necessary. Being a lean company, the research organisation is built upon a deep-rooted mindset from top management to frontline managers not to be complacent with where it is. They constantly question and challenge the data collected and information gathered through cross checking and proofing to avoid decisions being mis-led.

The third cluster of transformational leadership styles that surfaced is emotion and tension management. Here emotion management refers to managing one's own emotion whilst tension management refers to managing the friction and tension amongst team members and staff members. The common human reaction under the circumstance of crisis situation tends to be emotional and blame each other. Emotional instincts are so strongly programmed into the basic structure of human brain that people can evaluate a threat in a few milliseconds without conscious knowledge. Thus, defensive routines may be revealed well prior to a complete comprehension of the magnitude of the threat. Impulsive emotional responses have to wait for the rational mind (or thinking) to catch up to re-evaluate the threat. A rational response may be appropriate for the circumstances if the delay is short and the threat is determined to have been overestimated. If, instead, the thinking mind later confirms the threat, then we should be thankful that the emotional response provided us with an effective early warning. However, a rational mind that is preoccupied by anger, frustration, low self-esteem, anxiety, or a sense of victimisation will have difficulty in evaluating the threat, and any response is likely to contain a higher emotional content that could be too strong or off target for a given situation. The subconscious emotional memories retained from past experiences can

thus work to either improve rational decisions, or lead to systemic difficulty in controlling one's response in stressful business settings (Emiliani, 1998). Participants with successful risk mitigation experiences recalled their first reaction was to control their own emotions, not being panic. It is likely that one's emotional intelligence (Goleman, 1995) is a significant factor in determining one's ability to more regularly achieve flow in threatening environments such as the workplace. Emotional intelligence is the ability to control one's behaviour to eliminate self-defeating impulses, to know when and how to express emotions, and to discern the feelings of others. The benefit of emotion management is also confirmed by frontline managers of setting good examples and allows the whole team to calm down and work on solutions.

Leadership styles have long been associated with a variety of adverse corporate circumstances. The research demonstrates that key leadership styles primarily those associated with transformational styles bring positive effects to supply chain risk mitigation. It suggests that the organisation should consider developing necessary transformational leadership styles to the employees as this can be applied in risk mitigation.

6.6) Issues anticipated in literature review that did not emerge through primary research

As had been discussed in foregoing sections, a wide range of issues anticipated in the course of literature review were articulated by the study participants through the process of primary data collection. A number of new issues emerged through the study itself. At this point, it is perhaps useful to reflect upon any significant issues that were anticipated through the literature review but did not emerge eventually or others which emerged to an unexpected degree.

6.6.1) Perceived risks

Within the literature review in Chapter Three, a big array of risks was anticipated, Olson (2010) mentioned that the main supply chain risks range from external risks, including natural, political system, competitor and market, through to internal risks, including capacity availability, internal operation and information system. Christopher (2007) argued that supply chain disruptions are unavoidable and as a consequence, that all supply chains are inherently risky. The decision by a firm to pursue (i) supply base reduction increases node criticality; (ii) global sourcing increases complexity, and (iii) sourcing from supply clusters increases density, which, in turn, elevates the firm's exposure to severe supply chain disruptions.

This research, however, discloses that risks perceived by practitioners are not those risks associated with external factors, but rather associated with internal factors. More importantly, although there are commonalities with former authors (Christopher, 2007; Olson, 2010), such as in terms of quality, capacity, forecast, there is no available research claiming that functional mis-alignment manifested by KPI mis-alignment can lead to decision mis-alignment and subsequently mis-alignment on quality, capacity and forecast. If it is agreed that internal risks as aforementioned (Christopher, 2007; Olson, 2010) are the risk phenomenon, the mis-alignments as elaborated in this study can be considered as the root cause of the internal risks in the organisation being studied. It can be argued that former researchers' studies on supply chain risks tend to focus on study phenomenon, this study by deep dive into a single organisation, unveiled the root causes of supply chain risks arising internally from the company.

6.6.2) Risk mitigation methods

Literature review in the previous chapter suggests that commonly adopted risk mitigation approaches as asserted by Hendricks (2003), Christopher (2011), and Sodhi (2012) are mainly three-fold: alignment of supply chain partners' incentives to

reduce the behavioural risks with the supply chain; flexibility to reduce not only demand risks but also supply and process risks; and building “buffers” of redundancies. In vein of such school of arguments, supply risk researches (Faisal, 2006; Christopher, 2011; Kern, 2012; Gualandris, 2014) were mainly focusing on building numerical computer aided models to calculate and forecast risks and find out the supply chain equilibrium point. This is supported by Ho (2015) who reviewed 224 journal articles published between 2003 and 2013 and reported that the most popular individual analytical approach was mathematical programming (47 out of 119 articles or 39.50%), followed by newsvendor model (10 out of 119 articles or 8.40%) and simulation (10 out of 119 articles or 8.40%). Besides, the most popular individual empirical approach is the multiple regression model (3 out of 119 articles or 2.52%). Obviously, the empirical methods have attracted much less attention than the analytical methods, 7 vs. 112. One of the key reasons is that it is difficult for researchers to communicate with practitioners and gain access to industry to carry out empirical studies.

This research, based on empirical study, unveils practitioners’ views on effective risk mitigation methods. None of the participants considered that numerical models were important for either risk identification or risk mitigation. Practitioners believe that a set of mitigation methods which can largely fall into the category of resilience is effective in managing risk situations. There is a paradoxical view on resilience amongst researchers.

Christopher (2011) critiqued resilience on its two-fold limitations. Firstly, resilience invariably causes additional cost, in the form of slack resources (e.g. inventory and capacity), as well as higher coordination cost (e.g. due to multiple sourcing). While conceptually sensible, under stable conditions, this will place any firm at a competitive disadvantage: if the supply chain is stable, the resources spent on

creating that resilience are wasted; Secondly, some of the uncertainties we are talking about that arise from all sorts of areas can be controlled, whilst some others cannot. These are not isolated incidents (such as 9/11 or an earthquake), but fundamental shifts in many key variables that determine our business environment.

Interestingly the research demonstrates that practitioners' perceived risks indicate that the supply chain is not stable but is constantly challenged by different customers and internal mis-alignments, therefore the resources spend on creating resilience will not be wasted by adding value to business continuity; In addition, perceived risks are mainly internal mis-alignment, most of which can be controlled. This finding is also echoed by Pettit (2013) who suggested a correlation between increased resilience and improved supply chain performance. Similarly, Blackhurst (2011), through an empirical study suggested 19 resilience factors supporting supply chain risk mitigation and concluded that resilience supply chain is a means to reduce the likelihood of a disruption severity of supply chain disruption.

6.7) Interaction of findings

It was observed during data analysis process, some of the antecedents' resilience was revealed as being perceived to be effective supply chain risk mitigation enablers. As an example, it was suggested that although the research company does not have a company-wide contingency plan in place, participants maintained that a list of resilience elements, as a matter of fact, are practically well established back in their mind and applied on risk mitigations. Participants further reflected that their success in mitigating supply chain risks largely attribute to flexibility, backups, quick response, and effective communication.

The second key risk mitigation factor surfaced is transformational leadership. Participants recalled some common transformational leadership styles

demonstrated during the course of risk mitigation. It can be argued that those transformational leadership characters further strengthened the organisation's resilience capabilities. An example such as quick response is actually reinforced by assertive and risk-taking leadership character. Without such a transformational leadership character, the organisation would not have people quickly jumping into the crisis and setting up task force.

Good emotion and tension management reinforces communication – by building a positive atmosphere with no blame or stress, staff can better communicate and collaborate without concern.

Finally, being participative, such as being hands on, priority setting, authorisation, people engagement, and drive for perfection enables the organisation to be flexible and open up minds to identify backup sources. All these form the synergy of the organisation in mitigating the perceived supply chain risks. Figure 7 itself is novel and has been developed and proposed as a direct outcome of this study. It summarises that transformational leadership can reinforce organisation's resilience capability which in turn enhances its capability of supply chain risk mitigation.

In light of the philosophical stance adopted for this research project and with a social constructionist ontology and interpretivist epistemology, no overt attempt was made to quantify the perceptions of the relative importance or strengths of the findings. A set of themes and sub-themes has, however, emerged organically through the thematic analysis process with those issues as listed in Figure 7. Each of these is perceived to have a bearing on the effectiveness of others – transformational leadership strengthening resilience capability and further supporting the mitigation of perceived risks.

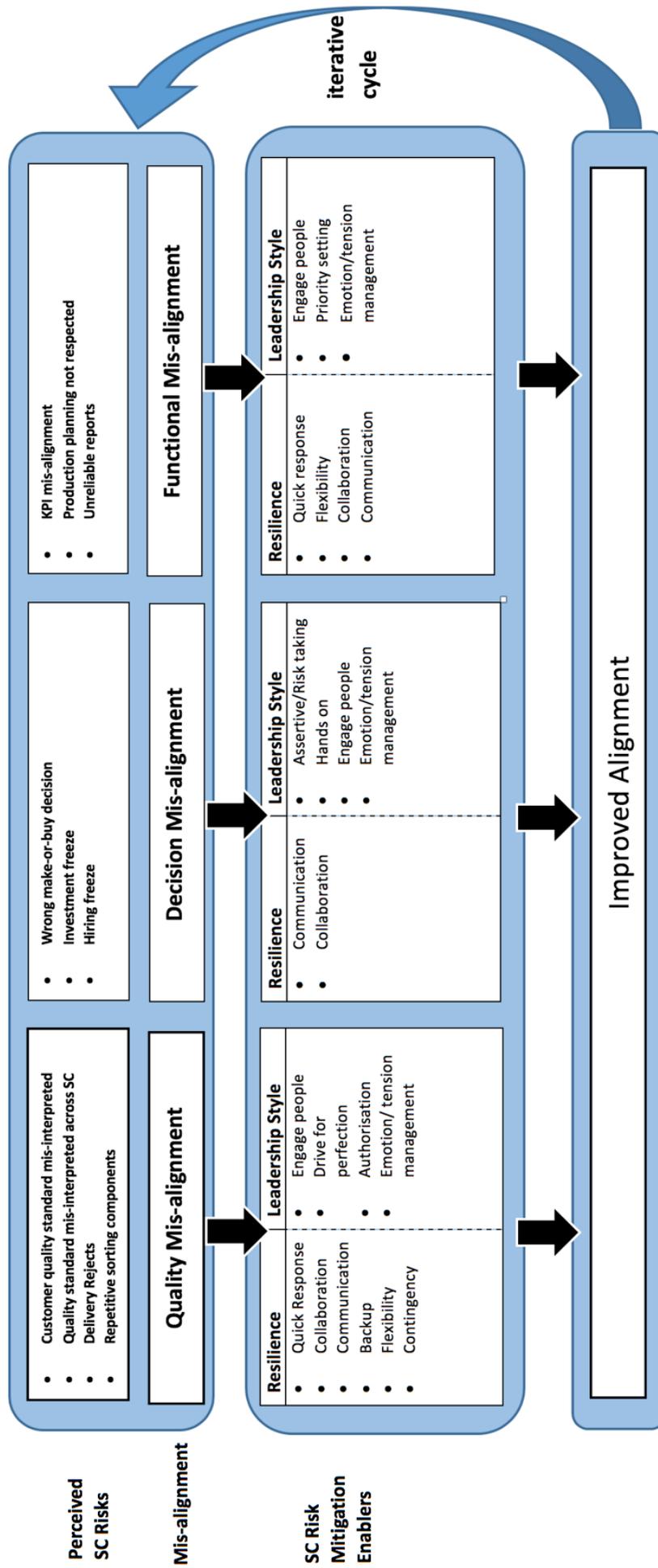


Figure 7: Framework on Perceived supply chain risks and mitigation enablers. (Source: Author)

The frame work on perceived supply chain risks and mitigation enablers (Figure 7) provides a supporting tool for Chinese automotive supply chain practitioners to gauge their internal organisational weakness on potential areas of mis-alignments, based on which countermeasures can be developed in order to strengthen resilience and leadership styles.

The framework starts by listing three clusters of perceived supply chain risks. Each cluster, according to the research, are categorised into quality mis-alignment, decision mis-alignment and functional mis-alignment. The research suggests that resilience and transformational leadership styles can synergise SC risk mitigation, based on which, a set of SC risk mitigation enables are provided for SC practitioners to choose based on their specific organisation situations. Under the support of the SC mitigation enablers, the supply chain will improve its alignment. It must be underlined; however, the supply chain mis-alignment improvement is an iterative cycle. When new mis-alignment may arise, the similar circle has to go through again to bring the supply chain back to enhanced alignment.

At present, the research findings and the perceived risk mitigation framework has been developed based on the ten-participant study. Whilst many of the sub-themes (and underlying relationships) have been uncovered through data analysis, it is important to clarify that the boundary of the study has been reached and that further work is required to have greater confidence in the list of enablers. Similarly at this stage, the enablers (sub-themes) are presented in equally amortised weight, suggesting an equal importance and strength of relationship. Likewise, this exercise can be furthered in the future to improve the sophistication of the relationship matrix and weight distribution in contributing to mitigating perceived risks. It is expected that the framework would evolve into a model with a predictive element

that would more compellingly demonstrate the relationship with the framework, which is however outwith the scope of the DBA study.

6.8) Recommended guidelines

Section 5.0 demonstrates a series of implications on practices which are identified as a natural flow from the study. Each of these is of pertinence to and worthy of consideration by supply chain practitioners and senior management of automotive companies.

6.8.1) Recommended guideline 1: Ensure internal management system well connected and aligned

Throughout the data collection process there has been considerable criticism on the study organisation's alignment in many aspects. These are perceived as barriers within the organisation and jeopardise supply chain operations. As an example of the interesting findings, none of the participants criticised their own function, but often blamed on others for malfunctioning. It is therefore the job of the leadership to reflect upon the problem areas within their organisation, especially in the following areas:

- With regards to quality mis-alignment, it can actually be traced back to new project acquisition phase and project development phase where customer quality expectations and company's internal capability need to be aligned and reflected in internal quality control documents. Even for carryover projects from Europe or North America, quality expectations need to be again re-aligned with customers and addressed, as Asian customers tend to be more rigid on aesthetical parts. Additionally, boundary samples need to be agreed and signed with customers so that measurable criteria can be established for internal quality control, even when sorting are necessary, there can be a quick guide to measure actual results and considerable time

and cost can be saved.

- With regards to decision mis-alignment, the main criticisms are that regional suggestions are not supported by the headquarters, which leads to wrong make-or-buy decisions. It is therefore recommended that regional business case preparation should involve a wider source of data input – apart from operation and finance, purchasing, logistics, supplier quality and customer quality should also be invited for risk assessment and input. In the event that a buy decision has to be made due to tight investment control, dedicated human resources and expenses have to be planned in advance and get signed off by relevant functions.
- Finally, with regards to functional mis-alignment, the perception is that functions tend to focus on their own KPIs, which may not be beneficial to the company. It is necessary for the senior management to organise cross-functional workshops to enable functional teams to understand the expectations from other functions and develop improvement plans. Next is that leadership team needs to align each functions' priorities and key initiatives during each year's budgeting phase, enabling necessary resources to be allocated and consensus reached based on the alignment. With such, it is further recommended that KPIs can be shared amongst functions by weight, so to encourage functions take care other functions and bring ultimate benefits to the company and eliminate mis-alignments.

To summarise, the above suggested guidelines shall be applicable to functions from the headquarters down to regional operations and plants, including programme management, sales, quality, operation, purchasing and supply chain management. Key focus here should be three-fold: 1) Align quality stand from project acquisition phase through to final project launch with customer, within the organisation and with suppliers; 2) Strategic decisions, such as make-or-buy should be made involving

all associated stakeholders and make sure necessary resources are allocated upfront and signed off by responsible managers; 3) Cross-functional workshops shall be organised at minimum once a year to agree common objectives based on changing business needs.

6.8.2) Recommended guideline 2: Build and strengthen resilience capability within the company

Resilience elements are perceived as vital in supply chain risk mitigation. Apart from contingency, all other elements including quick response, flexibility, backups, collaboration and communication are highlighted by participants to be effective for risk mitigation. It is necessary to identify key parts and prepare internal or external backups. This shall be further supported by flexible design to allow parts to be interchangeable so to save the time for validation. Although the top management considers contingency to be too costly, it can be noticed actually the frontline managers have a set of un-written contingency plan in their mind, with such they can quickly setup task forces, seek resources, collaborate internally and externally, and manage efficient communication in the same time. It is therefore recommended to lead by management to develop a set of risk mitigation guidelines to avoid high cost and allow enough flexibility for employees to follow under crisis circumstances, so that valuable time can be saved for taking effective actions.

In summary, with regards to resilience, the recommended guidelines are as follows:

1) Develop contingency plan at global, regional and plant levels while having the task force and resource allocation prepared, to enable quick and effective response; 2) Define clearly rules for internal communication and customer communication in crisis mode to eliminate confusion and panic to enable the team to be fully concentrated on key mitigation tasks; 3) Develop backups for critical parts with dual

sourcing and validation, and critical production processes capable of backup by sister plants or external suppliers.

6.8.3) Recommended guideline 3: Develop transformational leadership capability within the company across all functions at all levels

Transformational leadership style for risk mitigation is one of the most important findings of this study. A set of transformational leadership styles as discussed in Discussion Chapter is associated with successful supply chain risk mitigation. This is especially valuable for companies with many mis-alignments. A strong leadership is able to volunteer as a champion and to mobilise and motivate internal resources to work in the same direction. As such, it is recommended that employees with such identified transformational leadership styles shall be considered for key positions. Furthermore, company's human resources functions shall rank transformational leadership development into high priority and make it a company-wide programme to enable employees at all levels to develop necessary transformational leadership capabilities to drive for solutions.

As discovered in this study, transformational leadership style is critical for supply chain risk mitigation. Hence the following guidelines are recommended for regional leadership teams: 1) Company-wide transformational leadership style training programme; 2) Integrate aforementioned transformational leadership styles into new talents acquisition evaluation criteria; 3) Integrate transformational leadership behaviours into employee performance appraisal criteria.

6.9) Research question discussion

At the end of the Discussion Chapter it is important to revisit the research questions that were generated from the literature review and outlined in Chapter Three, in

order to discuss the findings of the study. Each of the three research questions is therefore considered in turn.

6.9.1) Discussion on research question 1

What are participant perceived supply chain risks in China's automotive sector?

During the data collection process, it was observed that there appeared to be a “blaming culture” inside the research organisation. This might attribute to the participants expectation to influence the author and hence have their messages passed to senior management, as they were aware that this research program has earned support from the senior management.

Despite the company politics, it was discovered however that majority of the participants firstly recalled that quality failures, either from suppliers, in-house, or customers cause most of the incidents of supply chain disruptions. Respondents such as the Asia Supply Chain Director, Plant General Manager, and Asia Operation Director all gave examples of mis-aligned quality standards of the company and customers. These respondents reflect partial connections highlighted in the literature. The Asia CEO, Asia Operation Director and General Manager all gave examples in a subtle way that headquarters refused to make equipment investment decisions, which led to premium airfreight cost due to supply chain disruptions.

The examples described above show that a deep dive into and sound interpretation of the data would be illusive should the researcher be not an employee of the research company. Certain subtle abbreviations or just a simple laugh of the staff may convey the messages of their discontent to the headquarters or their peers. This would be nearly not possible to be interpreted by an outsider researching several different companies.

Strikingly none of the participants perceived external risks, such as natural disasters, political turmoil or market fluctuation, as a main risk factor. Although the Asia Supply Chain Director recalled Tsunami in Japan back in 2011, he still reflected more on eliminating internal dis-connections and benefit of task force management associated with risk mitigation. It was believed by participants that external risks are not predictable, yet there are things can be done on internal mis-alignment to improve the response to supply chain disruptions.

6.9.2) Discussion on research question 2

What do participants perceive as the common and effective supply chain risk mitigation methods?

The most interesting finding here is the differed views on contingency plan. The Asia CEO and Asia Operation Director both confirmed that there is no company-wide contingency plan in place, and they both denied the needs to develop a contingency plan. However, the frontline manages, such as the purchasing manager, logistics manager, Asia supply chain director all believe that a contingency plan can be valuable in facilitating risk mitigation, especially in terms of defining roles and responsibilities for associated functions and thus making it easy for them to access internal resources. The differed view of the Asia CEO and Asia Operation Director sounds more sensitive on cost as they believe the cost for contingency plan could be enormous and not cost effective.

Apart from that, it was surfaced that participants appear to share similar views on quick response, flexibility, backup development, good collaboration, and communication. These are also listed in the framework (Figure 7) as key risk mitigation factors, and also in line with key elements as reported in resilience

literatures. The puzzle then comes out – if there are many mis-alignments in the organisation, how could the organisation behave in such an organised fashion in a crisis situation? Research Question 3 discovers the answer as a result of a deep dive.

6.9.3) Discussion on research question 3

What do participants perceive human behaviours can influence supply chain risk mitigation?

From the primary research undertaken for this study, a range of characteristics that affect the participants' ability to act in a supply chain crisis situation were identified. Participants perceived to have a key impact upon their ability in a crisis mode. As described earlier, these may be clustered in three groups – 1) assertive and risk-taking leadership character, without which the organisation would not have people quickly jumping into the crisis and setting up task force; 2) good emotion and tension management reinforces communication – by building a positive atmosphere with no finger pointing or stress, where staff can better communicate and collaborate without concern; 3) being participative, such as hands on, setting priority, authorisation, engage people and drive for perfection enables the organisation to be flexible and open up minds to identify backup sources. All these bring a synergy to the organisation in mitigating the perceived supply chain risks.

An example of the relationship is highlighted in Figure 7, where it is noted that transformational leadership styles reinforce the organisation's resilience capability in aggregated synergy which supports the organisation in successful risk mitigation.

6.10) Chapter conclusion

This Chapter includes the discussion on the analysis and findings of the study undertaken. Reflections are provided on the three main themes identified through

the primary research, i.e. perceived supply chain risks, resilience for supply chain risk mitigation, and transformational leadership for risk mitigation. Furthermore, consideration is given to those themes that were anticipated through the literature review but did not eventually emerge through the research. Relationship amongst the three main themes is also discovered and explored: A set of leadership styles reinforces the organisation's resilience capability which aggregates synergy for perceived supply chain risk mitigation. A new framework is developed and presented which outlines the relationship amongst risk mitigation enablers and perceived risks. With discussion being undertaken, consideration turns in next chapter with the conclusion and recommendations that may be drawn from the study.

CHAPTER SEVEN: CONCLUSION AND RECOMMENDATIONS

7.1) Chapter introduction

In light of the current dynamic yet turbulent nature of China's automotive business environment, it has been highlighted that there is an increasing pressure on automotive suppliers exposed to supply chain risks. Such a circumstance requires automotive companies to seek for new approaches to broaden their understanding on perceived supply chain risks and explore new alternatives of developing supply chain risk mitigation strategies. Within this context, this study has outlined increasing requirement for management team to remain resilient and develop necessary transformational leadership styles, with which the aggregated synergy will be able to support supply chain in risk mitigation in a new dimension.

The aim of this research is to explore practitioners' perceived supply chain risks and risk mitigation strategies within China's automotive context. As outlined in Chapter One, four key objectives have been guiding the study. The research aim is subsequently delivered through:

1. examining critically existing literatures regarding supply chain risks and risk mitigation strategies;
2. identifying the key elements influencing the organisations applying lean strategies in the automotive industry from the management perspective;
3. identifying key influencing factors in risk mitigation strategies used within lean organisations from the automotive industry;
4. identifying the key influencing factors impacting the outcome of risk mitigation strategies to enhance future development.

Built upon previous chapters and in particular the discussion presented in Chapter Six, this final chapter is to summarise the main conclusions that may be drawn from

the themes identified in the research herein. Implication on knowledge and practices are explored and recommendations thereof, as the outcome of this research, are presented for consideration by China's automotive sector. Opportunities for further research in the future, including future research recommendations in this area, are outlined before concluding remarks are offered.

7.2) Research objectives: Conclusion

In light of the material presented in this thesis, the following conclusion may be drawn regarding the three research objectives outlined earlier. It is also appropriate to reflect herein on how well each of the objectives supports the delivery of the overall research aim.

7.2.1) Research objective 1

The first objective of this study is to “examine critically existing literatures regarding supply chain risks and risk mitigation methods”. In order to address this objective, relevant literatures were identified and examined critically within literature review section. The review commenced with screening literatures associated with *disruption, risk mitigation, leanness, China automotive, resilience, agility, perception, human behaviour, leadership* and *decision making*, etc. in a wide spectrum of academic literature in this area. Throughout the review, it was brought to attention that lean firms are more likely to be exposed to the risk of supply chain disruptions due to every nodes being extremely compressed, whilst conventional risk mitigation methods can hardly fully address all the risks since earlier researches were more focused on mathematical models nonetheless a big portion of human elements remain under researched.

Key issues arise with three main research questions – 1) What are participants' perceived supply chain risks in China's automotive sector? 2) What do participants

perceive as the common and effective supply chain risk mitigation methods? 3) What do participants perceive human behaviours can influence supply chain risk mitigation? Conclusion may be drawn that this objective is essential in forging the comprehension of the main dimensions of the study, and hence is important in establishing the basis upon which the rest of the study is built.

7.2.2) Research objective 2

The second research objective is “identifying the key elements influencing the organisations applying lean strategies in the automotive industry from the management perspective”. Based on the research questions outlined in the literature review chapter, a full explication of the methodology and methods applied is unfolded in detail in the research methodology chapter, including an overview of why an inductive methodology and purposive data collection method are chosen for this study. It may be concluded that the methods chosen worked well on eliciting perceptions of participants regarding perceived supply chain risks and associated risk mitigation strategies. A wealth of research data is captured through interview transcripts, which is proven sufficient and appropriate to inform the delivery of the next research objective.

7.2.3) Research objective 3

The third research objective is “identifying key influencing factors in risk mitigation strategies used within lean organisations from the automotive industry”. An overview of thematic analysis undertaken in this study is provided in Chapter Four, which demonstrates a series of codes that had been identified through the data analysis. Throughout this process, it is identified that three major clusters or themes could be revealed as outlined in Chapter Five and subsequently discussed in greater depth in Chapter Six. The themes include: Perceived supply chain risks mainly arise from mis-alignment; Resilience is a vital part in risk mitigation; and Transformational

leadership for supply chain risk mitigation. A number of sub-themes and relationship between themes are also revealed with a number of which being summarised in the framework. It may be concluded that this objective and the thematic analysis undertaken has played a vital role in delivering the research aim.

7.2.4) Research objective 4

The fourth research objective is “identifying key influencing factors impacting the outcome of risk mitigation strategies to enhance future development”. Key issues arising from the primary data collection and analysis undertaken thereon is presented in Chapter Six (Discussion) with a load of contributions to academic knowledge and practices elaborated in Chapter Seven. Recommendations thereon are provided to supply chain practitioners. It may be concluded that delivery of the fourth research objective is critical to ensure that contributions to practice may be demonstrated from the study, which is a key requirement of the DBA programme.

7.2.5) Reflection on research objectives

It may be reflected that the four research objectives outlined for this study are appropriate, effective and successful in directing the delivery of this study’s research aim through exploring participants’ perceptions towards supply chain disruptions and associated risk mitigation strategies. Each objective is perceived by the researcher as being built upon the former, constituting solid support for the completion of the overall study. It should also be noted that the objectives are kept under review throughout the period of the study and are adapted to the final research aim.

7.3) Research questions answered

The research questions are outlined in the literature review chapter and addressed in the discussion chapter. It is important however that concise answers are provided to each of them in this Conclusion Chapter.

- Research question 1 answered

What are participants' perceived supply chain risks in China's automotive sector?

Participants perceive supply chain risks mainly arise from mis-alignments and gave examples of different forms of mis-alignments. In a nutshell, the mis-alignments can be summarised in three categories, including, quality mis-alignment, decision mis-alignment and functional mis-alignment. All these mis-alignments jeopardise supply chain operation and lead to disruptions.

- Research question 2 answered

What do participants perceive as the common and effective supply chain risk mitigation methods?

Participants' perceptions are well aligned with the criteria of supply chain resilience in support of supply chain risk mitigation, namely: quick response, flexibility, backups, collaboration, communication, and contingency plan. It has to be underlined that although top leadership does not consider contingency plan as a good choice due to its associated high cost, it is valued by frontline managers as an effective approach.

- Research question 3 answered

What do participants perceive human behaviours can influence supply chain risk mitigation?

A set of transformational leadership styles emerged from the thematic analysis that could support supply chain risk mitigation, which can be clustered in three groups, i.e., 1) Assertive and risk-taking; 2) Good emotion and tension management reinforcing communication; 3) Participative, such as hands on, priority setting,

authorisation, people engagement, and drive for perfection, enabling the organisation to be flexible and open up minds to identify backup sources.

7.4) Contribution to knowledge

As with any piece of doctoral level research, it is an important expectation that the implications for knowledge are considered and outlined clearly. The literature review in Chapter Three outlines a wide range of issues that are pertinent to support supply chain risk mitigation.

Furthermore there are reflections in this thesis on issues that what earlier researches suggested may not be fully applicable to the contemporary changing circumstances of supply chain risks, for example the arguments from Nienhaus (2006), Wee (2009), Ellis (2010), Tokar (2010), Kulas (2013), Sakar (2015), Sax (2015), and Asgari (2016). It further extended supply chain risks classification of five categories by Christopher (2004). With such, this research brings significant contributions to knowledge mainly in the following areas:

- Perceived supply chain risks mainly arise from mis-alignment, including quality mis-alignment, decision mis-alignment and functional mis-alignment.
- Resilience is a vital part in risk mitigation.
- Develop organisation and transformational leadership style for supply chain risk mitigation.
- Transformational leadership style and resilience can synergise to support supply chain risk mitigation.

The primary data collected and analysed in this research project confirm that many of the risk factors and risk mitigation strategies are indeed still pertinent within China's automotive sector. New and emergent factors have also arisen, such as,

mis-alignment is the major perceived risks and transformational leadership style can be applied on supply chain risk mitigation.

As reported above, the study has identified a number of antecedents of risk factors and mitigation methods as perceived by participants from China's automotive sector. It is further suggested that interactions may exist amongst some of the identified dimensions. Previous studies have not adopted the methodological approach of this research so far in seeking to draw out an understanding of practitioners' perceptions, although some evidence arising from the literature review indicate that some efforts are underway endeavouring to study the relationship from certain aspects. The study of perceived supply chain risks and application of resilience and transformational leadership style for mitigation may be somewhat novel and therefore sheds some new light to research in this field.

There is a wide body of published work that explores supply chain risks and associated risk mitigation methods through researching several organisations and attempt to address the solution by mathematical models. A selection of such works is considered within Chapter Three. This study takes inductive approach and has identified that mis-alignment as a matter of fact is perceived as the main supply chain risk. It became surfaced through data collection that resilience and a set of transformational leadership styles are effective for risk mitigation. Furthermore, it is established that the aggregated synergy of resilience and transformational leadership styles works towards mitigating supply chain risks.

7.5) Contribution to practice

The research undertaken for this study highlights a number of implications for organisational practices. A key outcome of the primary research phase is the identification of a wide spectrum of dimensions that are perceived by participants of

different manifestation of mis-alignments as the main source of supply chain disruption. The study has also identified key resilience factors that are considered to be supportive to supply chain risk mitigation. The factors identified by the study participants covered a diverse set of dimensions, many of which resonate with those identified in the literature outlined in Chapter Three. This analysis undertaken as part of this study however clusters these dimensions into six areas, i.e., quick response, flexibility, backup, collaboration, communication, and contingency plan. Furthermore, it was surfaced through thematic analysis a set of transformational leadership styles that can contribute to supply chain risk mitigation.

It may be worthwhile to supply chain practitioners in the following areas:

- Mis-alignment

Three sets of mis-alignments are identified through the primary research, i.e., quality mis-alignment, decision mis-alignment, and functional mis-alignment. The implication could be to invest more attention in streamlining internal management system so to improve overall quality management system. It is also necessary to eliminate silo thinking within the organisation to reduce functional mis-alignment. Finally, more authorisations from the headquarters may be necessary as many make-or-buy decisions are made by headquarters to outsource, thus leading to devastating disruptions. This is especially true for foreign investment companies in China as strategic decisions are usually made from their overseas headquarters.

- Resilience

As aforementioned, six clusters of resilience elements are identified as effective in supply chain risk mitigation. These are largely in line with the literatures based on previous researches from different business sectors as

outlined in Chapter Three and can be extended to businesses beyond automotive sector.

- Transformational leadership style

Three clusters of transformational leadership styles were surfaced through thematic analysis in this research, i.e., 1) assertive and risk taking; 2) hands on, priority setting, drive for perfection, people engagement, authorisation and people development; and 3) emotion and tension management. The study confirms those transformational leadership styles are effective in supply chain risk mitigation, especially for companies where there are many mis-alignments. This is valuable for practitioners to attain those transformational leadership styles as a high priority for development by utilising them in developing their management and staff, and improving their transformational leadership capability.

7.6) Limitations of study/recommendations for future research

Contributions to knowledge and theory are highlighted in this chapter. It is however recognised that the study does have its limitations in terms of both methodology and the research focus. These limitations are now considered, and recommendations are therefore made for further suggested research in the future.

7.6.1) Methodological recommendations

Chapter Four outlines the methodological approach adopted for this study. Post-study reflection on the methodology highlights that, whilst there is no explicitly right or wrong way to conduct the research, the methodological approach adopted is an appropriate means of drawing out a deeper understanding of the perceived risks and associated risk mitigation strategy being considered and acted as a golden

thread running through the research choices made. The stated philosophical stance informs clearly of the qualitative data collection methods chosen. Being a former employee of the organisation, the researcher decided a case focusing on a single organisation which allows a deep dive into the case, whilst observations and non-verbal messages are also captured and interpreted. A recommendation is therefore made that any future study of this subject matter could be undertaken successfully by adopting the same philosophical stance and combined data collection methods.

In choosing to undertake a study within China's automotive context, careful consideration is required regarding how many organisational contexts be appropriate to deliver the research aim and objectives. As outlined in Chapter Four a single case is selected as being sufficient and appropriate for this DBA study, although it is explicitly acknowledged that this would perhaps limit the claim for generalisability. In order to explore further the findings of this research, it is recommended that this study could be repeated in other single automotive company in China, or perhaps more effectively as a larger multi-case study. In order to broaden the research yet further, it may also be appropriate to undertake similar studies across other business sectors although this could change the research context significantly as outlined in previous chapters.

7.6.2) Research focus recommendations

As highlighted, the research conducted represents a number of contributions to knowledge and practice, all of which may be worthy of further consideration. Based on the work undertaken, the research would prioritise the following as recommendations for further research.

Three important findings of this study are the identification of the three themes and the subsequent development of a set of guidelines for perceived supply chain risk

mitigation as outlined in the Discussion Chapter. It is covered in the same chapter that certain transformational leadership styles can benefit resilience for risk mitigation. Although the research to date is considered sufficient for a DBA study, it is recommended that future studies can prioritise these guidelines and further implications for practice may be drawn therefrom. It is further recommended that future studies can demonstrate the relationship of specific transformational leadership styles and resilience elements which can further support practitioners in quickly deploying into their respective organisations.

7.7) Concluding remarks

This thesis is prepared in fulfilment of the requirements of a Doctor of Business Administration (DBA) programme. The motivation of the researcher is to go beyond the technical fulfilment of the programme, but rather make a contribution to both practice and knowledge, as outlined in Section 7.4 and 7.5 of this Chapter.

It is proposed that by undertaking the DBA journey and contemplating each of the research questions set out in the thesis, the research aim is fulfilled. In particular, the aim is accomplished through the examination of appropriate and supportive literatures, the undertaking of the semi-structured research interviews, and a thematic analysis to interpret the interview transcripts. Hence the outcomes of the research are presented as a framework in the Discussion Chapter for the development of theoretical and practical recommendations.

The thesis maintains its focus throughout the research journey. The outcomes of the research are filling the academic gap. More importantly, it brings practical application to future research and practice.

References

- Adamides, E.D., Papachristos, G. and Pomonis, N. (2012). Critical realism in supply chain research: Understanding the dynamics of a seasonal goods supply chain. *International Journal of Physical Distribution & Logistics Management*, 42(10), pp.906–930.
- Ahmed, N.U., Montagno, R.V. and Firenze, R.J. (1996), “Operations strategy and organizational performance: an empirical study”, *International Journal of Operations and Production Management*, Vol. 16 No. 5, pp. 41-53.
- Akao, Y. (Ed.) (1991), *Hoshin Kanri: Policy Deployment for Successful TQM*, Productivity Press, Cambridge, MA.
- Anon. (2014). CHINA V GASOLINE AND DIESEL FUEL QUALITY STANDARDS. *International Council on Clean Transportation*, (January).
- APCO Worldwide. (2010). Market Analysis Report : China ' s Automotive Industry. *Presented to: Israel Export & International Cooperation Insitute*.
- Aqlan, F. and Mustafa, E. (2014). Integrating lean principles and fuzzy bow-tie analysis for risk assessment in chemical industry. *Journal of Loss Prevention in the Process Industries*, 29, pp.39–48.
- Arlbjørn, J.S. and Freytag, P.V. (2013). Evidence of lean: a review of international peer-reviewed journal articles. *European Business Review*, 25(2), pp.174–205.
- Asgari, N. et al. (2016). Supply chain management 1982-2015: A review. *IMA Journal of Management Mathematics*, 27(3), pp.353–379.
- ATES, A., (2008) Fundamental concepts in management research and ensuring research quality: Focusing on case study method, 8th Annual European Academy of Management Conference, Slovenia, 14 – 17 May.
- Austin, Z. and Sutton, J. (2014). Qualitative research: getting started. *The Canadian journal of hospital pharmacy*, 67(6), pp.436–40.

Azad, N. et al. (2014). A new model to mitigating random disruption risks of facility and transportation in supply chain network design. *International Journal of Advanced Manufacturing Technology*, 70(9–12), pp.1757–1774.

BAKER, M. J. Selecting a research methodology. *Marketing Review*, v. 1, n. 3, p. 373-398, Spring 2001.

Balogun, J., and Johnson, G. (2004). “Organizational Restructuring and Middle Manager Sensemaking.” *Academy of Management Journal* 47(4):523–49.

Barroso, a. P. et al. (2010). Toward a resilient Supply Chain with supply disturbances. *Industrial Engineering and Engineering Management (IEEM), 2010 IEEE International Conference on*, pp.245–249.

Bass, B.M. (1985), *Leadership and Performance Beyond Expectations*, The Free Press, New York, NY.

Bass, B.M. and Riggio, R.E. (2006), *Transformational Leadership*, Routledge, London.

BEECH, N., (2005) *Research Methodology Course Notes: Strathclyde Business School*.

Birkie, S.E. (2016). Operational resilience and lean: in search of synergies and trade-offs. *Journal of Manufacturing Technology Management*, 27(2), pp.185–207.

Blackhurst, J., Dunn, K.S. and Craighead, C.W. (2011). An Empirically Derived Framework of Global Supply Resiliency. , 32(4), pp.374–391.

Blaikie, N.W.H. (2009) *Designing social research: The logic of anticipation*. 2nd edn. Cambridge, UK: Polity Press.

Bowen, G. A. (2008). Naturalistic inquiry and the saturation concept: A research note. *Qualitative Research*, 8(1), 137-152.

- Braun V, Clarke V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*; 3: 77–101.
- Burgess, K., Singh, P.J., Koroglu, R., (2006). Supply chain management: a structured literature review and implications for future research. *International Journal of Operations & Production Management* 26 (7), 703–729.
- CAAM (2014). [online]. Available from: <http://www.caam.org.cn/>
- Caldwell, N. et al. (2013). Impact of e-business on perceived supply chain risks. *Journal of Small Business and Enterprise Development*, 20(4), pp.688–715.
- Carter, C.R., Kaufmann, L. & Michel, A. (2007) Behavioral supply management: a taxonomy of judgment and decision-making biases. *International Journal of Physical Distribution and Logistics Management*, 37, 631–669.
- Castleberry, A. and Nolen, A. (2018). Thematic analysis of qualitative research data: Is it as easy as it sounds? *Currents in Pharmacy Teaching and Learning*, 10(6), pp.807–815.
- China Daily (2011), Study: China traffic deaths higher than police say, [online] Available from: http://www.chinadaily.com.cn/china/201101/07/content_11808453.htm
- Chen, H.L. (2018). Supply chain risk's impact on corporate financial performance. *International Journal of Operations & Production Management*, 38(3), pp.713–731.
- Chopra, S., Sodhi, M., (2004). Managing risk to avoid supply-chain breakdown. *MIT Sloan Management Review* 46, 53–61.
- Christopher, M. (2000). The Agile Supply Chain Competing in Volatile Markets. , 44, pp.37–44.
- Christopher, M. (2001). An integrated model for the design of agile supply chains supply chains. *International Journal of Physical Distribution & Logistics*, 31(4), pp.235–246.
- Christopher, M. and Peck, H. (2004). Building the Resilient Supply Chain. *The International Journal of Logistics Management*, 15(2), pp.1–13.

Christopher, M., & Lee, H. (2004). Mitigating supply chain risk through improved confidence. *International Journal of Physical Distribution and Logistics Management*, 34(5), 388–396.

Christopher, W., Johnny, M. and Robert, B. (2007). The Severity of Supply Chain Disruptions : Design Characteristics and Mitigation Capabiliti. *Decision Sciences*, 38(1), pp.131–156.

Christopher, M. et al. (2011). Approaches to managing global sourcing risk. *Supply Chain Management: An International Journal*, 16(2), pp.67–81.

Christopher, M. and Holweg, M. (2011). ‘Supply Chain 2.0’: managing supply chains in the era of turbulence. *International Journal of Physical Distribution & Logistics Management*, 41(1), pp.63–82.

Christopher, M., Mena, C., Khan, O., & Yurt, O. (2011). Approaches to managing global sourcing risk. *Supply Chain Management: An International Journal*, 16(2), 67–81.

Cilliers, F., Van Deventer, V. and Van Eeden, R. (2008). Leadership styles and associated personality traits: Support for conceptualization of transactional and transformational leadership. *South African Journal of Psychology*, 38(2), pp.253–267.

Closs, D. J., & Mollenkopf, D. A. (2004). A global supply chain framework. *Industrial Marketing Management*, 33(1), 37–44.

Craighead, C., Blackhurst, J., Rungtsunatham, M. J., & Handfield, R. (2007). The severity of supply chain disruptions: Design characteristics and mitigation capabilities. *Decision Sciences*, 38(1), 131–156.

Crotty, M., (2006) *The foundations of social research - meaning and perspective in the research process*, Sage Publications, London.

Davarzani, H., Zegordi, S.H. and Norrman, A. (2011). Contingent management of supply chain disruption: Effects of dual or triple sourcing. *Scientia Iranica*, 18(6), pp.1517–1528.

Defee, C.C., Stank, T.P., Esper, T.L. and Mentzer, J.T. (2009), "The role of followers in supply chains", *Journal of Business Logistics*, Vol. 30 No. 2, pp. 65-84.

Demeter, K. and Matyusz, Z. (2011). The impact of lean practices on inventory turnover. *International Journal of Production Economics*, 133(1), pp.154–163.

Denscombe, M (1998), 'The Good Research Guide for Small-Scale Social Research Projects' in NK Denzin & YS Lincoln (eds.), *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage.

Dick, B. (1990) cited in Carson, D. Gilmore A., Perry C., and Gronhaug, K. (2001), *Qualitative Marketing Research*, Sage Publications Inc, British, pp.86.

Eagly, A.H. (2007), "Female leadership advantage and disadvantage: resolving the contradictions", *Psychology of Women Quarterly*, Vol. 31 No. 1, pp. 1-12.

Easterby-Smith, M., Thorpe, R. and Jackson, R.R. (2008). *Management Research*. 3rd ed. Sage Publications Ltd., London.

Ellis, S.C., Henry, R.M. and Shockley, J. (2010). Buyer perceptions of supply disruption risk: A behavioral view and empirical assessment. *Journal of Operations Management*, 28(1), pp.34–46.

Emiliani, B. (2011). Lean management failure at HMRC. *Management Services*, 55(4), pp.13–15.

Emiliani, M.L. (1998). Lean behaviors. *Management Decision*, 36(9), pp.615–631.

Eraut, M. (1982). Effective evaluation: improving the usefulness of evaluation results through responsive and naturalistic approaches. *International Journal of Educational Development*, 2(3), pp.291–296.

Fahimnia, B. et al. (2015). Quantitative Models for Managing Supply Chain Risks: A Review. *European Journal of Operational Research*, 247(1), pp.1–15.

Faisal, M.N., Banwet, D.K. and Shankar, R. (2006). Supply chain risk mitigation: modeling the enablers. *Business Process Management Journal*, 12(4), pp.535–552.

Faisal, M.N., Banwet, D.K. and Shankar, R. (2007). Information risks management in supply chains: an assessment and mitigation framework. *Journal of Enterprise Information Management*, 20(6), pp.677–699.

Fontana, A., and Frey, J.H., edited by Denzin, N.K., and Lincoln, Y.S. (2005), *The Sage handbook of qualitative research*, third edition, Sage publications Inc, USA.

Given, M (2008) *The Sage Encyclopaedia of Qualitative Research Methods*. (Vol.2). Sage: Los Angeles.

Goleman, D. (1995), *Emotional Intelligence*, Bantam Books, New York, NY.

Goldman, S.L., Nagel, R.N. and Preiss, K. (1995). *Agile Competitors and Virtual Organisations*. New York, NY.: Van Nostrand Reinhold.

Gorman, G. E., and Clayton, P. (2005), *Qualitative research for the information professional: A practical handbook*, Second edition, Facet Publishing, London.

Grawe, S.J. (2009), “Logistics innovation: a literature-based conceptual framework”, *International Journal of Logistics Management*, Vol. 20 No. 3, pp. 360-377.

Gualandris, J. and Kalchschmidt, M. (2014). A model to evaluate upstream vulnerability. [tf], *International Journal of Logistics: Research and Applications*, 17(3), pp.249–268.

Guba, E.G. and Lincoln, Y.S. (1994). *Competing paradigms in qualitative research*. In London: Sage Publications, pp. 105–117.

Gurnani, H. and Mehrotra, A. (2012). *Supply chain disruptions: Theory and practice of managing risk*. London: Springer - Verlag London Limited.

Hazen, B.T., Overstreet, R.E. and Cegielski, C. (2012), "Supply chain innovation diffusion: going beyond adoption", *International Journal of Logistics Management*, Vol. 23, No. 1, pp.119-134.

Heckmann, I., Comes, T. and Nickel, S. (2014). A Critical Review on Supply Chain Risk – Definition, Measure and Modelling. *Omega*, 52, pp.119–132.

Hendricks, K.B. and Singhal, V.R. (2003). The effect of supply chain glitches on shareholder wealth. *Journal of Operations Management*, 21(5), pp.501–522.

Hendricks, K. and VR, S. (2005). Association between supply chain glitches and operating performance. *Management Science*, (5), pp.695–711.

Hines, P., Holweg, M. and Rich, N. (2004). Learning to evolve: A review of contemporary lean thinking. *International Journal of Operations & Production Management*, 24(10), pp.994–1011.

Ho, W. et al. (2015). Supply chain risk management: A literature review. *International Journal of Production Research*, 53(16), pp.5031–5069.

Hoek, R.I. Van, Harrison, A. and Christopher, M. (2001). Measuring agile capabilities in the supply chain. *International Journal of Operations & Production Management*, 21(1/2), pp.126–148.

Hofer, C., Eroglu, C. and Rossiter Hofer, A. (2012). The effect of lean production on financial performance: The mediating role of inventory leanness. *International Journal of Production Economics*, 138(2), pp.242–253.

Holweg, M., Luo, J. and Oliver, N. (2009). The past, present and future of China's automotive industry: a value chain perspective. *International Journal of Technological Learning, Innovation and Development*, 2(1/2), p.76.

Holstein, J.A. and Gubrium, J.F. (Eds) (2008) Handbook of constructionist research. New York. Guildford. Cited in Denzin, N.K and Lincoln, Y.S. (2005) The Sage handbook of qualitative research, Sage Publications p.341

Hudson, L.A., and Ozanne, J.L. (1988). "Alternative Ways of Seeking Knowledge in Consumer Research." *Journal of Consumer Research*, 14(4):508–21.

Huxham, C., & Vangen, S. (2003). Researching Organizational Practice Through Action Research. *Organization Research Methods*, 63: 383-403.

Huy, Q.N. 2002. "Emotional Balancing of Organizational Continuity and Radical Change: The Contribution of Middle Managers." *Administrative Science Quarterly*, 47(1):31–69.

Isabella, L.A. 1990. "Evolving Interpretations as Change Unfolds: How Managers Construe Key Organizational Events." *Academy of Management Journal* 33(1):7–41.

IHS, 2017, Global Auto Sales Set to Reach 93.5 Million in 2017, But Risk is Greater than Ever, IHS Market Says, 2/21/2017. [online]. Available from: <http://news.ihsmarket.com/press-release/global-auto-sales-set-reach-935-million-2017-risk-greater-ever-ihs-market-says>.

Jia, F., & Rutherford, C. (2010). Mitigation of supply chain relational risk caused by cultural differences between China and the West. *The International Journal of Logistics Management*, 21(2), 251–270.

Johnson, B.C., and Stewart, E.E. 2008. "The Key to Implementing Change in Your Practice." *Family Practice Management* 15(8): A5–A8.

Juttner, U., Peck, H. and Christopher, M. (2003). Supply chain risk management: outlining an agenda for future research. *International Journal of Logistics: Research and Applications*, 6(4), pp.197–210.

Karlsson, C. and Ahlstrom, P. (1996). Assessing changes towards lean production. *International Journal of Operations and Production Management*, 16(2), pp.24–41.

Kern, D. et al. (2012). Supply risk management: model development and empirical analysis. *International Journal of Physical Distribution & Logistics Management*, 42(1), pp.60–82.

- Kerr, C. (2010). Assessing and demonstrating data saturation in qualitative inquire supporting patient-reported outcomes research. *Expert Review of Pharmacoeconomics & Outcomes Research*, 10(3), 269-281.
- Knemeyer, a. M., Zinn, W. and Eroglu, C. (2009). Proactive planning for catastrophic events in supply chains. *Journal of Operations Management*, 27(2), pp.141–153.
- Kleindorfer, P.R. and Saad, G.H. (2005). Managing Disruption Risks in Supply Chains. *Production and Operations Management*, 14(1), pp.53–68.
- Konecka, S. (2010). LEAN AND AGILE SUPPLY CHAIN MANAGEMENT CONCEPTS IN THE ASPECT OF RISK MANAGEMENT. *Electronic Scientific Journal of Logistics*, 6(6), pp.23–31.
- Kracik, J. (1998). Triumph of the lean production system. *Sloan Management Review*, 30(1), pp.41–52.
- Kuei, C-H., Madu, C.N., Lin, C., 2001. The relationship between supply chain quality management practices and organizational performance. *International Journal of Quality & Reliability Management* 18 (8), 864–872.
- Kulas, J.T., Komai, M. and Grossman, P.J. (2013). Leadership , information , and risk attitude : A game theoretic approach. *The Leadership Quarterly*, 24(2), pp.349–362.
- Kuroda, T. (2015). A Model of Stratified Production Process and Spatial Risk. *Networks and Spatial Economics*, 15(2), pp.271–292.
- Laframboise, N. and Loko, B. (2012). Natural Disasters: Mitigating Impact, Managing Risks. *IMF Working Paper*.
- Lee, H. L. (2004). The triple-A supply chain. *Harvard Business Review*, 102–112.
- Lewis, M.A. (2000). Lean production and sustainable competitive advantage. *International Journal of Operations & Production Management*, 20(8), pp.959–978.

Li, S., Ragu-Nathan, B., Ragu-Nathan, T.S., Rao, S.S., 2006. The impact of supply chain management practices on competitive advantage and organizational performance. *Omega* 34, 107–124.

Liu, W. et al. (2017). Automotive Industry Bluebook China, Market: Witnessing the Transformation., pp.1–38. [online]. Available from: <http://www.pwccn.com>

Ma, Y. et al. (2014). A study on the risk control of supply chain under the background of globalization. *Journal of Industrial and Production Engineering*, 31(4), pp.221–228.

MacKenzie, C.A., Barker, K. and Santos, J.R. (2014). Modeling a severe supply chain disruption and post-disaster decision making with application to the Japanese earthquake and tsunami. *IIE Transactions*, 46(12), pp.1243–1260.

Marshall, M. N. (1996). Sampling for qualitative research. *Family practice*, 13(6), 522-526.

McMaster, I. 2005. Conducting Research Interviews Course Notes: Strathclyde Business School.

Manuj, I. and Mentzer, J. (2008). Global supply chain risk management. *Journal of Business Logistics*, 29(1), pp.133–35.

March, J.G., Shapira, Z., 1987. Managerial perspectives on risk and risk taking. *Management Science* 33 (11), 1404–1418.

Marley, K. a. and Ward, P.T. (2013). Lean management as a countermeasure for ‘Normal’ disruptions. *Operations Management Research*, 6(1–2), pp.44–52.

Marley, K.A., Ward, P.T. and Hill, J.A. (2014). Mitigating supply chain disruptions – a normal accident perspective. *Supply Chain Management: An International Journal*, 19(2), pp.142–152.

Maykut, P., & Morehouse, R. (1994). Beginning qualitative research: A philosophic and practical guide. London: The Falmer Press.

- Mello, J.E., and Flint, D.J. 2009. "A Refined View of Grounded Theory and Its Application to Logistics Research." *Journal of Business Logistics* 30(1):107–25.
- Mentzer, J.T., DeWitt, W., Keebler, J.S., Min, S., Nix, W.N., Smith, C.D., Zacharia, G.Z., 2001. Defining supply chain management. *Journal of Business Logistics* 22 (2), 1–25.
- Miles, M.B., Huberman, M.A. and Huberman, A.M. (1994) *Qualitative data analysis: An expanded sourcebook*. 2nd edn. Thousand Oaks, CA: Sage Publications.
- Mitchell, V.-W., 1999. Consumer risk perception: conceptualizations and models. *European Journal of Marketing* 33 (1/2), 163–195.
- Mishra, A.K. (1996), "Organizational responses to crisis: the centrality of trust", in Kramer, R.M. and Tyler, T.R. (Eds), *Trust in Organizations*, Sage, Thousand Oaks, CA, pp. 261-87.
- Mizgier, K.J., Wagner, S.M. and Jüttner, M.P. (2015). Disentangling diversification in supply chain networks. *International Journal of Production Economics*, 162, pp.115–124.
- Mohammaddust, F. et al. (2017). Developing lean and responsive supply chains : A robust model for alternative risk mitigation strategies in supply chain designs. *International Journal of Production Economics*, 183, pp.632–653.
- Mollenkopf, D. et al. (2010). Green, lean, and global supply chains. *International Journal of Physical Distribution & Logistics Management*, 40(1), pp.14–41.
- Namdar, J. et al. (2018). Supply chain resilience for single and multiple sourcing in the presence of disruption risks. *International Journal of Production Research*, 7543, pp.1–22.
- Munoz, A. and Dunbar, M. (2015). On the quantification of operational supply chain resilience. *International Journal of Production Research*, 7543(July), pp.1–16.

Naslund, D. (2002), "Logistics needs qualitative research – especially action research", *International Journal of Physical Distribution & Logistics Management*, Vol. 32 No. 5, pp. 321-38.

Naylor, J. Ben, Naim, M.M. and Berry, D. (1999). Leagility: Integrating the lean and agile manufacturing paradigms in the total supply chain. *International Journal of Production Economics*, 62(1-2), pp.107-118.

Nienhaus, J., Ziegenbein, A. and Schoensleben, P. (2006). How human behaviour amplifies the bullwhip effect. A study based on the beer distribution game online. *Production Planning and Control*, 17(6), pp.547-557.

Nock, D.A. (1991). A Matter of Record: Documentary Sources in Social Research. *Canadian Journal of Sociology/Cahiers canadiens de sociologie*, 16(3), pp.337-339.

Norrman, A. and Lindroth, R. (2004). Categorization of supply chain risk management. In *Supply Chain Risk*. Ashgate, London, pp. 14-28.

Olson, D.L. and Wu, D. (2010). *Enterprise Risk Management Models*. Springer - Verlag Berlin Heidelberg.

Olson, D.L. and Swenseth, S.R. (2014). Trade-offs in Supply Chain System Risk Mitigation. *Systems Research and Behavioral Science*, 31(4), pp.565-579.

Ou, C.S., Liu, F.C., Hung, Y.C., Yen, D.C., 2010. A structural model of supply chain management on firm performance. *International Journal of Operations & Production Management* 30 (5), 526-545.

Parry, G., Mills, J. and Turner, C. (2010). Lean competence: integration of theories in operations management practice. *Supply Chain Management: An International Journal*, 15(3), pp.216-226.

Patton, Michael Quinn. (1990). *Qualitative Evaluation and Research Methods*. Thousand Oaks, London, New Delhi: Sage.

- Peck, H. (2006). Reconciling supply chain vulnerability, risk and supply chain management. *International Journal of Logistics: Research and Applications*, 9, pp.127–42.
- Pettit, T. J., K. L. Croxton, and J. Fiksel. 2013. “Ensuring Supply Chain Resilience: Development and Implementation of an Assessment Tool.” *Journal of Business Logistics*, 34: 46–76.
- Perrow, C. (1984). *Normal accidents*. New York, NY: Basic Books.
- Pinsent Masons. (2013). *Go West! (and North) China’s New Automotive Manufacturing Clusters*. [online]. Available from: www.pinsentmasons.com/asia.
- Ponomarov, S.Y. and Holcomb, M.C. (2009). Understanding the concept of supply chain resilience. *The International Journal of Logistics Management*, 20(1), pp.124–143.
- Renn, O. (1998), “The role of risk perception for risk management”, *Reliability Engineering and System Safety*, Vol. 59 No. 1, pp. 49-62.
- Reuters news, “Costs of natural disasters in China surge to \$69 billion”, February 24, 2014. [online]. Available from: <https://www.reuters.com/article/us-china-disasters-idUSBREA1N0JW20140224>
- Ritchie, J. and Lewis, J. (eds.) (2003) *Qualitative research practice: A guide for social science students and researchers*. London: Sage Publications.
- Riddalls, C. and Bennett, S. (2002). Production-inventory systems controller design and supply chain dynamics. *International Journal of System Science*, 33(3), pp.181–195.
- Robinson, C.J., Malhotra, M.K., 2005. Defining the concept of supply chain quality management and its relevance to academic and industrial practice. *International Journal of Production Economics*, 96, 315–337.
- Sachan, A. and Datta, S. (2005), “Review of supply chain management and logistics research”, *International Journal of Physical Distribution & Logistics Management*, Vol. 35 Nos 9/10, pp. 664-705.

Sarkar, S. and Kumar, S. (2015). A behavioral experiment on inventory management with supply chain disruption. *International Journal of Production Economics*, 169, pp.169–178.

Saunders, M., Lewis, P. and Thornhill, A. (2012). *Research Methods for Business Students*. In Harlow, Essex: Pearson Education Limited.

Sax, J. and Torp, S.S. (2015). Speak up! enhancing risk performance with enterprise risk management, leadership style and employee voice. *Management Decision*, 53(7), pp.1452–1468.

Scholarios, D. 2005. Research Methodology Course Notes: Research Methods: Strathclyde Business School.

Schonberger, R.J. (2007). Japanese production management: An evolution—With mixed success. *Journal of Operations Management*, 25(2), pp.403–419.

Schmitt, A.J. and Singh, M. (2012). A quantitative analysis of disruption risk in a multi-echelon supply chain. *International Journal of Production Economics*, 139(1), pp.22–32.

Seuring, S. and Mu, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, 16, pp.1699–1710.

Sheaffer, Z., Bogler, R. and Sarfaty, S. (2011). Leadership attributes, masculinity and risk taking as predictors of crisis proneness. *Gender in Management*, 26(2), pp.163–187.

Sheffi, Y., & Rice, J. B. J. (2005). A supply chain view of the resilient enterprise. *MIT sloan management review*.

Silverman, D. (Ed.). (2016). *Qualitative research* (4th ed.). Los Angeles, CA: Sage.

Simangungsong, E., Hendry, L. C., & Stevenson, M. (2012). Supply-chain uncertainty: A review and theoretical foundation for future research. *International Journal of Production Research*, 50(16), 4493–4523.

Skipworth, H. et al. (2015). Supply chain alignment for improved business performance: an empirical study. *Supply Chain Management: An International Journal*, 20(5), pp.511–533.

Sodhi, M.S. and Tang, C.S. (2012). *Managing Supply Chain Risk*. F. S. Hiller & C. C. Price, eds. London: Springer Science + Business Media, LLC.

Spear, Steven, and Kent Bowen, “Decoding the DNA of the Toyota Production System,” *Harvard Business Review*, (Sept.-Oct. 1999), pp. 99-106.

Sreedevi, R. and Saranga, H. (2017). International Journal of Production Economics Uncertainty and supply chain risk: The moderating role of supply chain flexibility in risk mitigation. *International Journal of Production Economics*, 193(July), pp.332–342.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Thousand Oaks, CA: Sage.

Sun, J., Matsui, M. and Yin, Y. (2012). Supplier risk management: An economic model of P-chart considered due-date and quality risks. *International Journal of Production Economics*, 139(1), pp.58–64.

Tang, C. S., & Tomlin, B. (2008). The power of flexibility for mitigating supply chain risks. *International Journal of Production Economics*, 116, 12–27.

Tang, R. (2009). The Rise of China ' s Auto Industry and Its Impact on the U . S . Motor Vehicle Industry. *Congressional Research Service*, 7–5700/R40.

Tang, R. (2012). China ' s Auto Sector Development and Policies : Issues and Implications. *Congressional Research Service*, 7–5700, R4. [online]. Available from: <http://www.crs.gov>.

Tang, O. and Nurmaya Musa, S. (2011). Identifying risk issues and research advancements in supply chain risk management. *International Journal of Production Economics*.

Tapiero, C.S. (2007). Consumers risk and quality control in a collaborative supply chain. *European Journal of Operational Research*, 182(2), pp.683–694.

Taylor, M. and Taylor, A. (2008). Operations management research in the automotive sector: Some contemporary issues and future directions. *International Journal of Operations & Production Management*, 28(6), pp.480–489.

Tennant, C. and Roberts, P. (2001), “Hoshin Kanri: implementing the catch ball process”, *Long Range Planning*, Vol. 34 No. 3, pp. 287-308.

Thomson, A; Jiang, M. (2009). Momentum : China ’ s automotive components sector emerging from the crisis.

Thun, J.-H. and Hoenig, D. (2011). An empirical analysis of supply chain risk management in the German automotive industry. *International Journal of Production Economics*, 131(1), pp.242–249.

Tokar, T. (2010) Behavioural research in logistics and supply chain management. *International Journal of Logistics Management*, 21, 89–103.

Tranfield, D. and Starkey, K. (1998). The Nature, Social Organization and Promotion of Management Research: Towards Policy. *British Journal of Management*, 9, 341-353.

Trautrim, A., Cunliffe, A.L. and Wong, C. (2012). Using the “documentary method” to analyse qualitative data in logistics research. *International Journal of Physical Distribution & Logistics Management*, 42(8), pp.828–842.

Trkman, P. and McCormack, K. (2009). Supply chain risk in turbulent environments-A conceptual model for managing supply chain network risk. *International Journal of Production Economics*, 119(2), pp.247–258.

Tse, Y.K. et al. (2018). Managing quality risk in supply chain to drive firm’s performance: The roles of control mechanisms. *Journal of Business Research*, (January), pp.0–1.

Tse, Y.K. and Tan, K.H. (2011). Managing product quality risk in a multi-tier global supply chain. *International Journal of Production Research*, 49(1), pp.139–158.

Tummala, R. and Schoenherr, T. (2011). Assessing and managing risks using the Supply Chain Risk Management Process (SCRMP). *Supply Chain Management: An International Journal*, 16(6), pp.474–483.

van der Vorst, J.G.A.J. and Beulens, A.J.M., 2002. Identifying sources of uncertainty to generate supply chain redesign strategies. *International Journal of Physical Distribution and Logistics Management*, 32 (6), 409–430.

van Hoek, R.I., Chatham, R., Wilding, R., 2002. Managers in supply chain management, the critical dimension. *Supply Chain Management: An International Journal*, 7 (3), 119–125.

Wang, A; Liao, W; Hein, A. (2012). Bigger, better, broader: A perspective on China's auto market in 2020. *Automotive & Assembly Practice*. [online]. Available from: www.mckinseychina.com.

Wang, Y., Greasley, A. and Albores, P. (2016). Do manufacturing firms need informality in ERP post-implementation? A study of Chinese manufacturing sites. *Journal of Manufacturing Technology Management*, 27(1), pp.100–123.

Wang, X., Stößlein, M. and Kan, W. (2010). Designing knowledge chain networks in China — A proposal for a risk management system using linguistic decision making. *Technological Forecasting and Social Change*, 77(6), pp.902–915.

Wagner, S.M. and Bode, C. (2008). An empirical examination of supply chain performance along several dimensions of risk. *Journal of Business Logistics*, 29(1), pp.307–325.

Wee, H.M., Wu, S., 2009. Lean supply chain and its effect on product cost and quality: a case study on Ford Motor Company. *Supply Chain Management: An International Journal*. 14 (5), 335-341.

Westbrook, R. and Scott, C. (1991), "New strategic tools for supply chain management", *International Journal of Physical Distribution & Logistics Management*, Vol.21No. 1, pp. 23-33.

Whittington, R. (2006), "Completing the practice turn in strategy research", *Organization Studies*, Vol. 27 No. 5, pp. 613-34.

Williams, L.R., Esper, T.L. and Ozment, J. (2002), "The electronic supply chain: its impact on the current and future structure of strategic alliances, partnerships and logistics leadership", *International Journal of Physical Distribution and Logistics Management*, Vol. 32 No. 8, pp. 703-719.

Womack, J., Jones D. and Roos, D. (1990), *The Machine that Changed the World*, Macmillan, New York, NY.

Wong, C. et al. (2012). Towards a theory of supply chain alignment enablers: a systematic literature review. *Supply Chain Management: An International Journal*, 17(4), pp.419–437.

Wu, D. and Olson, D.L. (2008). Supply chain risk, simulation, and vendor selection. *International Journal of Production Economics*, 114(2), pp.646–655.

Yates, J.F., Stone, E.R., 1992b. Risk appraisal. In: Yates, J.F. (Ed.), *Risk-taking Behaviour*. John Wiley & Sons, New York, pp. 49–85.

Yates, J.F., Stone, E.R., Parker, A.M., 1994. Risk communication: absolute versus relative expressions of low-probability risks. *Organizational Behaviour and Human Decision Processes*, 60, 387–408.

Yin, R. K. (2003). *Case study research: Design and methods*. Newbury Park: Sage.

Zhang, L. (2014). The Chinese Auto Industry: Challenges and opportunities for management and labor. *Management - Labor*, (December 2014), pp.54–115.

Zhao, Johnny; Hou, M. (2013). NEWS ALERT FEBRUARY 2013 China Strengthens Auto Recall Rules NEWS ALERT FEBRUARY 2013. *TaylorWessing News Alert February*, (626),

pp.1–4.

Zolkos, R. (2003b), “Many companies still ignoring supply-chain risks”, *Business Insurance*, Vol. 37 No. 43, p. 21.

Zsidisin, G., Melnyk, S., et al., 2005. An institutional theory perspective of business continuity planning for purchasing and supply management. *International Journal of Production Research*, 43 (16), 3401–3420.

Appendices

Appendix 1 – Company Ethical Consent

Edinburgh Napier University Research Consent Form

Research Title: Understanding perceived risks in lean company for supply chain risk mitigation in China automotive sector

Edinburgh Napier University requires that all persons who participate in research studies give their written consent to do so. Please read the following and sign it if you agree with what it says.

1. I freely and voluntarily consent to be a participant in the research project on the topic of perceived supply chain risk and associated risk mitigation strategies to be conducted by Yuliang Hui who is a doctoral research student at Edinburgh Napier University.
2. The broad goal of this research study is to understand from managers what are the key risks for supply chain operating in China automotive context and what are the effective mitigation strategies. Specifically, I have been asked to participate in a semi-structured interview, answering questions in relation to my own organisation's approach and offering my personal opinion of the effects of business decisions and their impact on supply chain operations. This should take approximately one hour to complete.
3. I have been told that my responses will be anonymised. My name will not be linked with the research materials, and I will not be identified or identifiable in any report subsequently produced by the researcher.
4. I also understand that if at any time during the interview I feel unable or unwilling to continue, I am free to leave. That is, my participation in this study is completely voluntary, and I may withdraw from it without negative

consequences. However, after data has been anonymised or after publication of results it will not be possible for my data to be removed as it would be untraceable at this point.

5. In addition, should I not wish to answer any particular question or questions, I am free to decline.
6. I agree to my interview being digitally recorded and notes taken.
7. I have been given the opportunity to ask questions regarding the interview and my questions have been answered to my satisfaction.
8. I have read and understand the above and consent to participate in this study. My signature is not a waiver of any legal rights. Furthermore, I understand that I will be able to keep a copy of the informed consent form for my records.

Participant's Signature

Date

I have explained and defined in detail the research procedure in which the participant has consented to participate. Furthermore, I will retain one copy of the informed consent form for my records.

Researcher's Signature

Date

Appendix 2: Semi structured interview questions

Introductory Questions

1. Please state how long you have been working with our company and how long have you have been in your current role?
2. Please briefly describe your perceived role within our company?

Theme: Perceived supply chain risks are mainly coming from mis-alignment

3. How did you realise you may be in a risk situation?
4. Please outline your understanding of supply chain risks often occurred; what are the main risks?
5. How comfortable do you feel with me describing the root causes of those risks?

Theme: Resilience is a vital part in risk mitigation

6. When you find yourself encounter the risk situation, what is your initial feeling and reaction?
7. With your reaction, how did your colleagues respond to that?
8. What are the procedures to guide your risk mitigation actions?
9. Reflecting on the issues you've raised can you outline a specific example of a time when you've felt particularly helped or hindered by these aspects of our company?
10. Please give your thoughts on whether any of the key factors you've outlined could be managed or amended to better support your activities here?
11. What do you consider the main difficulties to change such issues?

Leadership style for supply chain risk mitigation

12. What do you think the reasons for the different reactions?
13. Assuming there is a chance for job rotation, what would you do in the new position?
14. What do you monitor with the current reports, meeting, business reviews, supplier visits, customer visits?

To Close the Interview

15. Would you like to add anything further, which you don't feel you've had an opportunity to say thus far that's relevant to this study?

Appendix 3: Themes and sub-themes

Theme	Sub-theme	Quotation
Mis-alignment	Quality failure	2.2/2.6/4.6/4.8/4.9/4.10/4.11/4.13/4.22/4.29/6.19/7.3/7.5/7.11/7.18/9.1
	Capacity mis-management	1.7/5.2/5.6/6.12/6.13/
	Forecast mis-alignment	2.1/
	Decision mis-alignment	2.3/2.5/2.7/6.6/6.9/6.10/6.29/6.30
	KPI mis-alignment	4.15/4.17/4.18/4.19/4.21/5.11/6.14/6.17/8.5/8.6/8.8
	Functional mis-alignment	4.24/4.25/7.15/8.4/8.15
	Develop backup	2.12/4.28/5.3/5.5/7.10/8.2/8.11/8.12/10.4/10.29
	Collaboration across SC	1.20/2.10/2.11/3.6/7.6/7.19/8.10/9.4/9.7/10.20/10.26
	Quick response	6.7/7.12/10.3/10.6/10.7
	Flexibility	6.32/7.22/8.9/10.38
Resilience	Communication	3.9/3.31/10.10/10.11/
	Contingency	1.5/3.8/3.10/3.11/3.12/3.13/3.14/3.15/5.7/5.8/5.9/5.18/5.19/6.33/7.9/8.13/8.14/10.15/10.16/10.17/10.18/10.33/10.40
	Authorisation	2.15/5.17/6.28/10.19/10.21
	Risk taking	6.20/
	Drive for perfection	1.8/1.9/1.11/10.11/10.12
	Priority setting	3.34/6.16
	Tension management	3.33/
	Hands on	3.27/10.12
	Engage people	3.30/
	Emotion management	1.2/1.4/3.25/5.15/6.15/
Leadership	Assertive	1.18/3.23/6.22/6.26/6.27
	People development	1.6/1.12/1.14/1.19/2.13/2.14/3.3/3.5/3.19/3.20/3.24/4.28/4.30/6.2/6.24/7.20/

Thesis Ends